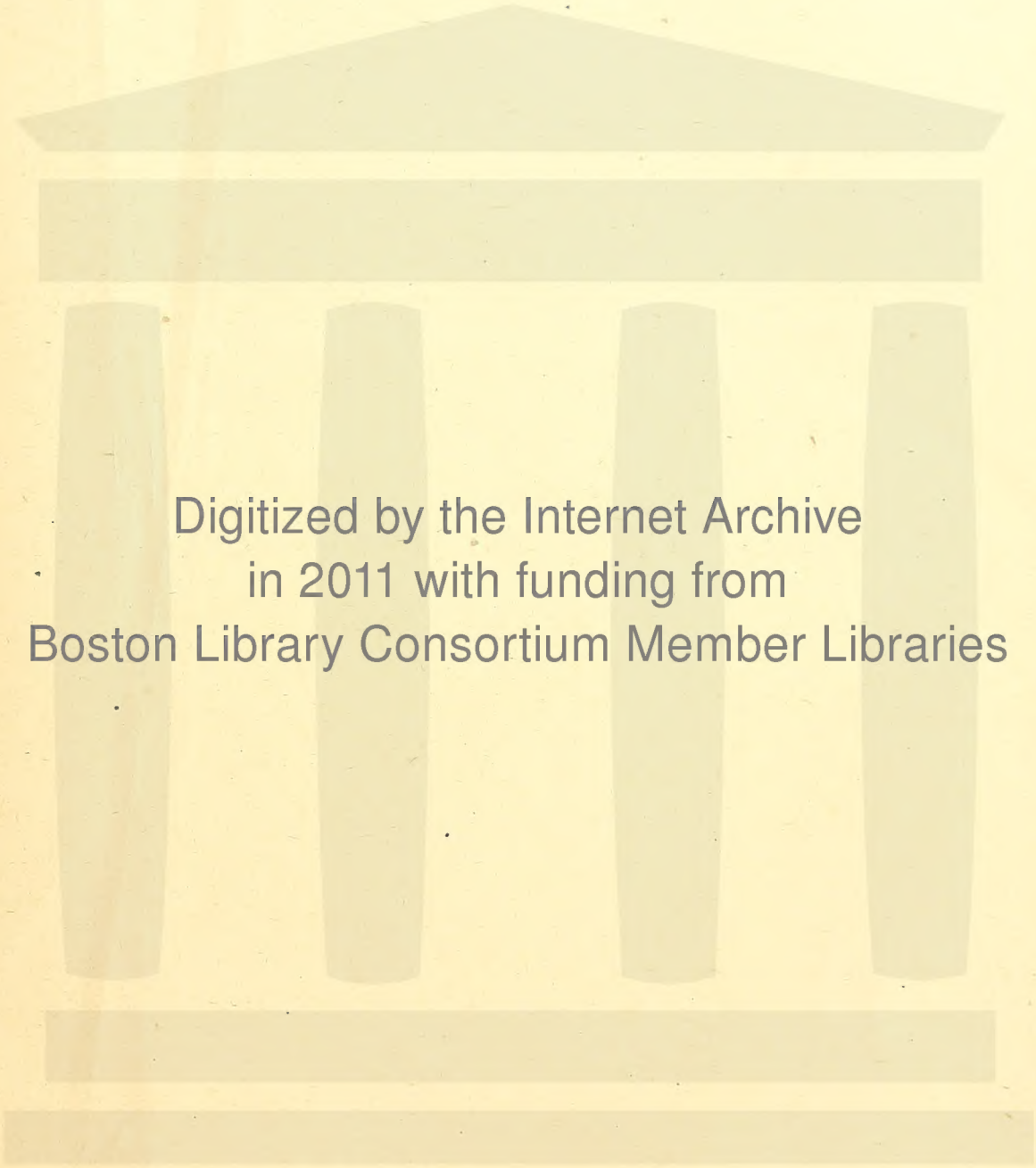
IX


Digitized by the Internet Archive
in 2011 with funding from
Boston Library Consortium Member Libraries

http://www.archive.org/details/westernelectrici09chic

The Western Electrician.

EVERY SATURDAY.

MASS. INSTITUTE OF TECHNOLOGY NOV 17 1894 LIBRARY.

621.305

MASSACHUSETTS INSTITUTE OF TECHNOLOGY DEPARTMENT OF PHYSICS

VOLUME IX.

NUMBERS 1--26.

July 4–December 26, 1891.

ELECTRICIAN PUBLISHING COMPANY,
CHICAGO.

INDEX.

Accounts, Uniformity in the Method of Keeping Central Station. By J. J. Burleigh. And Discussion (National Electric Light Association)....170, 171
Accumulators in Belgium.... 75
Accumulators, Patent Litigation Over....66, 67
Actinism a Species of Electrolysis, Is? By Edwin J. Houston (Franklin Institute)....334, 335
Adams' Dynamo and Motor. Illustrated.... 186
Advantages of the Electric Street Railway, by H. B. Prindle....79, 80
African Explorer, The Electric Light in the Service of the. Illustrated.... 8
Aging Liquors by Electricity. Illustrated.... 344
Air Gap and the Shape of the Poles to the Performance of Dynamo Electric Machinery, On the Relation of the. By Harris J. Ryan. And Discussion (American Institute of Electrical Engineers). Illustrated....206, 207, 208, 220, 221
Allen Flats, Chicago, Lighting Plant at the. Illustrated.... 47
Alternating Currents, Distribution and Care of, Discussion of T. Carpenter Smith's Paper Read Before the Providence Convention (National Electric Light Association)....164, 165
Alternate Current Motor, Brown's Three Phase. Illustrated.... 274
Alternating Current Motor, The Hubin-Le Blanc. Illustrated.... 46
Alternate Currents of Very High Frequency and Their Application to Methods of Artificial Illumination, Experiments with. By Nikola Tesla. Illustrated. (American Institute of Electrical Engineers)....18, 19, 21, 22, 23, 24
Alternating Current Telephone Transmitter, O'Connell's. Illustrated.... 300
Alternating Dynamos, New. Illustrated.... 275
Alternating Electric Systems and Their Physical Hazards. By George P. Low....335, 336
Alternator, National Self Contained. Illustrated.... 193
Alternating Plant, English. Illustrated.... 186
Alternating Systems, A Central Station Combining the Advantages of both Continuous and. By H. Ward Leonard. And Discussion (National Electric Light Association)....168, 169 170
Alternating System in Long Distance Transmission, The. By F. B. Badt (Communication).... 117
Aluminum, Production of....24, 25
Amalgamating Process, Electrical Illustrated.... 319
Amateur Electricians.... 117
America, Following the Lead of.... 330
American Institute of Electrical Engineers..17, 18, 19, 21, 22, 23, 24, 201, 206, 207, 208, 219, 220, 221, 272, 277, 278, 279, 280, 303, 305, 306, 377, 378, 379
American International Telephone Cable.... 117
American Street Railway Association....87, 196, 205, 243
American Street Railway Association, Proceedings of the Annual Convention at Pittsburg.
President's Address.... 256
Report of the Executive Committee....256, 257
Treasurer's Report.... 257
Perfect Electric Motor. By H. A. Everett, and Discussion....257, 258, 259
The Dependent—Overhead or Underground—System of Electric Motive Power. By George W. Mansfield, and Discussion..259, 261, 262, 263
The Independent—Storage or Primary Battery—System of Electric Traction. By Knight Neftel. And Discussion....263, 264
Resolutions....264, 266
Standards in Electric Railway Practice. By O. T. Crosby, and Discussion....264, 265, 266
Election of Officers.... 266
The New President.... 266
Delegates in Attendance....266, 267
Applications for Membership.... 267
The Banquet.... 267
Excursions and Entertainments.... 267
The Souvenir Badges. Illustrated.... 268
Convention Notes, Exhibits and Personals.... 268
Apparatus for Indicating Variations of Pressure in Gaseous Currents. Illustrated.... 75
Arc Lamp Hanger. Illustrated.... 106
Arc Lighting and Hazards. by Geo. P. Low....93, 94
Arc Lighting System as Practiced in the "Municipal" of St. Louis, Some Details of the Care and Management of an. By J. I. Ayer, and Discussion (National Electric Light Association)....179, 180, 181
Armstrong's Starting Device for Motors at a Distance. Illustrated.... 372, 373
Asbestos Manufacturers Consolidate, Prominent.... 65
Augusta Exposition, Electricity at the.... 320
Automatic Detector of Fire Damp in Coal Mines. Illustrated.... 194
Automatic Pay Call Box for Telephones. Illustrated. 102
Avoiding Dead Centers, Micheles' Ingenious Device for. Illustrated.... 120

Bain's Compensating Voltmeter. Illustrated.... 249
Ball Engine, Cross Compound. Illustrated.... 133
Battery Cells, Samples. Illustrated.... 33
Battry Chemistry of the Primary. By Frank K. Irving....361, 362
Batteries, Grouping. By Frank K. Irving.... 320
Battery, Midget. Illustrated.... 350
Battery, The Champion. Illustrated.... 292
Battery, The Gladiator Dry. Illustrated.... 220
Battery with an Iron Electrode Secondary. Illustrated.... 356
Beckley, John N., with portrait.... 85
Bell Telephone Stock.... 64
Bell, The Door Knob Alarm. Illustrated.... 302
Berliner Patent. Illustrated....315, 316
Block Signal Problem, Solution of the, by H. Ward Leonard. Illustrated....221, 222

Bloomington, Ill., Electric Road at..... 47
Board of Trade and the Telegraph..... 183
Book Table, the.....50, 75, 116
Boston Street Railway Officials in Chicago..... 219
Bridges Operated by Electric Power. Illustrated..85, 86
British Postmaster General, Death of the..... 133
Bradbury-Stone Storage Battery Car at Sioux City, Ia. Illustrated..... 272
Brush Generator and Motor. Illustrated..... 193
Buffalo Street Railway Company Electric System of. Illustrated..... 103
Burning of Wiman's Electric Light Plant at St. George, Staten Island. Illustrated..... 87
Business, (Notes).....14, 28, 42, 56, 70, 84, 98, 112, 126, 142, 156, 184, 198, 212, 226, 240, 254, 270, 283, 284, 297, 298, 312, 325, 326, 340, 354, 368, 382
Byllesby, Henry M., with portrait..... 57

C. and C. Fan Motor. New. Illustrated..... 35
Cable Road Dismantled, the Oldest..... 199
Camp's Conduit. Illustrated..... 303
Canadian Electrical Association, Proposed..291, 292, 347
Canada's International Exhibition..... 29
Carbons Used in Arc Lighting, Different Forms of, by E. P. Warner, (National Electric Light Association)..... 181
Carriage, an Electric. Illustrated..... 333
Cassel, Germany, Electric Plant at. Illustrated.244, 245
Census, Electrical Industries and the.....208, 251
Census, Electrical Statistics for the (National Electric Light Association).....174, 175
Central Stations Operated by Water Power. By George A. Redman. Discussion (National Electric Light Association).....165, 167, 168
Centrifugal Machines, Application of Electricity to. Illustrated..... 319
Chemistry of the Primary Battery. By Frank K. Irving.....361, 362
Chicago Amateur Electric Society..... 196
Chicago and Milwaukee, Proposed Electric Road Between.....30, 50
Chicago Arc Light & Power Company's Station Burned..... 333
Chicago City Lighting Plant..... 46
Chicago Edison Company.....49, 117
Chicago Edison Company's Operations..... 92
Chicago Electric Club.....74, 87, 245, 268, 269, 270, 306, 319, 333 342, 348, 349, 350, 361, 362, 380
Chicago Electric Club and the Electrical Congress of 1893..... 234
Chicago Electric Road, Proposed New.....7, 88, 89, 183, 184, 347
Chicago Herald Building's New Electrical Equipment. Illustrated..... 329
Chicago News Electrical Plant. Illustrated.....375, 376
Chicago's Parks and Boulevards, Lighting..... 355
Chicago Society of Operative Electricians..... 301
Chicago Telephone Exchange, the New Ticket Distributor at the..... 57
Chicago Trolley Clamp. Illustrated..... 65
Chicago West Side "L" Road Syndicate, Thomson-Houston Company and the..... 29
Chicago's West Side Suburbs, an Electric Road for.. 43
Chicago, Cable Roads in..... 370
Chicago, Municipal Lighting in..... 373
Chilian War Affecting Telephone Interests..... 65
China Switch, New Electrix. Illustrated..... 334
Cigar Lighter, Electric. Illustrated..... 328
Cincinnati, O., (Correspondence).....124, 210, 237, 309
Circuit Protector, The W. B. G. Illustrated..... 24
City & South London Railway..... 92
City & South London Electric Railway, Advantages of the..... 281
Cleveland, O., (Correspondence).....154, 224, 238, 338
Clock, Electric. Illustrated..... 10
Coal Cutter, Solenoid. Illustrated..... 133
Collier's Audible Telephone. Illustrated..... 33
Columbia College, Electrical Engineering at..... 364
Columbia System, The. Illustrated..... 217
Columbus, O., (Correspondence)..... 238
Combination Electric Railway Section Insulator and Lightning Arrester. Illustrated..... 330
Composing Room, Electricity in the..... 301
Construction and Operation of Cable and Electric Railways.....37, 38
Constitution, Report of Committtee on (National Electric Light Association)..... 162
Continuous and Alternating Systems, A Central Station Combining the Advantages of both the, By H. Ward Leonard. And Discussion. (National Electric Light Association) 168, 169, 170
Continuous Current Motor by Alternating Current, Driving a. Illustrated..... 49
Contract, A 2,700 Light..... 272
Concord, N. H. (Correspondence).....55, 210
Condenser, Tesla's Oil Insulated. Illustrated..... 365
Cone, Evans' Friction. Illustrated..... 280
Congress of Electricians, International. By Henry S. Carhart..... 233
Controversy Over a Franchise..... 16
Cope Automatic Wire Puller. Illustrated..... 150
Copper Men Think, What the 91
Copper Production in the United States.....65, 66
Cornell Men at Chicago..... 331
Corn Palace, Electricity at the. Illustrated..... 331
Correspondence.....11, 12, 13, 25, 26, 38, 39, 40, 53, 54, 55, 67, 68, 69, 81, 82, 94, 95, 96, 109, 110, 111, 123, 124, 140, 153, 154, 196, 209, 210, 224, 237, 238, 252, 253, 270, 281, 282, 294 295, 296, 308, 309, 310, 322, 323 336 337, 338 351 352, 364, 365, 366, 380, 381
Cranes, Electric and Steam..... 314
Crane, English Traveling. Illustrated..... 331
Cuadros' Apparatus for Automatically Regulating the Firing of Ordnance on Ships. Illustrated.... 35
Currents from the Sun, Electric..... 219
Cut out, Wheeler's. Illustrated 330
Crystal Palace, Electrical Exhibition.....50, 130

Darmstadt, Central Stations at Mulhausen and. Illustrated.....313, 314
Data, Report of Committee on. By A. J. DeCamp. (National Electric Light Association)..... 163
Dental Drill, Electrically Operated. Illustrated..... 220
Dentistry, Electricity as a Motive Power in. By Peter Brown, L. D. S..... 237
Denver, Colo. (Correspondence) 96, 153, 154, 323, 337, 338
Dependent-Overhead or Underground—System Electric Motive Power, The. By Geo. W. Mansfield. And Discussion. (American Street Railway Association).....259, 261, 262, 263
Detroit, Electrical Decorations at..... 143
Detroit, Mich. (Correspondence).....12, 13, 40
Detroit, New Railway Management for..... 64
Detroit, Rapid Transit for..... 7
Diminutive Electric Light Plant. Illustrated..... 117
Distribution and Care of Alternating Currents, Discussion of T. Carpenter Smith's Paper, Read Before the Providence Convention. (National Electric Light Association).....164, 165
Double Carbon Suit, New.....319, 327
Drilling Machine, The Edco Electrical. Illustrated.. 371
Drills at Lost Chance Mine, Idaho, Electric Percussion. Illustrated..... 33
Driving a Continuous Current Motor by Alternating Current. Illustrated..... 49
Druggist's Danger Signal. Illustrated..... 302
Dubuque Storage Battery Road..... 308
Dynamos at the Frankfort Exposition, Largest. Illustrated..... 149
Dynamos at the Frankfort Exhibition, One of the. Illustrated..... 370
Dynamo, La Roche Alternating. Illustrated..... 202
Dynamo, La Roche Arc. Illustrated..... 280
Dynamo, La Roche Special. Illustrated 359
Dynamo Men, Useful Hints for. Illustrated. 302
Dynamos, New Alternating. Illustrated..... 275
Dynamo, New C. & C. Illustrated.....274, 275
Dynamo, Parsons' Steam Turbine. Illustrated..... 102
Dynamo, Perret, on the Romola. Illustrated..... 9
Dynamo, Prentice. Illustrated..... 9
Dynamos, Riker Low Speed Motors and. Illustrated. 376

Easton Electric Company's Apparatus. Illustrated.. 291
Edco Electrical Drilling Machine, The. Illustrated.. 371
Edison Convention in New York.....79, 89, 106, 107
Edison Electric Illuminating Company at Paterson, N. J., Stations of the 59, 60, 61
Edison Electric Locomotive for Mines and Mills. Illustrated..... 9
Edison's Inventions, Claims an Interest in..... 65
Edison Men in Council..... 347
Edison Pressure Indicator. Illustrated..... 202
Edison Removal in Chicago..... 116
Editorial.....6, 20, 34, 48, 62, 76, 90, 104, 118, 134, 148, 166, 190, 204, 218, 232, 246, 260, 276, 290, 304, 318, 332, 346, 360, 374
Electric Clock. Illustrated..... 10
Electric Cranes..... 153
Electric Heating..... 92
Electric Light in the Service of the African Explorer, The. Illustrated..... 8
Electric Light, New Use for..... 71
Electric Light Plant for the Masonic Temple, Chicago 57
Electric Light Plant in the Land of the Midnight Sun. Illustrated..... 32
Electric Light Plant in the New York *World* Building. Illustrated..... 89
Electric Light Plant on the Virginia. Illustrated 114, 115
Electric Light Plants Operated by Gas Companies, Growth of..... 33
Electric Lighting, Data on (National Electric Light Association)..... 164
Electric Lighting (Notes).....13, 27, 41, 55, 69, 83, 96, 97, 111, 125, 141, 154, 184, 197, 211. 225, 238 239, 253, 282, 283, 296, 324, 338, 353, 367, 381
Electric Mining (Notes). 13, 27, 55, 56, 70, 83, 79, 111, 125, 141, 155, 184, 211, 225, 239, 325, 338, 367, 381
Electric Motive Power for Street Railways. Report of the Committee on. By John N. Beckley. A Discussion. (New York State Street Railway Association).....188, 189, 191, 192
Electric Motor (Notes)..... 69, 83, 111, 211, 325
Electric Motors for Switching and Suburban Work on Steam Railroads.....74, 75
Electric Organs, by James Swinburne.....10, 11
Electric Percussion Drills at Lost Chance Mine, Idaho. Illustrated..... 33
Electrical Plant, *Chicago News*. Illustrated 375, 376
Electric Power Transmission. By F. B. Badt. 60, 61, 121
Electric Power Transmission Plant at Aspen, Colo. Illustrated.....1, 2
Electric Railway, (Notes).....13, 27, 41, 55, 69, 83, 97, 111, 125, 141, 154, 155, 184, 197, 211, 225, 239 253, 283, 297, 324, 325, 338, 353, 367, 381
Electric Railway, Evanston..... 49
Electric Railway Construction and Operation and the Consideration of Their Connection with Central Station Interests. By C. J. Field. A Discussion. (National Electric Light Association) .. 177, 178, 179
Electric Railway. Future of the. By Frank J. Sprague.....139, 140
Electric Railway Patents, George F. Green's. Illustrated..... 375
Electric Railway System, New..... 38
Electric Railways, Three Years' Development of. By Eugene Griffin. And Discussion. (National Electric Light Association.).....171, 172, 173, 174
Electric Road at Bloomington, Ill..... 47
Electric Road Between Chicago and Milwaukee, Proposed.....30, 50
Electric Road for Chicago's West Side Suburbs, An.. 43
Electric Road from Jersey City to Newark, Proposed. 36
Electric Street Railway, Advantages of the. By H. B. Prindle.....79, 80
Electric Wires in Rochester, N. Y..... 7
Electrical Advancement in England, A London Electrician's Opinion on..... 91
Electrical Census of the State of New York..... 79
Electrical Congress, Carl Hering and the. (Communication)..... 364
Electrical Development in the Northwest..... 30
Electrical Engineering as a Profession in England. 306, 307
Electrical Executions, The..... 36
Electrical Grave Annunciator, An Illustrated..... 35
Electrical Method of Shaping Metal Bars. Illustrated..... 116
Electrical Patents. (Issued in the United States)... 14, 28, 42, 56, 70, 84 98, 112, 126, 142, 156, 198, 212, 226, 240, 254, 284, 298, 312, 326, 340, 354, 368, 382
Electrical Signaling on Board the Chicago in New York Harbor. Illustrated.....72, 73, 74
Electrical Sky Effects.....149, 150
Electrically Driven Ship's Winch. Illustrated..... 91
Electrically Regulated Clocks in Chicago..... 248
Electricity at "A Night in Pekin"..... 57
Electricity for Submarine Torpedoes. Illustrated... 77
Electricity in a Chicago Rolling Mill. Illustrated... .....43, 44, 45
Electricity in Life. By Edward P. Jackson..... 153
Electricity on our Great Railways. By H. S. Wynkoop. 114, 115, 116
Electric Magnet in Eye Surgery, The. By Silvanus P. Thompson and J. Tatham Thompson. Illustrated..... 37
Electric Therapeutical Office Outfit. Illustrated ... 150
Elevator at the Chicago Athenæum, Electric. Illustrated..... 248
Elevator, Transmitting Power From an Electric Motor to a Hand. Illustrated..... 361
Elliott Pull-off. Illustrated..... 362
Engine for Central Station Plants, New. Illustrated 216
Engine, Weston Automatic. Illustrated..... 219
Engine, Weston Compound. Illustrated..... 281
English Electrical Exhibition.....119, 120
Enterprise in forwarding War News..... 133
Enterprising Suprintendent, An..... 107
Eternal City, Electric Lights for..... 293
Evans Friction Cone. Illustrated..... 280
Evanston's Electric Railway..... 49
Exaggerations, Electrical..... 320
Exhibits at the Pittsburg Convention, Street Railway. Illustrated.....255, 256, 257, 258, 259, 261
Experiment on the Zipernowski Electric Railway With a Vertical Track. Illustrated.....16, 17
Experiments With Alternate Currents of Very High Frequency and Their Application to Metoods of Artificial Illumination. By Nikola Tesla. Illustrated. (Am Inst. of El. Eng.)..18, 19, 21, 22, 23 24

Fair Building, Chicago, The Lighting Plant in the. Illustrated 369, 370
Fan Motor, New C. & C. Illustrated..... 35
Fan Outfit, La Boiteaux. Illustrated..... 24
Faraday's Religious Life..... 36
Ferranti, How About..... 133
Ferranti System, The..... 59
Feed Water Heater, Improved. Illustrated..... 78
Feeding Mechanism for Arc Lamps, New. Illustrated..... 119
Fire Apparatus, Portable Electric. Illustrated..... 242
Fire Department Chief's Buggy, Electric Light on a. Illustrated..... 345
Firemen Aided by Electricity..... 49
Firemen's Convention, Electricity at the..... 107
Fires in Chicago, Two Central Station. Illustrated. 343
Fiske Range Finder..... 356
Flying by Means of Electricity..... 94
Forging Steel by Electricity..... 89
Frankfort Electrical Congress..... 234
Frankfort Electrical Exhibition..... 91
Frankfort Electrical Exhibition. By F. B. H. Paine. 109
Frankfort Electrical Exhibition. Illustrated..... 213
Frankfort Exhibition, A Glimpse of the Siemens & Halske Exhibit at the. Illustrated.....228, 229
Frankfort Exhibition and the World's Fair. Illustrated.....285, 286, 287, 288
Frankfort Exhibition, Electric Boat at the. Illustrated..... 228
Frankfort Exhibition, Electric Race Track at the. Illustrated..... 241
Frankfort Exhibition, One of the Dynamos at the. Illustrated..... 370
Frankfort Exhibition, Schuckert Dynamo at the Illustrated..... 242
Frankfort, Germany, Transformer, House of the High Tension Transmission System. Illustrated..... 301
Frankfort-Offenbach Electric Railroad. Illustrated.....341, 342
Frankfort, The Iron Tower at. Illustrated..... 231
Frankfort Transmission, The Lauffen. Illustrated.230, 231
Franklin Experimental Club..... 220, 373
Franklin Institute, Electrical Section of.....334, 335
Frey's Compensating Shunts for Galvanometers. Illustrated.....376, 377
Frisbie Electric Elevator. Illustrated..... 165

Galvanometer Battery Gauge, Pocket. Illustrated.. 234
Gas Interests, Electricity Beneficial to the..... 38
Gearless Motors for Street Railways. Illustrated..88, 89
Generators, Polyphasal, by M. I. Pupin, Ph. D. Illustrated. (American Institute Electrical Engineers).....377, 378, 379

Goubert's Watt Meter. Illustrated 77
Governor for Steam Engines, Improved. Illustrated. 78
Grant Locomotive Works, Electricity at the 234
Grassot Electric Meter. Illustrated 119
Grave Annunciator, An Electrical. Illustrated 35
Green's Electric Railway Patents, George F. Illustrated 375
Gregory's Electrically Driven Model of an Ocean Steamer. Illustrated 107

Hale's Wire Cutter for Firemen. Illustrated 362
Halm, W. G., Death of 343
Harrisburg, Trouble at 146
Harvey Electric Road, Proposed 45
Havana Electric Light Station 307
Heat in its Relation to Electricity and its Influence Upon the Animal Body in Health. By J. D. Bonner, M. D. 364
Heat into Electricity, Direct Conversion of 251
Heating, Electric 294
Heating Houses by Electricity 121, 122
Hercules Electric Motor. Illustrated 46
Hoist at the Black Diamond Mine, Electric. Illustrated 230
Holland, Electric Light in 235
Horse Clipper, Electric. Illustrated 273
Hotel Proprietors, Suggestion to. Illustrated 328
Hubin-LeBlanc Alternating Current Motor. Illustrated 46
Hummel's Motor Meter. Illustrated 361
Hunt Street Generating Station, Cincinnati, O. Illustrated 299

Impression Indicator for Printing Presses, Richardson's Electrical. Illustrated 47
Improvements in Steno-Telegraphy. Illustrated. 63, 64
Incandescent Lamp Litigation 51, 52, 53
Incandescent Lamps, Treating Filaments for. Illustrated 358, 359
Incandescent Lamp Socket. Illustrated 234
Incandescent Lamp Suit Decided in Favor of Edison 32
Incandescent Lighting; Its Physical Hazard and Means for Restricting the Same. By Geo. P. Low 151, 152, 153
Independent—Storage or Primary Battery—System of Electric Traction. By Knight Neftel. And Discussion (American Street Railway Association) 263, 264
Indicator, a Simple. Illustrated 32
Indianapolis, Ind. (Correspondence.) 40, 55, 296
Instrument for Measuring the Strength of Magnetic Fields. Illustrated 8
Insulating Joint, a New. Illustrated 65
Insulating Material, New 379
Insulating or Break Knob. Illustrated 334
Insulator, New Porcelain. Illustrated 65
International Congress of Electricians at Frankfort .. 50
International Congress of Electricians. By Henry S. Carhart 233
Iowa Electric Club 242

Jersey City to Newark, Proposed Electric Road from 36
Jewish Synagogue, Lighting a 199, 200
Joints In Battery Wires, Method of Making Reliable. Illustrated 49

Kankakee, Ill., New Electric Road at. Illustrated .. 87
Kansas City (Correspondence) 337, 365, 380
Keyhole Circuit, a 103

La Boiteaux Fan Outfit. Illustrated 24
Lamp Holder, New. Illustrated 293
Lamp Lighter, Wanted to See the 364
Lamp Shades and Holders. Illustrated 334
Largest Electric Pump in the World. Illustrated 113
La Roche Alternating Dynamo. Illustrated 202
La Roche Arc Dynamo. Illustrated 280
La Roche Special Dynamo. Illustrated 359
Legislation Affecting Lighting Interests (National Electric Light Association) 164
Leonard's, H. Ward, Criticism of F. B. Badt's Handbook. By Thos. G. Grier 146
Lighting Chicago Boulevards 202
Lighting Display, a Chance for a Wonderful. Illustrated 187
Lighting Plant at the Allen Flats, Chicago. Illustrated 47
Lighting the Model City 80
Lightning Conductors, Is "Earth" of Any Value as the Termination of a. By Sidney A. Walker. 194, 195, 196
Lightning in Germany, Statistics of Accidents Caused by 244
Lightning, Protection Against 10
Line Tools, New. Illustrated 36
Liquors by Electricity, Aging. Illustrated 344
Litigaton in St. Louis, Electrical 186
Litigation, Incandescent Lamp 51, 52, 53
Litigation over Accumulators, Patent 66, 67
Locomotive for Mill Use, Electric 236
Locomotive for Mines and Mills, Edison Electric. Illustrated 9
Locomotive, New Thomson-Houston Freight Switching Electric 327
London, Electric Lighting in 359
London, Electric Traction in 120, 121
London's Electric Lights 91
Louisville, Ky., (Correspondence) 55, 366

Magnetic Button Fastener. Illustrated 47
Magnetic Reluctance. By A. E. Kennelly. And Discussion. (American Institute of Electrical Engineers 277, 278, 279, 305, 306
Mailloux Electric Motor, The. Illustrated 100
Maintaining a Constant Potential, Hering's Device for. Illustrated 4
Manchester Square Electric Light Station. Illustrated 150, 151
Masonic Temple, Chicago, Electric Light Plant for the 57
Mathematics, Use of 92
Mather Quadripolar Motor, New. Illustrated 191
Mayo System, The. Illustrated 36
Measuring Electric Currents, Thomson's Method of. Illustrated 64
Measuring the Strength of Magnetic Fields, Instrument for. Illustrated 8
Measurement Apparatus, New Standard. Illustrated 292
Medical Lighting Apparatus. Illustrated 49
Meter, Hummel's Motor, Illustrated 361
Meter, The Grassot Electric. Illustrated 119
Method of Making Reliable Joints in Battery Wires. Illustrated 49
Method of Producing Light by Means of Currents of High Frequency, Tesla's. Illustrated 8
Method of Securing Metal Bands on Wooden and Other Articles, Thomson's. Illustrated 35
Micheles' Device for Avoiding Dead Centers. Illustrated 120
Military Field Telegraph Line, Laying a. Illustrated 32
Mills, Thomson-Houston Electric Tramway for. Illustrated 10
Milwaukee, Proposed Electric Road between Chicago and 30, 50
Milwaukee, Wis. (Correspondence) 40, 54, 252, 253, 282, 296, 310, 337, 366
Mine Shafts, Safety Device for 317
Mines and Mills, Edison Electric Locomotive for. Illustrated 9
Mines, Electric Lighting in Coal 220
Mining, An Expert Opinion on Electricity in 302
Mines, Notes on Electric Work in. By Albion T. Snell 236
Mining Apparatus, Recent Development in Electric. By J. W. Kirkland. Illustrated 2, 3
Mining, Electricity in 78
Mining Machinery Abroad, Electric 314
Mining Machinery at the Inter-state Industrial Exposition, Electrical. Illustrated 227, 228
Mining Machinery, Electric 122, 123
Mining Work, Electric Haulage for. Illustrated 203
Minimum Cost Discussion, The, by Irving Hale, ... 228, 229, 230
Minimum First Cost of Plant and Maximum Cost of Operating in the Electrical Transmission of Power. By F. B. Badt. (Communication) 145, 146
Minimum First Cost of Plant and Maximum Economy of Operation in the Electrical Transmission of Power. By H. Ward Leonard .. 135, 136, 137, 138, 139
Minneapolis Cable Contract 88
Minneapolis Electric Railway System, St. Paul. Illustrated 146, 147
Minneapolis, Minn. (Correspondence) 26, 39, 54, 82, 95, 96, 294, 295, 309, 310, 323
Minneapolis, Underground Wires, at 17
Miscellaneous (Notes) 13, 27, 41, 42, 56, 69, 97, 111, 125, 141, 142, 155, 211, 225, 239, 339, 353, 354, 367
Model Central Station at Dixon, Ill. Illustrated 243
Monrath-Devold System of Rope Transmission for Electric Car Trucks. Illustrated 31
Montreal as the Electric Light Convention Will See It. Illustrated 127, 128, 129, 130, 131, 132
Montreal Convention 3, 50, 64, 105, 117, 130
Montreal Convention, Englishmen Interested in the. 245
Montreal Convention. Illustrated 144, 145
Moor's Blow-pipe. Illustrated 300
Morrison's Storage Battery Electrode. Illustrated .. 359
Motor, Brown's Three Phase Alternating. Illustrated 274
Motor, Collom's. Illustrated 345
Motor Installation, Interesting. Illustrated 105
Motor Operating Automatically at any Desired Speed or Torque, and with Maximum Efficiency Under all Conditions. By H. Ward Leonard 320, 321, 322
Motor Operating Light Machinery, Small. Illustrated 192
Motor, Perret Low Speed Multipolar. Illustrated ... 291
Motor, The Porter. Illustrated 280
Motor Wiring. By Thos. G. Grier. Illustrated 233
Motors and Dynamos, Riker Low Speed. Illustrated. 376
Motors at a Distance, Armstrong's Starting Device for. Illustrated 372, 373
Motors in England, Electric 280
Mulhausen and Darmstadt, Central Stations at. Illustrated 313, 314
Multiphase Current Rotary or. Illustrated 120
Multiple Current, The 250
Multiple No-break Contact System. By J. J. O'Connell. Illustrated 316
Municipal Lighting in Chicago 373
Municipal Plant, Sale of a 214

Nashville, Tenn. (Correspondence) 54, 366
National Electric Light Association 227
National Electric Light Association. Proceedings of the Fourteenth Convention at Montreal.
Formal Opening 157
Prof. Bovey's Address 157
Mayor McShane's Address of Welcome 157
Sir Donald A. Smith's Address 157
Sir J. W. Dawson's Address 157, 158
Ex-Mayor Beaugrand's Address 158
U. S. Consul Knapp's Address 158, 159
Judge Armstrong's Address 159
Erastus Wiman's Address 159, 160
President Huntley's Address 160
Members and Guests 160, 161, 162
Report of Committee on Constitution 162
Report of Committee on Relations of Manufacturing and Central Station Companies, and Discussion 162, 163
Report of Committee on Data—Comparison of Economy in the Generation of Power. By A. J. DeCamp 163
World's Columbian Exposition—Address by J. Allan Hornsby 163, 164
Data on Electric Lighting 164
Underground Conduits. By M. J. Francisco 164
Discussion of Paper, by T. Carpenter Smith, on the Distribution and Care of Alternating Currents, read before the Providence Convention, ... 164, 165
Central Stations Operated by Water Power. By George A. Redman. And Discussion. 165, 167, 168
A Central Station Combining the Advantages of both the Continuous and Alternating Current Systems. By H. Ward Leonard. And Discussion 168, 169, 170
Uniformity in Method of Keeping Central Station Accounts By J. J. Burleigh. And Discussion 170, 171
Three Years' Development of Electric Railways. By Eugene Griffin. And Discussion 171, 172, 173, 174
Electrical Statistics for the Census 174, 175
Wiring and Insurance Rules, and Discussion 175, 176, 177
Electric Railway Construction and Operation, and a Consideration of their Connection with Central Station Interests. By C. J. Field. And Discussion 177, 178, 179
Some Details of the Care and Management of an Arc Light System as Practiced in the "Municipal" of St. Louis. By J. I Ayer. And Discussion 179, 180, 181
Different Forms of Carbons Used in Arc Lighting. By E. P. Warner 181
Secretary's Report 181
Treasurer's Report 181, 182
Convention Notes 182, 183
The Banquet 183
National Electric Light Association Convention ... 373
National Series Transformer System for Street Lighting. Illustrated 46
Newark, Proposed Electric Road from Jersey City to. 36
New Incorporations 13, 27, 41, 55, 69, 83, 96, 111, 124, 141, 154, 197, 210, 211, 225, 238, 253, 282, 297, 311, 324, 338, 352, 353, 366, 367
New Orleans, Pole Chopping in 17, 29
New York Electric Club 208, 209
New York Notes. (Correspondence) 11, 12, 25, 26, 38, 39, 53, 67, 68, 81, 94, 95, 109, 110, 123, 124, 140, 153, 196, 209, 224, 237, 252, 270, 281, 282, 294, 308, 322, 336, 337, 351, 352, 364, 365, 380
New York Street Railway Association. Proceedings of the Convention at New York.
Members and Visitors 188
President Lewis' Address 188
Report of the Executive Committee 188
Treasurer's Report 188
Report of the Committee on Electric Motive Power for Street Railways. By John N Beckley. And Discussion 188, 189, 191, 192
Dues from Small Companies 192
Election of Officers and Adjournment 192
Niagara, To Utilize the Power of 213
Niagara, Utilizing the Power of. Illustrated 359

Ocean Cables, Projected 231
O'Connell's Alternating Current Telephone Transmitter. Illustrated 300
O'Connell's Metallic Telephone Exchange System. Illustrated 92
O'Connell's Short Core Repeating Coil. Illustrated .. 146
O'Connell's Telephone Relay. Illustrated 319
Ohio Tramway Association, Proceedings of the Convention at Akron 307
Old Time Telegraphers 71, 72
Omaha, Neb. (Correspondence.) 96, 110
Operation of Electric and Cable Railways, Construction and 37, 38
Order of Railway Telegraphers 5
Organs, Electric. By James Swinburn 10, 11
Ottumwa, Ia., Electric Development at 302
Overhead Conductors, Electric Tramways with. By A. Reckenzaun 333

Paris, Electric Lighting in. Illustrated 75
Paris, Underground Conductors in. Illustrated 102
Paris, Underground Electric Roads for 347, 348
Parsons' Steam Turbine Dynamo. Illustrated 102
Patent Decision, Interesting 301
Patents, Edison on 302
Paterson, N. J., Stations of the Edison Electric Illuminating Company at 59, 60, 61
Paudroux Battery. Illustrated 102
Peculiar Accident. Illustrated 275
Perfect Electric Motor. By H. A. Everett. And Discussion. (American Street Railway Association.) 257, 258, 259
Perret Dynamo on the Romola. Illustrated 9
Perret Low Speed Multipolar Motor. Illustrated. 290
Perry's Rotary Ice Cutter. Illustrated 186
Phonograph Batteries. Illustrated 92
Phonographic Telephone Signaling Apparatus. Illustrated 4
Photo-chronograph. Illustrated 101, 102
Photographer's Dark Room, Electricity in the. Illustrated 342
Photometer, Queen's Laboratory. Illustrated 150
Pinion, New Rawhide. Illustrated 183
Pipe Threading Attachment for Lathes. Illustrated. 308
Pipe Welding Plant in Chicago. First Electric. Illustrated 15, 16
Pittsburg Convention, Street Railway Exhibits at the. Illustrated 255, 256, 257, 258, 259, 262
Pittsburg, Electric Railways at 66

23447

Pittsburg, Pa. (Correspondence)..... 13, 26, 40, 53, 69, 81, 82, 96, 110, 111, 124, 140, 154, 352
Plymouth Church, Brooklyn, Electric Lights in. Illustrated..... 355, 356
Pole Chopping in New Orleans..... 17
Poles on Streets, Electric Railroad..... 275
Polyphasal Generators, by M. I. Pupin, Ph. D. Illustrated. (American Institute Electrical Engineers.)..... 377, 378, 379
Portable Electric Light Plant, German. Illustrated.. 344
Porcelain Insulator, New. Illustrated..... 350
Porter Motor, The. Illustrated..... 280
Postal Cars on Electric Roads in St. Louis..... 131
Postal Telegraph, The..... 89
Power Distribution, Electric. By H. C. Spaulding... 363
Power in California, Electric..... 307
Power Transmission Plant at Aspen, Colo., Electric. Illustrated..... 1, 2
Power Transmission Scheme, Big..... 203
Power Transmission, The Lauffen-Frankfort. By Gisbert Kapp. Illustrated..... 222, 223
Prediction from San Francisco, A..... 77
Prentice Dynamo. Illustrated..... 9
Pressure Valve, New Straightway Back. Illustrated. 293
Protection against Lightning..... 10
Pump, Largest Electric, in the World. Illustrated.. 113
Pumps, Triplex Electric. Illustrated..... 29, 30

Quarrying at Night by Electric Light..... 31
Quebec, Electricians Entertained at..... 192, 193
Queen's Improved Portable Testing Set. Illustrated 183
Queen's Laboratory Photometer. Illustrated..... 150
Queen's New Portable Galvanometer. Illustrated.. 192
Queen's New Type of Siemens' Electro Dynamometer. Illustrated..... 203

Racing News, How the Western Union Company Obtained Its. Illustrated..... 214 215, 216
Railway Signal Controller. Illustrated..... 49
Rapid Transit for Detroit..... 7
Rapid Transit in New York..... 147
Rapid Transit in New York and Chicago..... 270
Rapid Transit in New York. Illustrated..... 273
Rebuked at Home..... 209
Reflected Light in Dentistry. Illustrated..... 107
Regulating the Firing of Ordnance on Ships, Cuadros' Apparatus for Automatically. Illustrated..... 35
Relations of Manufacturing and Central Station Companies, Report of Committee on, and Discussion. (National Electric Light Ass'n)..... 162, 163
Reluctance, Magnetic. By A. E Kennelly and discussion (American Institute of Electrical Engineers) 277, 278, 279, 280, 305, 306
Richardson's Electrical Impression Indicator for Printing Presses. Illustrated..... 47
Ries' Electric Riveting Patent, Elias E. Illustrated. 371, 372
Riker Low Speed Motors and Dynamos. Illustrated. 376
Riverside, Ill., Edison Station at..... 74
Riveting Patent, Elias E. Ries. Illustrated..... 371, 372
Rochester, N. Y., Electric Railway, Switch-Board for the. Illustrated..... 24
Rochester, N. Y., Electric Wires in..... 7
Roebling's Wire Works, Trenton, N. J., Electric Plant at. Illustrated..... 99, 100
Rolling Mill, Electricity in a Chicago. Illustrated.. ..... 43 44, 45
Romances of the Telegraph..... 130, 131
Rope Transmission for Electric Car Trucks, Monrath-Devold System of. Illustrated..... 31
Rope Transmission, Memorandum on. By Thos. G. Grier..... 361
Rotary or Multiphase Current, The. Illustrated.... 120
Rotary Engine, A New. Illustrated..... 303
Royal Naval Exhibition, Electric Lighting at the. Illustrated..... 372
Runaway Horses Stopped by Electricity..... 187

Safety Devices. By C. C. Haskins. And Discussion, (Chicago Electric Club)..... 348, 349, 350, 363
Sample's Battery Cell. Illustrated..... 33
San Francisco, Cal. (Correspondence)..... 12, 39, 40, 82, 209, 210, 237, 238, 295, 296, 309, 310, 322, 323, 380, 381
Schlosser's Trolley Pole. Illustrated..... 358
Screws, Combination Adjusting. Illustrated..... 293
Secondary Battery with an Iron Electrode. Illustrated..... 356
Shain, Chas. D., with portrait..... 71
Short Railway Generator, New. Illustrated..... 135
Siemens & Halske's Lighting Plant at Charlottenburg. Illustrated..... 200
Signal Oilers, Improved. Illustrated..... 92
Single Reduction Motors for Street Railway Work. Illustrated..... 88
Sioux City's New Railway. Illustrated..... 4, 5
Sioux City Corn Palace, Electricity at the..... 105
Small Electric Light Plants. Illustrated..... 202
Sociological Aspect of Electric Traction..... 248, 249
Socket, New Incandescent. Illustrated..... 65
South London Railway, City and..... 92
Span Wire Tightener, New. Illustrated..... 203
Sperry Railway Generator, New 150 Horse Power. Illustrated..... 199
Spreckles' Sugar Refinery, Philadelphia, Electric Plant at Claus. Illustrated..... 373
Steno telegraphy, Improvements in. Illustrated 63, 64
Spokane Falls, (Correspondence)..... 224
Stage Regulator, Wirt. Illustrated..... 234
Standards in Electric Railway Practice. By O. T. Crosby And Discussion (American Street Railway Association)..... 264, 265, 266
Stanley's Large Transformer. Illustrated..... 253
Steam Locomotives Supplanted by Electricity..... 209
Sterling, Ill. (Correspondence)..... 69
Stopping an Engine by Electricity..... 59
Stopping Electric Cars, Device for..... 153
Storage Battery Car at Sioux City, Ia., The Bradbury Stone. Illustrated..... 272
Storage Battery Electrode, Morrison's. Illustrated.. 359
Storage Battery Road, Dubuque..... 308
Street Lighting, Statistics of..... 120
Street Railway Magnates, with portraits..... 205
Street Railway Track, The Duplex Illustrated..... 217
St. Gothard's Tunnel, Cables in the..... 149
St. Louis Electrical Exchange..... 347
St. Paul, Minn. (Correspondence)..... 309
St. Paul-Minneapolis Electric Railway System. Illustrated..... 146, 147
Switches, Hart. Illustrated..... 194
Switch for Dynamos, Carbon. Illustrated..... 200
Switch, New Double Pole. Illustrated..... 281
Switch, New Push Button. Illustrated..... 280
Subways at Cincinnati..... 241, 242
Submarine Cable in the Pacific, Surveying for a.. 288, 289
Submarine Torpedoes, Electricity for. Illustrated... 77
Supply Interests, Proposed Consolidation of the ... 24

Taunton Electrical Exhibition..... 133
Telegraph Message, First..... 373
Telegraphers' Strike, The..... 377
Thomson-Houston Carbon Works, Fire at the..... 330
Thomson-Houston Company and the Chicago West Side "L" Road Syndicate..... 29
Thomson-Houston Electric Tramway for Mills. Illustrated..... 10
Thomson-Houston Freight Switching Electric Locomotive. Illustrated..... 327
Thomson's Method of Securing Metal Bands on Wooden and Other Articles. Illustrated..... 35
Toledo, O. (Correspondence)..... 310, 323, 366
Trade News (Notes) 13, 14, 27, 28, 42, 56, 70, 83, 84, 97, 98, 112, 125, 126, 142, 155, 156, 184 198, 211, 212, 225, 226, 239, 240, 253, 254, 270, 283, 297, ... 311, 312, 325, 339, 340, 354, 367, 368.
Trailer Connecter, Wood's. Illustrated..... 249
Tramway for Mills, Thomson-Houston Electric. Illustrated..... 10
Transmitting Power from an Electric Motor to a Hand Elevator. Illustrated..... 361
Triplex Electric Pumps. Illustrated..... 29, 30
Triumphs of Electricity..... 329, 330
Trolley Pole, Schlosser's. Illustrated..... 358
Trolley Wire Hanger. Illustrated..... 248
Trolley Wires, Removing Ice from. Illustrated..... 301
Trolley Wires, Splice for. Illustrated..... 345
Telegraph and Telephone Scheme, The Postal..... 347
Telegraph Bill, Who Informed Morse of the Passage of the..... 303
Telegraph, Governmental Control of the..... 351
Telegraph in China, Extending the..... 307
Telegraph in Guatemala, The..... 184
Telegraph, Making Love by..... 307
Telegraph (Notes.)..... 27, 41, 56, 83, 97, 111, 125, 141, 155, 184, 197, 198, 211, 225, 325, 338, 353, 367
Telegraph, Romances of the..... 130, 131
Telegraph, The Writing..... 223
Telegraph Thirty Years Ago, The..... 330
Telegraph Wires in Chicago Conduits, Tapping..... 71
Telegraphers' Convention at Washington, D. C..... 117
Telegraphers in Convention..... 107, 108, 109
Telegraphers, Old Time..... 71, 72
Telegraphers' Societies, Consolidation of..... 196
Telephone Cable, American International..... 117
Telephone, Collier's Audible. Illustrated..... 33
Telephone, London-Paris..... 193
Telephone Men Ahead..... 186
Telephone (Notes)..... 27, 69, 97, 111, 125, 141, 155, 225, 239, 325, 338, 353
Telephone Numbers, Reform in..... 356
Telephone Relay, O'Connell's. Illustrated..... 319
Telephone Stock and the Bell Patents..... 119
Telephone Suit, Status of the Bell..... 343
Telephone Transmitter, O'Connell's Alternating Current. Illustrated..... 300
Telephone Transmitter without an Induction Coil, Operating a. Illustrated..... 328
Telephone, Use of the..... 247, 248
Telephones, Automatic Pay Call Box. Illustrated.. 102
Temperature Indicators, Ingenious Electrical. Illustrated..... 289
Tesla's Oil Insulated Condenser. Illustrated..... 356
Type Setting Machine, Electrical..... 272

Underground Conduits, Report of Committee on. By M. J. Francisco (National Electric Light Association)..... 164
Underground Electric Road for Paris..... 347
Underground Electric Road in Germany..... 330
University of Wisconsin, Electrical Engineering at the..... 147
Underground Wires at Minneapolis..... 17
Underground Wires for Cities..... 355, 356

Ventilating Chicago's Electrical Conduits, Project for 133
Villard, Henry, Reported Resignation of..... 146
Villard's, Henry, Plans..... 50
Virginia, Electric Light Plant on the, Illustrated. 114, 115
Voltmeter, Bain's Compensating. Illustrated..... 249

War Time Reminiscence, A..... 209
Water Power, Data Relating to. By F. B. Badt. Illustrated (Electric Transmission Hand book)... 235
Water Power, Central Stations Operated by. By George A. Redman. And Discussion. (National Electric Light Association.)..... 165, 167, 168
Watt Meter, Goubert's. Illustrated..... 77
Weather Prophet's Views on Electric Wires, A..... 123
Weber, Wilhelm Eduard's, Death, with portrait..... 7
Weehawken, Interesting Plant at..... 32
Welding Plant at the Okonite Factory, Passaic, N. J., Electric. Illustrated..... 247
Welding Plant at Chicago, First Electric Pipe. Illustrated..... 15, 16
Western Union Telegraph Company Obtained Racing News, How the. Illustrated..... 214, 215, 216
Westinghouse Company, Reorganization of the..... 9, 10
Westinghouse Interests, Reorganization of..... 50
Weston Automatic Engine. Illustrated..... 219
Weston Compound Engine. Illustrated..... 281
Weston Quick Break Switch. Illustrated..... 249
Wheeler's Cut-Out. Illustrated..... 330
Wire Gauge Novelty Electric. Illustrated..... 350
Wiring and Insurance Rules. (National Electric Light Association)..... 175, 176, 177
Wire Cutter for Firemen, Hale's. Illustrated..... 362
Wiring Contract, Large..... 89
Wiring Motors. By Thos. G. Grier. Illustrated.... 233
Wiremen, Convention of..... 272
Wires, Regulations for Electric..... 234
World's Columbian Exposition. By J. Allan Homsby. And Discussion. (National Electric Light Association)..... 163, 164
World's Congress of Electricians in 1893. By Elisha Gray, Ph. D., L. L. D. And Discussion. (Chicago Electric Club.)..... 245, 268, 269, 270
World's Fair at Night. Illustrated..... 143
World's Fair, Electricity at the. 2, 30, 31, 45, 57, 58, 73, 74, 86, 99, 100, 113, 114, 132, 133, 143, 144, 185, 186, 201, 214, 233, 249, 250, 255, 275, 285, 286, 287, 288, 293 299, 300, 313, 314, 327, 328, 341, 342, 357, 358, 376
World's Fair, Electric Subways for. Illustrated.... 317
World's Fair Electrical Congress..... 342
World's Fair, Temporary Lighting and Power Plant at the. Illustrated..... 271, 272
Wooden Toothed Gearing, New Type of. Illustrated..... 249
Wood's Trailer Connecter. Illustrated..... 249
Working by Electric Light..... 100

Zipernowsky Electric Railway with a Vertical Track, Experiments on the. Illustrated..... 16

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, JULY 4, 1891. No. 1

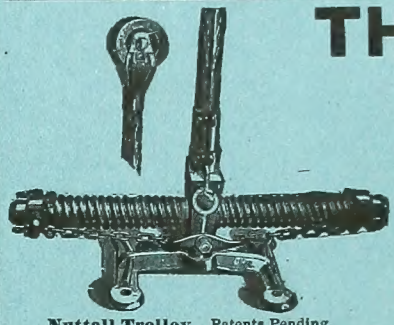
"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes
Telephonic transmission through Our Cable an easy
GAME.

An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices.
Standard Underground Cable Co., New York, Pittsburgh, Chicago.

THE HOLTZER-CABOT ELECTRIC CO.,
MANUFACTURERS OF AND DEALERS IN
EVERYTHING ELECTRICAL.
SEND FOR 256-PAGE CATALOGUE,
111 Arch Street, BOSTON, MASS.
SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.
A full line of our manufacture can be found at our Agencies.


Nuttall Trolley. Patents Pending.

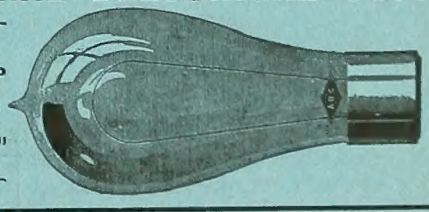
THE BEST!
$30.00
WRITE US.
Electric Railway Specialty COMPANY,
29 Broadway, NEW YORK.

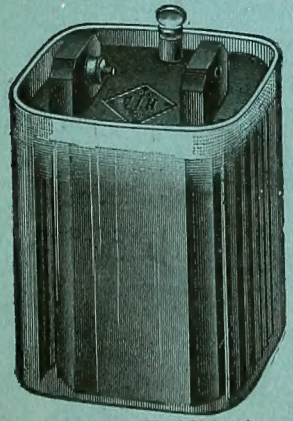
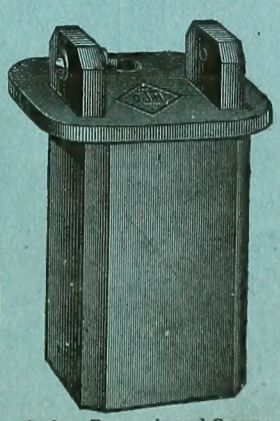
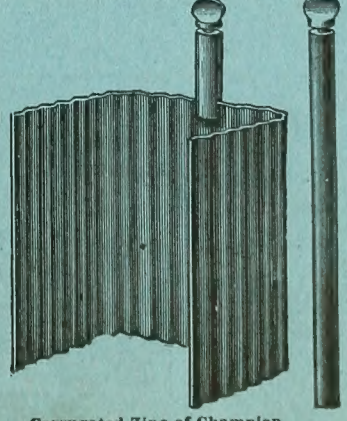
KELLOGG
COMBINATION STEEL CENTER AND SIDE
POLES.
ENGINEERING EQUIPMENT CO.,
SOLE AGENTS,
NEW YORK, 143 Liberty St.
BOSTON, 126 Pearl St.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.
OKONITE TRADE MARK
INSULATED **WIRES AND CABLES,**
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.
BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco.

New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP
AGENTS
J.W. PEALE, 1 BROADWAY, NEW YORK.
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.
DAY'S KERITE
The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.
Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.
GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.
THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE "CHAMPION" BATTERY.
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery.

Carbon Reservoir and Cover of Champion Battery.

Corrugated Zinc of Champion Battery.
Rod Zinc of Champion Battery.

The E. S. GREELEY & CO.
5 AND 7 DEY STREET, NEW YORK.
Manufacturers, Importers and Dealers in
Electrical Supplies
OF ALL DESCRIPTION.
Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.
STANDARD ELECTRICAL MEASUREMENT APPARATUS.

NOTE THE CONTRAST!!

INCANDESCENT LIGHTS

In Central Stations July 1st, 1890.

THOMSON-HOUSTON SYSTEM.		Aggregate of All Other Systems
4,150	VERMONT,	2,200
12,800	TENNESSEE,	1,485
1,500	SOUTH CAROLINA,	NONE.
18,450	TOTAL,	3,685

FIVE TIMES as many of the Thomson-Houston System as of

ALL OTHERS COMBINED.

The figures referring to "total of all systems," taken from table published in August number of "Electrical Industries," for year 1890, are of undisputed accuracy.	Total of all systems.	Thomson-Houston System.	
		Number.	Percentage to total of all systems.
Vermont, - - - - -	6,350	4,150	$65\frac{3}{10}$ per cent.
Tennessee, - - - -	14,285	12,800	$89\frac{1}{2}$ per cent.
South Carolina, - -	1,500	1,500	100 per cent.

THOMSON-HOUSTON ELECTRIC CO.,

620 Atlantic Avenue, Boston, Mass.
Wall and Lloyd Streets, Atlanta, Ga.
115 Broadway, New York City.
15 First Street, San Francisco, Cal.
831 New York Life Building, Kansas City, Mo.

148 Michigan Avenue, Chicago, Ill.
405 Sibley Street, St. Paul, Minn.
215 West Fourth Street, Cincinnati, O.
1110 Noble Street, Philadelphia, Pa.
1333 F Street, Washington, D. C.
115 North 3d Street, St. Louis, Mo.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....xxvi
Abendroth & Root Mfg. Co.... —
Alexander, Barney & Chapin.. i, ix
American Electrical Works.....xv
Automatic Switch Co.....ix
Andrews & Co., A. H.....xvi
Baggot, E.....xvi
Bain Electric Mfg. Co.....xii
Ball Engine Co.....xx
Baxter Electric Motor Co.....xxvi
Bernstein Electric Co.....—
Blatz, L.....—
Borden & Selleck Co.....xvii
Bostwick & Burgess Mfg. Co...xix
Braun Illustrating Co.....xx
Brownlee & Co.....xiv
Brush Electric Co.....xxv
Buckeye Electric Co.....—
Butler Hard Rubber Co.....x
C. B. & Q. R. R.....—
C. & C. Electric Motor Co.v, xviii
Card Electric Motor & Dynamo Co.....—
Central Electric Co.....vii
Chicago Electric Mfg. Co.....xv
Chicago Insulated Wire Co.....xix
Cleveland Aluminum Co.....xvii
Cleverly Electrical Works...iv
Colburn & Co., I. W. xvi
Coolidge, Fuel & Supply Co...—
Cowles Electric Smelting and Aluminum Co.....xvii
Crocker-Wheeler Electric Motor Co.....xv
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co.xviii
Eastern Electric Cable Co.....xv
Easton Electric Co.....xv
Edison General Electric Co.,— Motor Dept.....viii
Edison General Electric Co., Wire Department.....ix
Electric Merchandise Co.....ix
Electric Railway Specialty Co....i
Electric Construction & Sup. Co.. vi
Electrician Pub. Co.....xii, xix
Electrical Construction Co., The. xv
Electrical Engineering Co.....xv
Electrical Supply Co., The...xxiv
Elektron Mfg. Co.....xii
Empire City Electric Co.....xv
Empire China Works.....xiv
Engineering Equipment Co.....i
Evans Friction Cone Co.....xix
For Sale.....xv
Fort Wayne Electric Co.....xxvi
Freeman, Coleman & Co.....xvi
Globe Carbon Co.....xvii
Greeley & Co., The E. S.....i
Hawkeye Electric Mfg. Co.....—
Hay-Horn Mfg. Co.....—
Hazelton Tripod Boiler Co.....xv
Heisler Electric Light Co.....—
Hill Clutch Works.....xix
Holmes, C. H.....xv
Holmes, Booth & Haydens.....iv
Holtzer-Cabot Electric Co.....i
Hood, Wm.....xii
Hunt Machine Co., Rodney.....xix
India Rubber & Gutta Percha Insulating Co.....iv
Interior Conduit & Insulation Co..xiv
International Okonite Co.....i
Ireson, Chas. L.....—
Kartavert Mfg. Co.....xvi
Knapp Electrical Works.....xxi
Leffel & Co., Jas.....xv
McLaughlin, James.....xvi
Mason, James H.....xv
Mason, J. W.....xv
Milliken Bros.....iv
Minneapolis Street Railway Co.—
Monitor Electric Co.....xii
Munsell & Co., Eugene.....xv
National Carbon Co.....iv
National Electric Mfg. Co.....xi
N. Y. Belting & Packing Co.....xiv
New York Insulated Wire Co..xviii
New York & Ohio Co.....i
Northwestern Electrical Specialty Co.....—
Ostrander & Co., W. R.....xvi
Paiste, H. T.....xiv
Page Belting Co.....xvi
Partrick & Carter Co.....xii
Payne & Co., Geo. W.....xvi
Pearson & Co., W. B.....xii
Phoenix Glass Co.....xix
Pond Engineering Co.....xx
Powell Co., Wm.....—
Queen & Co.....xv
Roeblings' Sons Co., Jno. A.....x
Rose Polytechnic Institute....xvi
Sawyer-Man Electric Co.....xiii
Schieren & Co. Chas. A.....xiv
Schoonmaker, A. O.....xv
Schuyler Electric Co.....xvi
Short Electric Railway Co.xiv, xxiii
Shultz Belting Co.....—
Sioux City Engine Works.....xx
Southern Electrical Supply Co..xx
Standard Underground Cable Co....i
Stanley & Hall.....xiv
Standard Paint Co.....xiv
Stanley Electric Mfg. Co.....vi
Star Iron Tower Co.....—
Stearns Mfg. Co.....xx
Stephenson Co., Jno.....xviii
Sterling, W. C.....xix
Stilwell & Bierce Mfg. Co..xvi, xvii
Sunbeam Incand. Lamp Co....xvii
Taussig, S.....—
Temple, J. C.....xvii
Thomson-Houston Electric Co. Lighting Department.....ii
Thomson-Houston Electric Co., Railway Department.....xxii
Triumph Comp'd Engine Co.....xx
Turner Brass Works.....xv
Union Hardware Co.....xiv
United States Electric Lighting Co.....xiii
Van Nuis C. S.....i
Vulcanized Fibre Co.....xvii
Wanted.....xv
Western Electric Co.....x
Westinghouse Electric and Mfg. Co.....—
Westinghouse Machine Co.....xx
Weston Electrical Instrument Co.....xiv
Woodbridge & Turner Engineering Co.....xvii
Worthington, Henry R.....xiv

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Cleveland Aluminum Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Stanley & Hall.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co.,The.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Stanley & Hall.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Stanley & Hall.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Ireson, Chas. L.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Chicago Electric Mfg. Co.
Bain Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
McLaughlin, Jas.
Temple, J. C.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Chicago Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Engineering Equipment Co.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Monitor Electric Co.
Southern Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Southern Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Colburn & Co., I. W.
Easton Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sioux City Engine Works.
Stearns Mfg. Co.
Triumph Compound Engine Co.
Westinghouse Machine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Electrical Supply Co.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Easton Electric Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Stanley & Hall.
Thomson-Houston ElectricCo.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Globes and Electrical Glassware.
Baggot. E.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Butler Hard Rubber Co.
Central Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Empire City Electric Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Monitor Electric Co.
New York and Ohio Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
[illegible]

Mica.
[illegible]

Mining Apparatus, Electric.
[illegible]

Motors.
Bain Electric Mfg. Co.
[illegible]
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Standard Electrical Works.
Southern Electrical Supply Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Milliken Bros.
Sterling, W. C.
Star Iron Tower Co.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Pond Engineering Co.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Telephones, Non-Electric.
Bostwick & Burgess Mfg. Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Stanley Electric Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.
Roebling's Sons Co., Jno. A.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

Cleverly
1015 CHESTNUT ST.
PHILA.

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

REMEMBER

That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY **MILLIKEN BROS.**

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K.K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THOS. L. SCOVILL, New York Agent, - - - - 25 Park Place, NEW YORK.

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.,

—MANUFACTURERS OF—

VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES.

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS. SILK. HEMP. COTTON. DYNAMO WIRES and CABLES. very pliable. Every variety of INCANDESCENT CORES.

HABIRSHAW

RUBBER COVERED

CABLES AND CORES.

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High Insulation and Long Life, all milage.

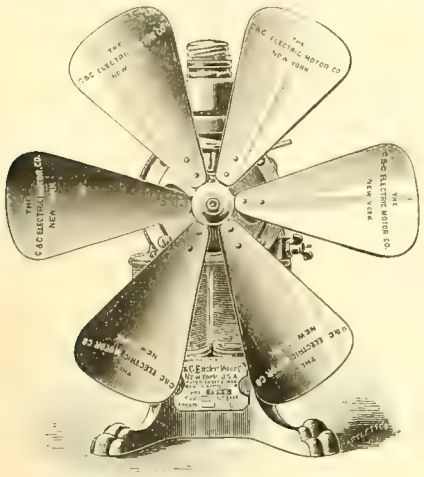
If you are not acquainted with the merits of Habirshaw Insulation we shall be pleased to send you samples upon application.

W. M. HABIRSHAW, Gen'l Mgr. OFFICE: 315 Madison Ave., Cor. 42d St., New York.

FACTORY: Glenwood, Yonkers, N. Y.

WESTERN AGENTS, The Electrical Supply Co., 171 Randolph Street, Chicago, Illinois.

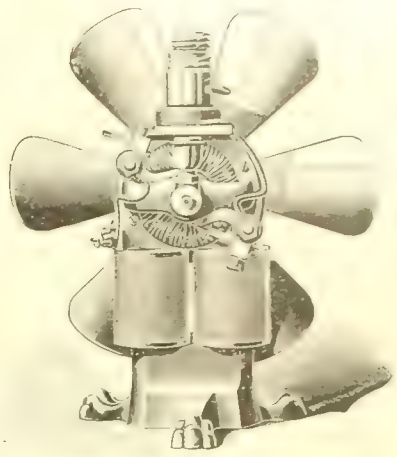
C. & C. FAN OUTFITS.



110 Volt Fan Outfit. Front View.

THE OLDEST AND BEST.

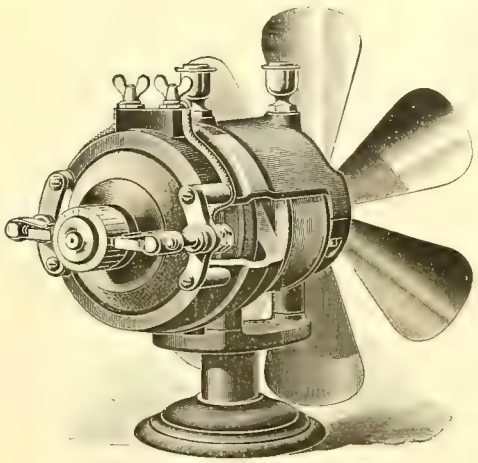
The season of 1891 marks the fifth year since the introduction of the C. & C. Fan Outfits.



110 Volt Fan Outfit. Back View.

Thousands in Operation in Every State and Territory in the Land.

With each season some improvement either Electrical or Mechanical has been made, until the Machine as placed this year on the market, is absolutely without defect.

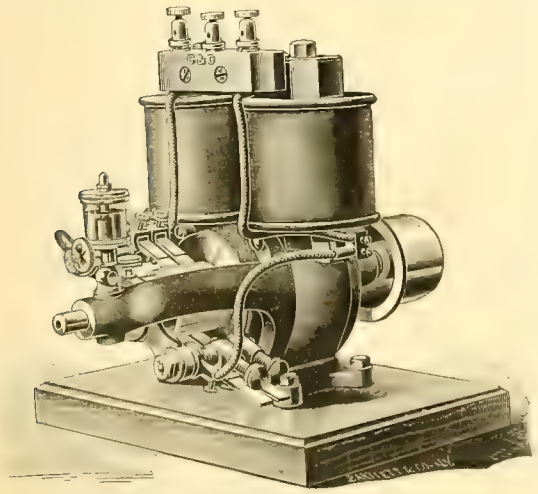


500 Volt Fan Outfit.

Wound for any direct current Circuit.

Finished in dipped brass, polished or nickeled.

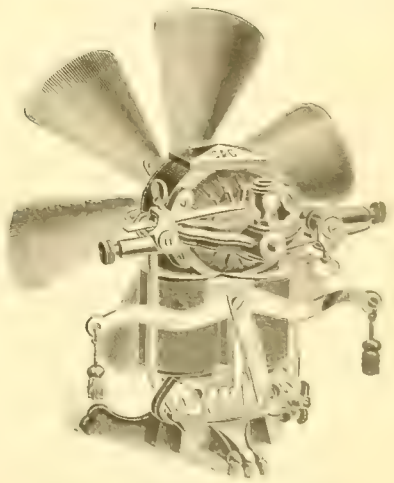
For Electric Railway and Power Circuits we are this year ready to supply a Fan Outfit designed especially for high Potential Circuits.



1-4 H. P. Motor for operating Ceiling Fans.

OFFICES:

BOSTON, 63 Oliver Street.
CHICAGO, Phenix Building.
DENVER, 1316 Eighteenth Street.
CINCINNATI, Cincinnati Electric Light Company.
ST. LOUIS, 411 N. 11th Street.
SAN FRANCISCO, 35 Market Street.
WASHINGTON, 609 Twelfth Street.



Constant Current Fan Outfit.

C. & C. ELECTRIC MOTOR COMPANY,

402 and 404 Greenwich Street, NEW YORK.

STANLEY ELECTRIC MFG. CO.

TRANSFORMERS.

Compare these weights with weights of other transformers:

5 light,	48 lbs.
10 light,	65 lbs.
20 light,	85 lbs.
30 light,	101 lbs.
40 light,	130 lbs.
100 light,	300 lbs.

A. C. FAN MOTORS.

SMALL,
NOISELESS,
RELIABLE.

Less than 1½ Amperes required to drive it.

Price, $20.00.

PITTSFIELD, MASS.

"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

We Guarantee our Lamps Electrically and Mechanically.

In corresponding please give full particulars and state voltage.

Electric Construction and Supply Co.,

Phenix Building, CHICAGO, ILL.

Established 1881.

18 Cortlandt Street, NEW YORK CITY.

Our St. Louis Branch:
Southern Electrical Supply Co.,

OKONITE
TRADE MARK.

823 Locust St.,
ST. LOUIS, MO.

HEADQUARTERS

FOR ALL KINDS OF

Our Kansas City Branch:
Gate City Electric Company,

OKONITE

522 Delaware St.,
KANSAS CITY, MO.

ELECTRICAL SUPPLIES

Besides being General Western Agents for

OKONITE

AND

Improved Candee Weather-proof Wires.
Bryant Switches.
Bryant Sockets.
Packard High Grade Incandescent Lamps.
Commercial Fire-proof Lamp Cord.

WE CARRY A FULL LINE OF

Railway Supplies,
Electro-Medical Apparatus,
Electrical House Goods,
Etc., Etc., Etc.

Our Omaha Branch:
Western Electrical Supply Co.,

OKONITE
TRADE MARK.

418 S. 15th St.,
OMAHA, NEB.

CENTRAL ELECTRIC COMPANY,
116 & 118 Franklin Street,
CHICAGO.

Connected by Private Wire with Postal Telegraph-Cable Company's System.

Our Denver Branch:
Electric Power Transmission Co.,

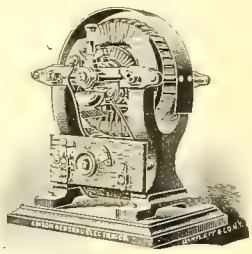
OKONITE
TRADE MARK.

1722 Lawrence St.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.

NEW



ELECTRIC MOTORS.

MINIMUM OF ATTENTION AND REPAIR.

Highest Efficiency,
Slow Speed,
No Sparking.

H. P.	LIST PRICES.	PRICES TO USERS, 45 PER CENT. OFF LIST.
1-12	$ 40	$22.00
1-6	60	33.00
1-3	100	55.00
1-2	125	78.75

Independent Coils,
Improved Lubrication,
Mechanically Perfect.

SEND FOR DESCRIPTIVE CIRCULAR TO NEAREST DISTRICT OFFICE.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BUILDING, 20 Cortlandt St., NEW YORK.

VOLTMETERS. TRADE A.B.C. MARK **AMMETERS.**

ELECTRICAL SUPPLIES. | ARC AND INCANDESCENT LAMPS.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

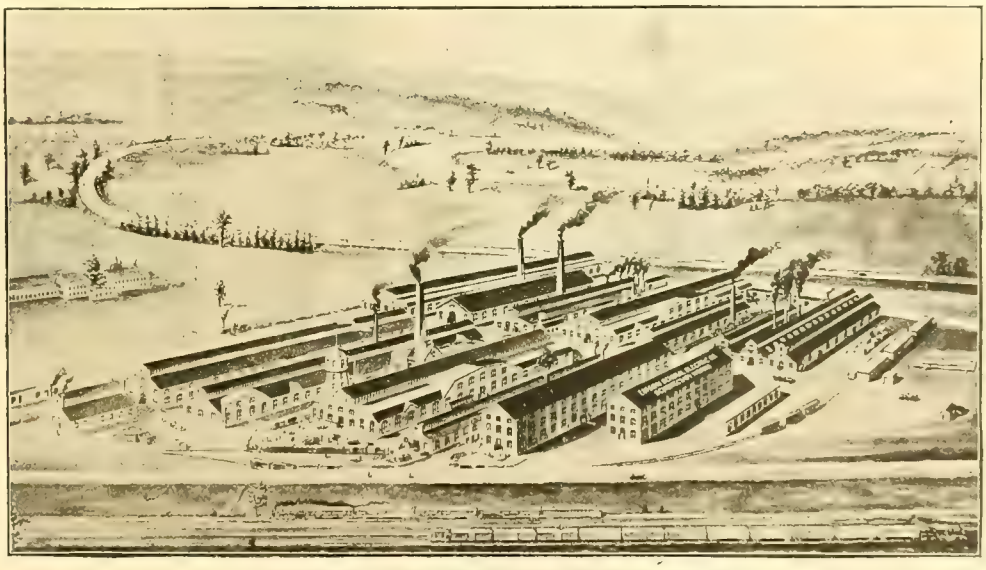
W. R. MASON, General Manager.

SIEMENS CABLES.

Submarine,

Telegraph,

Underground,



Telephone,

Interior,

Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Wire Department, Edison General Electric Company,

EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, uncqualed for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

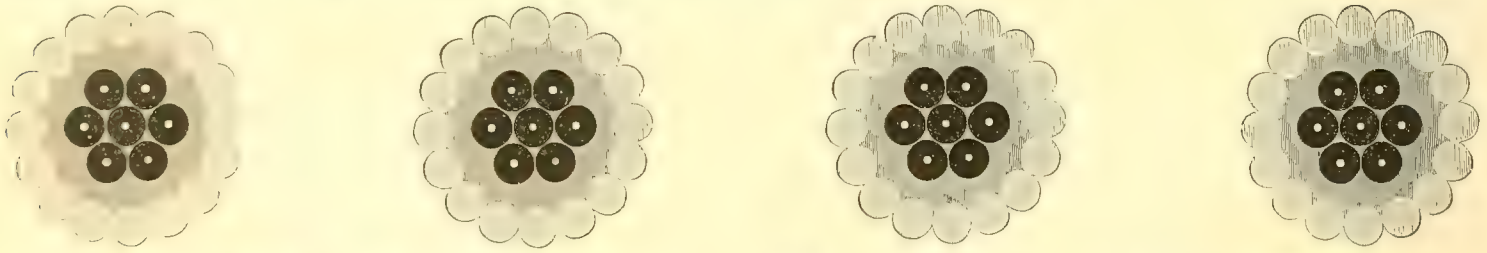
Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

To Electric Railway Companies:

We shall be pleased to make you quotations on Washburn & Moen's hard drawn copper trolley wire, and our own make of Weatherproof insulation feeder wires. Our Weatherproof wire is superior to any other wire of like character in the market.

WESTERN ELECTRIC COMPANY, CHICAGO. NEW YORK.



CABLES OF ALL KINDS.

UNDERGROUND CONDUCTORS.
LEAD COVERED TELEPHONE CABLES.
WEATHERPROOF AND UNDERWRITERS' LINE WIRE.
COPPER AND BRONZE TROLLEY WIRE.
MAGNET WIRE.

—MANUFACTURED BY—

JOHN A. ROEBLING'S SONS CO.,

TRENTON, N. J.

Warehouse, 171 and 173 Lake St., Chicago, Ill.

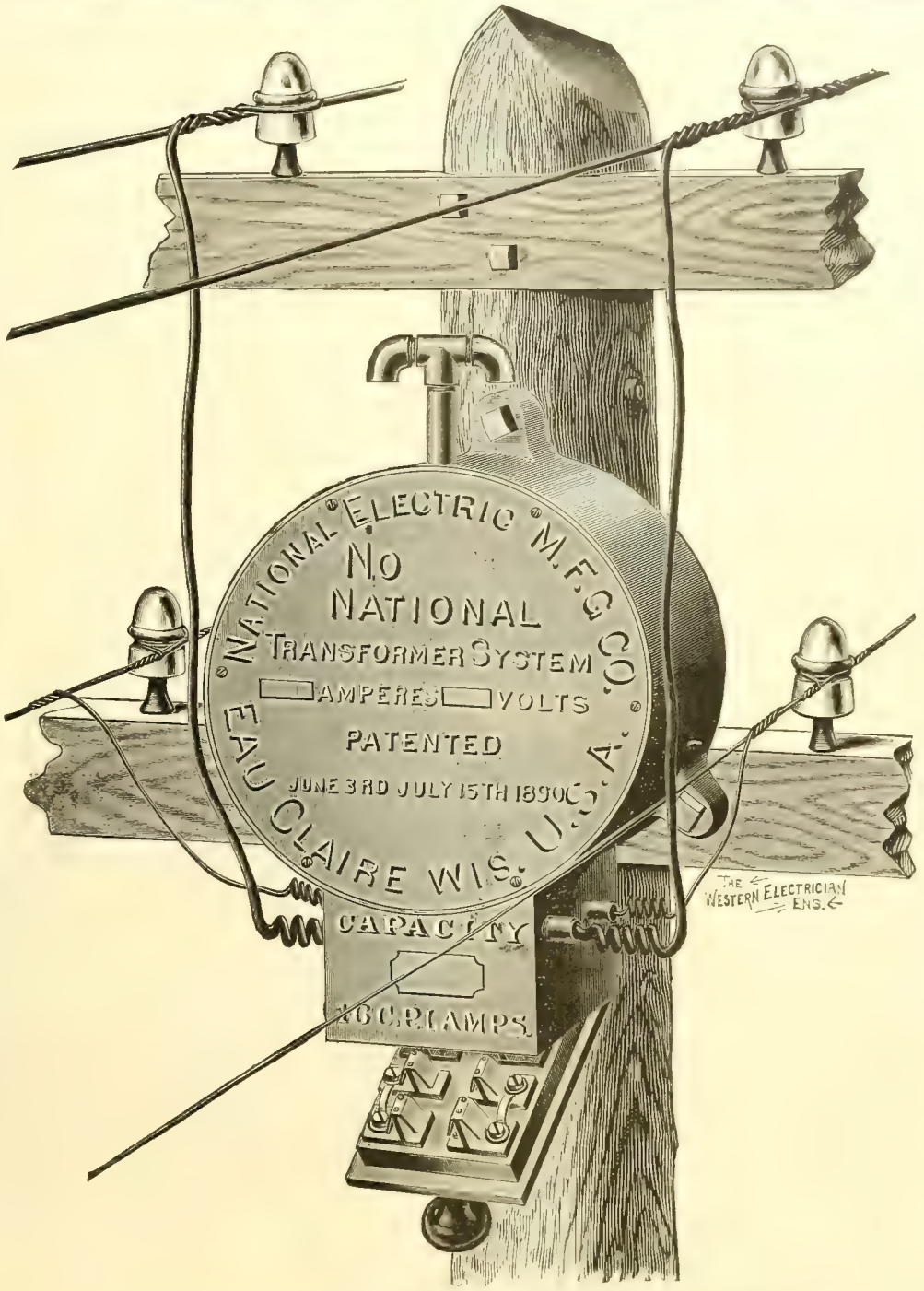
THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.

CONVERTER EFFICIENCIES.

It Will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



Transformer on Pole Showing National Safety Fuse Box.

No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, (95.2%.) They are absolutely safe. Their regulation is practically perfect.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

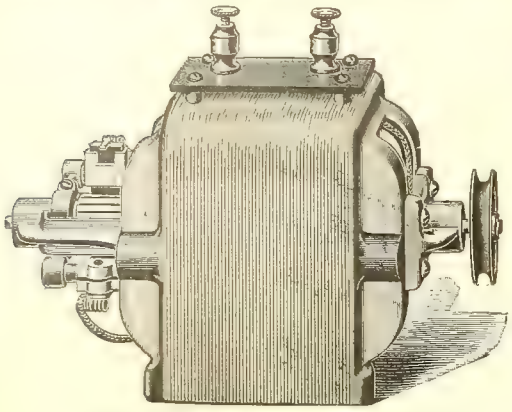
NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

AGENTS:

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	DETROIT, MICH.,	Commercial Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	DENVER, COLO.,	The Mountain Electric Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
SAN FRANCISCO, CAL.,	National Electric Development Co.		

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

ELECTRICAL BOOKS

OF ALL KINDS.

Send for Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building CHICAGO, ILL.

WONDERFUL!

WHAT?

WM. HOOD, GEN'L. AGENT.

JEWEL

INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

The New Incandescent Lamp,

"THE JEWEL."

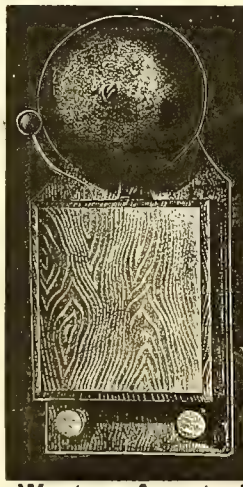
FOR ANY VOLTAGE. FOR ANY SOCKET.

For particulars apply to

WM. HOOD,

GENERAL AGENT,

239 LaSalle St., - CHICAGO.



MONITOR

WOOD · BOX

BELLS

ARE THE BEST.

Polished Case, Nickel Plated Trimmings, Heavy Magnets, Quick Stroke, Clear Ring.

Write for Quotations to

C. A. HARMOUNT, M'gr,

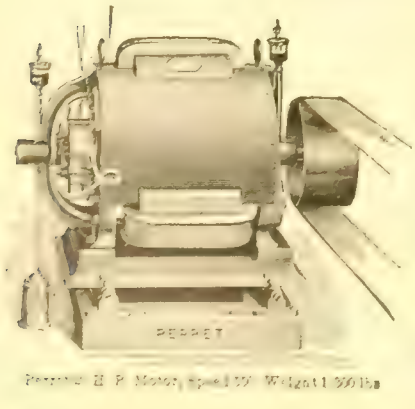
MONITOR ELECTRIC COMPANY

149 Wabash Av., CHICAGO, ILL.

Western Agents Alfred F. Moore's Wires and Cables.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.



MANUFACTURERS OF

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. *Factories equipped throughout with Electric Power*
Isolated Plants for Incandescent Electric Lighting.

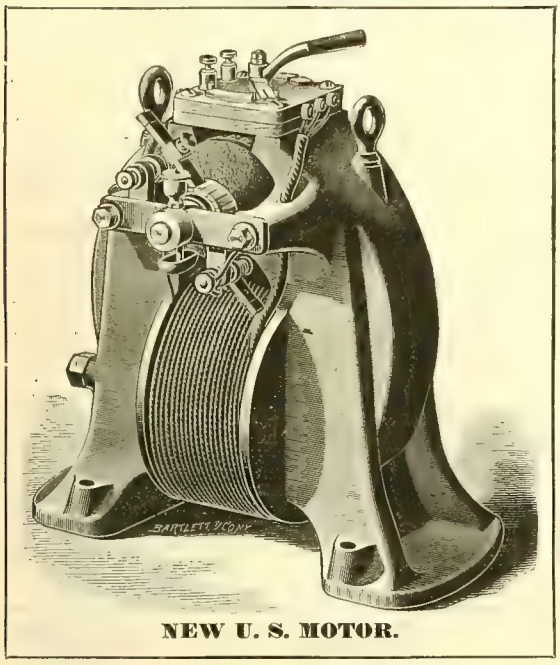
SELLING AGENTS:

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos. — Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

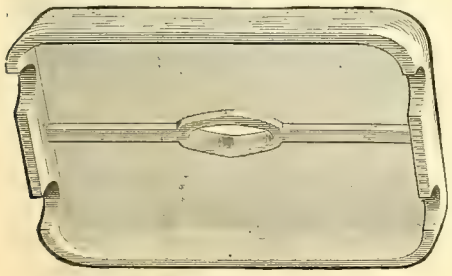
MOTORS and GENERATORS

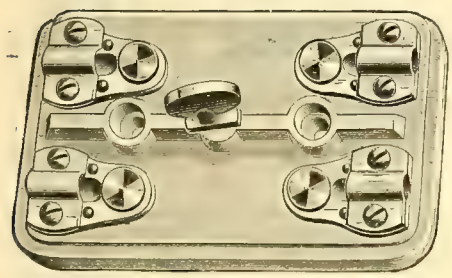
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

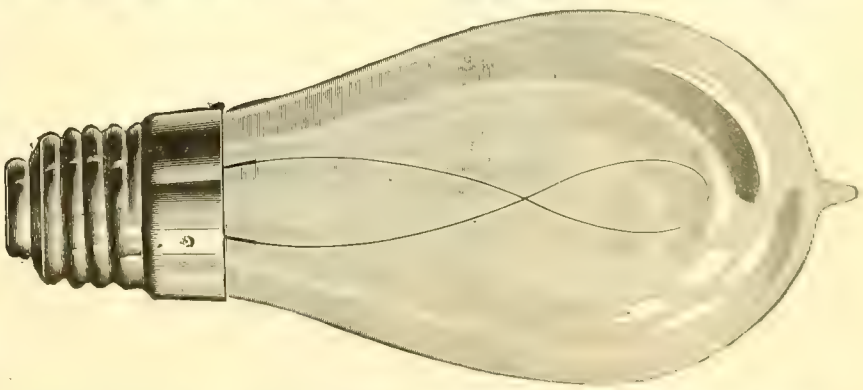
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

WRITE US FOR PRICES ON

SPEAKING TUBES

AND SUPPLIES.

FORTY CENTS

FOR OUR DUST-PROOF BELL.

STANLEY & HALL,

32 AND 34 FRANKFORT STREET, - - - NEW YORK CITY.

—THE—

UNION HARDWARE CO.,

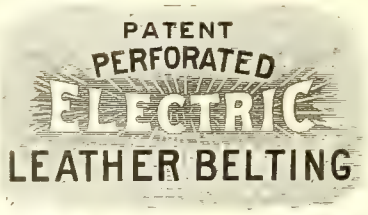
PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.



Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

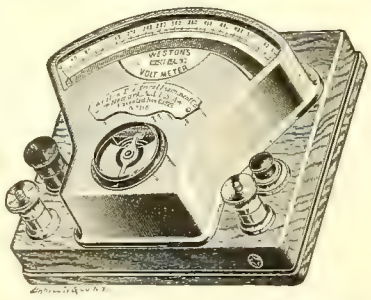
Also New York, Boston, Philadelphia,

46 SOUTH CANAL ST., CHICAGO. ILL.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, Newark, N. J.

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

THE NEW CATALOGUE

—OF THE—

UNDERGROUND CONDUIT SYSTEM

OF THE Interior Conduit & Insulation Company

IS NOW READY.

Copies mailed upon application to

INTERIOR CONDUIT & INSULATION COMPANY.

EDWARD H. JOHNSON, President.

WORKS, 527 to 531 W. 34th St. and 526 to 528 W. 35th St.

GENERAL OFFICES, 42 & 44 BROAD ST., NEW YORK.

H. M. UNDERWOOD, Gen. Western Agent, Rookery Building, Chicago.

B. FRANK JOHNSON, Gen. Agt. for Pa., Provident Bldg., Philadelphia, Pa.

THOS. DAY & CO., Gen. Agents for California, San Francisco, Cal.

THE SHORT GEARLESS MOTOR.

SOLE PROPERTY OF

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, - OHIO.

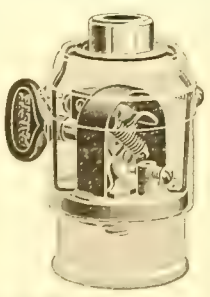
H. T. PAISTE,

MANUFACTURER OF

Paiste Electrical Specialties.

Western Office and Store-room:
341 THE ROOKERY,
CHICAGO, ILL.

Eastern Office and Factory:
1201 MARKET ST.,
PHILADELPHIA, PA.



PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.

EMPIRE CHINA WORKS,

114 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

— INCLUDING —

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

P AND B. Armature Varnish, Insulating Compounds, Insulating Tapes, Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, JULY 4, 1891. No. 1

Electric Power Transmission Plant at Aspen, Colo.

An excellent idea of the rapid strides that are being made in the application of electricity to mining may be had by examining the electric power transmission plant at Aspen, Colo. This is beyond doubt one of the most interesting electric transmission plants in the United States.

Aspen had been lighted by electricity for four years, the power having been obtained from several small water powers, when, owing to the limited quantity of water flowing in the mountain streams of this region in winter, it became necessary either to put in a steam plant or to use water under a much greater head. The latter course was deemed advisable, and the construction of a plant providing for the use of water under a head of 900 feet was begun about three years ago.

A dam was built on Hunter Creek, about three miles from town. At this point a twelve foot dam creates a reservoir covering several acres of ground. It has been necessary, during a few of the coldest winter nights, to draw upon the supply of water, but the reservoir always refilled during the following day.

From the dam the water is carried about two miles in a wooden flume, buried in the ground, to the head of the pipe line, which is 4,500 feet long and has a fall of 876 feet, giving a pressure of 380 pounds per square inch at the water wheels. Lap welded pipe, fourteen inches in diameter and about one-quarter inch in thickness, is used. This pipe line terminates at the power house, which is shown in Fig. 2.

Here there are eight Pelton water wheels, each two feet in diameter, and each capable of developing 150 horse power. The water wheels run at the rate of 1,100 revolutions per minute and each wheel is belted directly to one or more dynamos. This power has now been in use about three years, and has proved absolutely reliable. The wheels at present operate three 60 light Brush arc dynamos; two 450 light Brush incandescent dynamos, 110 volt direct current; three 750 light Westinghouse 1,000 volt alternators; one 500 volt 80 ampere Edison dynamo, and one 500 volt 160 ampere Edison dynamo. An excellent view of the dynamo room is presented in Fig. 1.

The arc lights are used for lighting the streets and stores; the incandescent lights for stores, residences and mines; the 500 volt dynamo furnishing power to mines.

The power dynamos supply current for driving motors, generally used for ventilation and hoisting in mine inclines.

There are now in use one 10 horse power electric hoist in the Regent mine, one 10 horse power electric hoist in the Aspen mine, one 25 horse power electric hoist in the Aspen mine, one 20 horse power motor running Taylor & Brunton's sampling works and one three horse power motor operating a blower in the Regent mine.

For hoisting purposes motors of the street car type are used, so that the speed is under control of the operator. The motors are connected to ordinary mine hoists by spur gearing and paper friction wheels. These electric hoists are all underground, at points where it would be both difficult and expensive to obtain power in any other way. The distance of the motors from the dynamo is, in most cases, about two miles. Some of the hoists have been running more than three years, and all have proved satisfactory and reliable. The expense for motor repairs has been very small. There are also motors in use for running rock crushers, etc. The motors range in size from three to seventy-five horse power.

The mining engineers in Aspen are wide awake to the great advantages of electric mining machinery. The Roaring Fork Electric Light & Power company and the Aspen Mining & Smelting company have lately contracted with F. B. Badt, manager western power and mining department, Thomson-Houston Electric company, for complete electric percussion drill outfits made by the Thomson Van Depoele Electric Mining company. As the distances in these cases are very great, the Van Depoele direct current motor transformers will be used to transform a direct current of high potential into a pulsating current of 220 volts.

Electric tramways and electric pumps, both for station and sinking purposes [illegible] of the tunnels and shafts.

As already stated, the water power is utilized by means of Pelton wheels. In Fig. 3 is clearly shown the principle of this wheel. The water arriving under high pressure is thrown out of a nozzle against buckets of peculiar shape, Fig. 4, fastened to the outer rim of the wheel. The function of a water wheel, operated by a jet of water escaping from a nozzle, is to convert the energy of the jet, due to its velocity, into useful work. In order to utilize this energy fully the wheel bucket, after catching the jet, must bring it to rest before discharging it, without inducing turbulence or agitation of the particles.

This feature is successfully obtained in the Pelton bucket. Fig 5 shows the jet of water entering and leaving the bucket, under conditions theoretically and practically correct, and, it is claimed, giving a high commercial efficiency to the wheel.

In the plant of the Roaring Fork Electric Light & Power company the power developed is made to conform to the requirements of the plant by the use of reducing tips, so that only as much water is applied as is necessary to run the machinery to which the wheels are attached.

Close regulation is afforded by means of a deflecting nozzle and hydraulic governor attached to each wheel.

Some idea of the enormous power of these wheels, running under the conditions noted, may be obtained from the fact that the weight of the wheels alone is but ninety pounds each. This shows a capacity of nearly two horse power for every pound of weight of material, and, including accessories to make the plant complete, such as shafting, pulleys, boxes, gate, nozzles, etc., the proportion would be four and one-quarter pounds to every horse power developed. The relative proportion in the best type of steam plants would be from 400 to 500 pounds of material to every horse power developed.

As far as the reliability of this power is concerned it is said that the wheels have [illegible] without interruption from any cause since they started, some two years ago. Considering the severe weather en

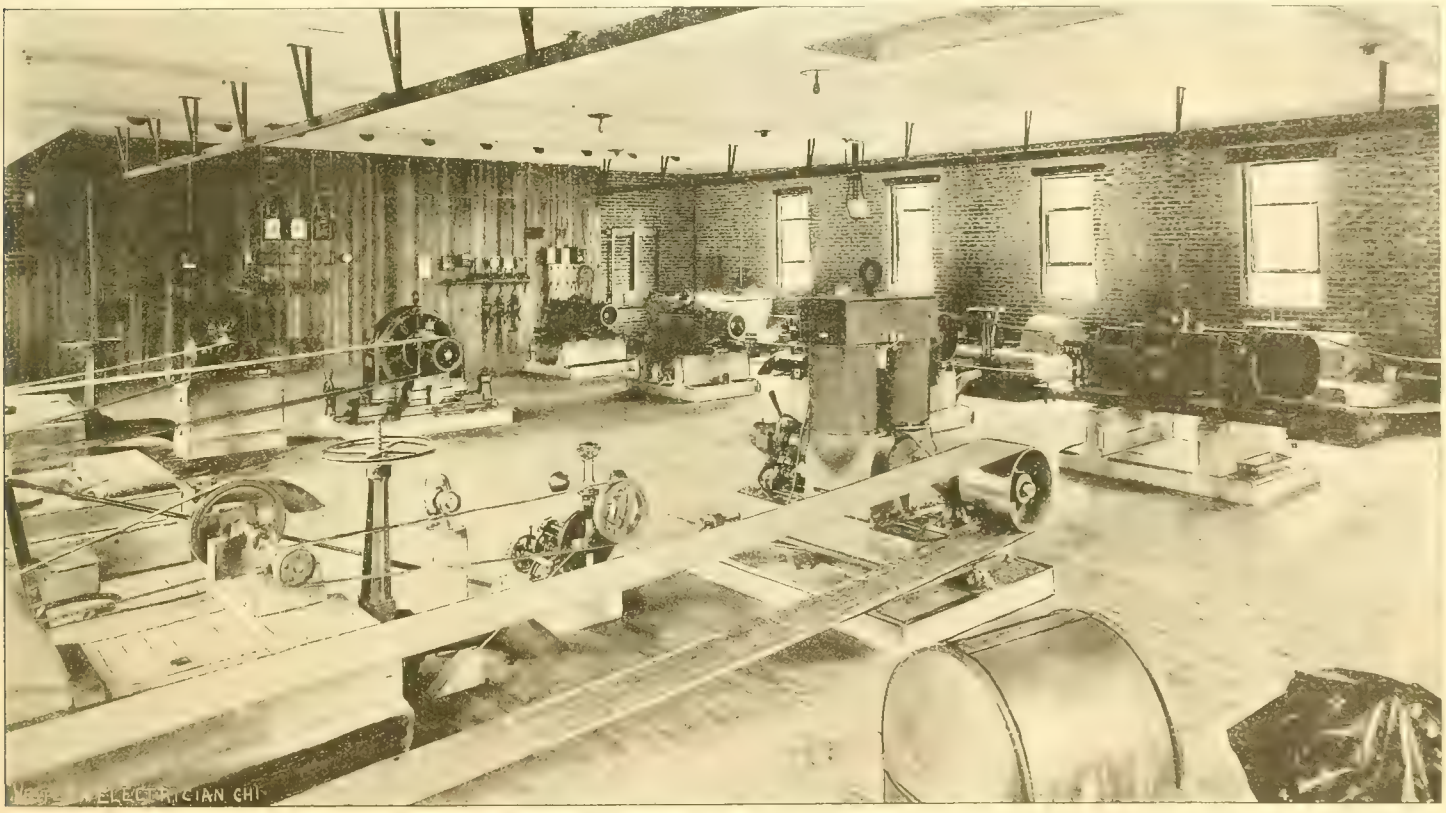


FIG. 1. ELECTRIC POWER TRANSMISSION PLANT AT ASPEN, COLO.

countered at such an altitude during the winter season, [illegible] may be considered quite remarkable. The statement is also made that no interruption of any moment has occurred in the electrical service. Electric power transmission is assuming such dimensions that the water power [illegible] Roaring Fork Electric Light & Power company is all utilized, and the company will put in two Corliss compound condensing engines of 250 horse power each to supply power to customers.

A large number of mining companies at Aspen own their

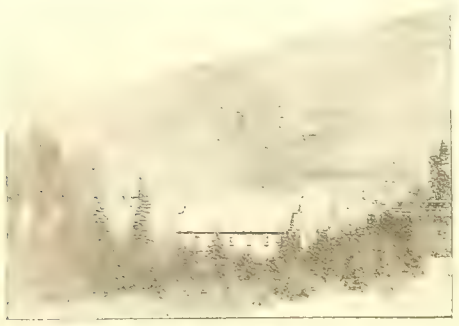


FIG. 2. ELECTRIC POWER TRANSMISSION PLANT AT ASPEN, COLO.

own water power and use Pelton wheels with the best results.

The Aspen Mining & Smelting company has an excellent installation, using two 80 horse power Thomson-Houston 500 volt generators to drive the electric mining machinery, and the Castle Creek Tunnel & Power company, which, under the management of Geo. S. Newman, is just driving a tunnel which promises to be a rival to the famous Sutro Tunnel, has erected one of the finest water power plants in the United States. This company also uses the Pelton wheels. Water power and electricity promise to revolutionize mining in the near future.

The WESTERN ELECTRICIAN is indebted to C. E. Doolittle, superintendent of the Roaring Fork Electric Light & Power company, through whose courtesy the photographs and data were received.

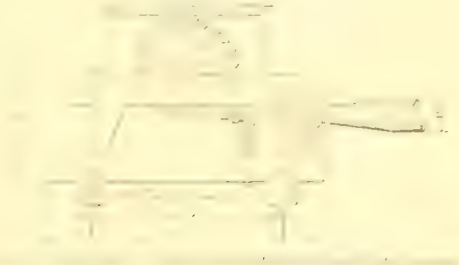
Electrical Department, World's Fair.

Of course the subject of keeping the exposition open evenings is one of prime importance to the electric light interests, and it is one which is engaging considerable attention just now. Chief Barrett is naturally desirous that night displays should be a feature of the fair, and he recently addressed a communication to Director-General Davis setting forth the fact that such displays would form a most attractive characteristic of the exposition, and asking that a definite decision be made regarding the matter.

In conversing on this subject with a representative of the WESTERN ELECTRICIAN General Davis said: "We certainly want to make arrangements for lighting the grounds and buildings at the fair at night. The exposition will be open some evenings—on fete days, for instance—if not on every evening. I have therefore instructed Prof. Barret, acting in conjuction with the Department of Construction, to prepare plans and estimates for the electric light-

It will therefore be seen that, while the matter has not been definitely settled, there is no doubt that electric [illegible] as well as [illegible] lan lscape and water effects, will be a feature of the World's Columbian

No action has yet been taken in contracting for the



*b*uilding as well. Consequently, a second set of bids has been requested.

Engineer Keller, whose appointment was announced in last week's paper, has taken charge of his work at the Department of Electricity.

Elisha Gray, the veteran inventor, writes from Highland, Ill., to say that he desires 10,000 square feet in the electrical building at the World's Fair to display his inventions. "I desire my application to be somewhat flexible," he says, "for I hope to have one or more new things ready to exhibit by the time the exposition opens." Mr. Gray will exhibit hotel signals, musical and speaking telephones, telegraphic apparatus and his latest production, the telautograph.

Recent Developments in Electric Mining Apparatus.[1]

BY J. W. KIRKLAND.

No other section of this continent offers such exceptional and striking facilities for the introduction of electricity as does this great province of Quebec. Nature has been bounteous in her distribution of water, and your hills have, by their ruggedness, forbidden these masses of water from pursuing a slow and unbroken course to the sea. In traveling through your country the visitor from the United States is impressed by the fact that there is hardly a town, hardly a mine, hardly a factory, which is not almost within hailing distance of some river or torrent which has for ages been expending its kinetic energy in re-arranging its chan-

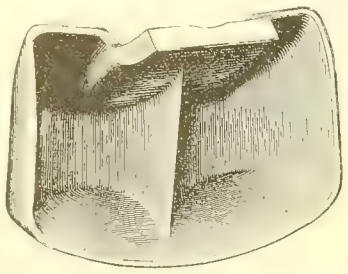


FIG. 4. ELECTRIC POWER TRANSMISSION PLANT AT ASPEN, COLO.

nel and cutting away the rock over which it flows. These waterfalls are destined to become the great agency for opening your mines and driving your mills, and for transporting their joint products. So much for the water facilities; but we may still go farther in congratulating you upon your possessions of cheap power. Even where water power is not at hand you are still more advantageously situated than are your neighbors, with your great woodlands waiting to be cleared in order that better things may be planted, and in the clearing supplying cheap fuel for your boiler fires.

In connection with the development which is bound to

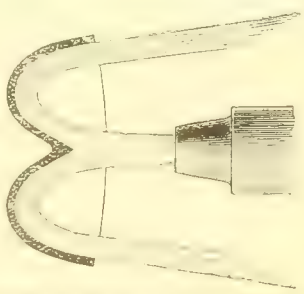


FIG. 5. ELECTRIC POWER TRANSMISSION PLANT AT ASPEN, COLO.

spring from these great natural bequests, one fact is assured; one powerful agent, electricity, must play an important part. The strides in its application have been tremendous in the last few years; the prophet who will not foretell still greater advances is faint-hearted indeed.

An electric mining equipment consists of three elements, each to be considered separately and each forming a distinct part of the problem to be solved. They are, the generating plant, the line, and the motor or other device for utilizing the current. The generating plant, which comes first, from its very nature, differs but very little from electric lighting installations, already so common, the dynamo electric machines having, however, a rather different form. The [illegible] and protective devices, consist of the usual ground and potential indicators, the lightning arresters, the [illegible] the [illegible] cut-outs, the desirable position of which and the method, connection are often pre- [illegible]. The generators are, as a [illegible] for [illegible] potential of 220 volt this seem [illegible] become one of the standard units [illegible]

of electric pressure by reason of the fact that the incandescent lamp is conveniently made for a pressure of 110 volts, so that upon 220 volts two incandescent lamps may be run in series. The pressure chosen is one which is perfectly harmless to either human or animal life. It admits of very perfect insulation in the underground chambers of mines, which are, as a rule, impregnated with moisture which is always seeking to form a by-path for the electric current. The generating station requires primarily a source of power,

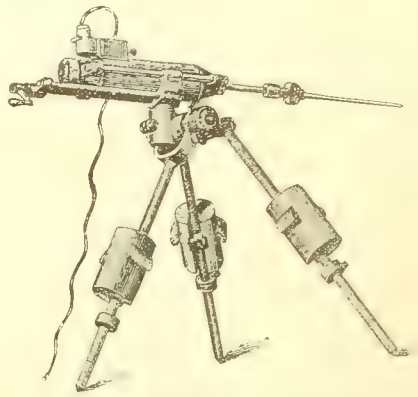


FIG. 3 RECENT DEVELOPMENTS IN ELECTRIC MINING APPARATUS.—VAN DEPOELE ELECTRIC PERCUSSION DRILL.

whether of water or steam, and its position with reference to the mine is therefore determined principally by the condition of obtaining power cheaply and conveniently. It may be several miles from the mine or quarry; it may be in the quarry; or again it may be at the bottom of the mining shaft, as is the case in a somewhat celebrated plant in the Comstock Lode.

The line is so simple a feature as to require no description. You have your poles close at hand, generally needing but a few strokes of a woodman's axe to prepare them for their work; your wire and supplies you can buy cheaply right here in Canada.

Having brought your power to the mine, the ways in which you can dispose of it are almost without limit; with it you may displace your ponderous steam pump, your costly air compressor, your steaming, sweating, and, worse still, short-lived mules; and last, but not least, your dangerous miner's lamp. With it you can ventilate the most remote corner of your workings, and the shaft which has previously been useless because mother nature has chosen it as an artery for her watery blood becomes, by the introduction of an electric pump, a dividend-paying property.

I will call your attention to the form of drill invented by Chas. J. Van Depoele and manufactured by the Thomson-Van Depoele Electric Mining company. This photograph (reproduced in Fig. 1) shows the drill as it appeared in a practical test made at the quarry of the Cape Ann Granite company, Cape Ann, Massachusetts, a few months ago. The rock drill which is represented in the cut has a capacity to drill a hole two inches in diameter in the hardest kind of granite that we were able to obtain for the test at the rate of something over 1½ in. per minute, and this with an expenditure of only about 2½ electrical horse power. The coils and connections, the carriers of the power-giving current are completely inclosed within a solid iron casing and are simple in the extreme, a quality which should be one of the very first to be sought in designing all mining machinery, whether electrical or otherwise. A cable consisting of three separate insulated conductors of small

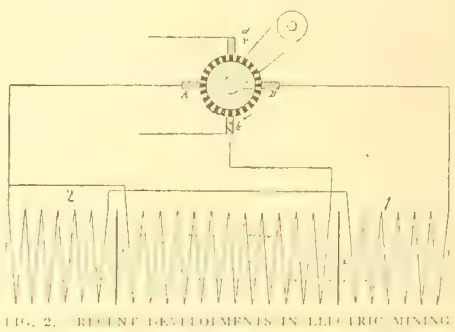


FIG. 2. RECENT DEVELOPMENTS IN ELECTRIC MINING APPARATUS.—VAN DEPOELE ELECTRIC PERCUSSION DRILL.

cross-sections is connected to corresponding terminals in the junction box at the top of the machine. This diagram, Fig. 2, which has been prepared from the patent granted to Mr. Van Depoele on his invention, shows the three wires running from the dynamo D and the three coils or solenoids within the drill. The central coil is traversed by a current pulsating in intensity but constant

in sign or direction, which serves to keep the iron core or piston in what is electrically termed a saturated condition—that is to say a state of maximum magnetization at all parts of the stroke. It is termed a polarizer, and consists of many turns of small wire. One terminal of this coil is connected to one of the revolving brushes and the other to a stationary one which is in this case the negative. The current, therefore, in this coil varies from zero to maximum and back again to zero, as the brush *A* moves from the position in line with the negative brush all round the commutator and back to its original place. Let us examine the coincident conditions in the outside coils, first stating that these are of few turns of comparatively large wire, and so that if a north pole is at any instant at the inside end of the upper coil, marked number 1, a similar pole finds itself at the corrresponding extremity of the coil number 2.

The polarizing coil is energized by a current produced by the difference of potential between the brushes *A* and *b* equal to one-half of the voltage of the dynamo—or 110 volts. At this instant the outside coils are neutral because the brushes *A* and *B* are at their middle points, and the core is now drawn towards the middle of the drill, lagging behind the magnetism an appreciable amount.

Assuming now that one-quarter turn of the yoke holding the revolving brushes has been made, the middle coil is now getting its maximum current due to the total electo-motive force of the dynamo; the outside coils are also at their maximum, and while one is tending to repel the similarly magnetized core in the direction of the coil, the latter is itself at the same time exerting an attraction upon the core. Another one quarter turn and the current in the outside has waned and disappeared entirely, and the current in the polarizer has also decreased to one-half its maximum value. Another one quarter turn and the conditions are the same as those when the brush *R C* was in line with the positive terminal, except that the direction of current in the two outside solenoids is at present of opposite sign. The core is therefore pulled toward the other extremity of the drill. This action is repeated continuously, the magnetized core always seeking to place its north pole as close as possible to the nearest pole of opposite sign, that is, it tends to embrace at each instant the greatest possible number of lines of force, or in lay terms, magnetism.

From this I hope that those of you who have not neglected your electrical education will see why the core is kept vibrating, making one stroke up and down for each complete revolution of the revolving brushes. The length of the stroke depends upon the rate of pulsation and upon the distance of the drill from the rock it is cutting. Fig. 2 is another view of the drill familiar to some of you. The motion is imparted to the revolving brushes by means of a small intermediate shaft, belted to a sliding yoke which revolves close to the commutator and carries brush-holders at its two opsite extremities It may be well to state that an automatic device consisting of a steep pitched screw and nut gives the drill a turn of one-eighth of a revolution at every stroke, thus insuring a clean-cut round hole. The same form is at present made in three sizes. These drills are also, when required, placed upon quarry bars for mine and tunnel work.

Before leaving reciprocating apparatus entirely, it will be well to touch upon a machine similar in principle to the drill, viz., the reciprocating pump, in which the power end resembles in outward appearance the corresponding end of a steam pipe, but which, instead of containing a carefully turned cylinder with close fitting piston and steam valves and joints, contains essentially the same arrangement of solenoids as I have described in connection with the rock drill. The pump is light and compact and lends itself readily to use in sinking shafts, where space is of much importance, and where it is necessary to suspend the pump vertically and lower it by means of chains as the work progresses. A pump of this kind having a water cylinder of 4 by 8 inches, built by the Knowles Pump company, Warren, Mass, is now in Frankfort, Germany, at the great electrical exhibition. The results obtained from its tests may be of interest. I quote directly from the report of the expert in charge: "Weight complete on base, about 800 pounds; weight of motor end, 400 pounds; strokes per minute, 120; horse power consumed, about 2½ or 3; gallons raised per minute, 50; head, 100 feet. The water piston was so tight that it could not be moved by hand, so that a good deal of power was thus absorbed. After a day or two of continuous working this difficulty will be removed."

Passing now from electrical apparatus in which the magnetic attraction is exerted to produce rectilinear motion, let us turn to those in which the electric motor in its usual form delivers its energy by a rotary motion.

FIG. 1. RECENT DEVELOPMENTS IN ELECTRIC MINING APPARATUS.—VAN DEPOELE ELECTRIC PERCUSSION DRILL.

Mine traction is one of the first problems to be solved, and happily it is one to which electricity is peculiarly well adapted. A new design of mining locomotive of a capacity of 60 horse power is being built for the Blossburg Coal company, operating the Bear Run mine in Pennsylvania.[1] Another of the same size is under construction for the Hillside Coal & Iron company, another of 40 horse power is to go to Schofield, Utah, and a fourth of 25 horse power to the Livingstone Coal & Coke company, Livingstone, Montana.

The mechanism is inclosed completely in an iron covering which prevents the admission of water and protects the moving parts from injury which might be caused by falling rock or careless workmen.

This machine weighs, complete, about 21,000 pounds; it has an estimated traction of 2,000 pounds, at 10 miles per hour, and will haul a load of 85 tons at a speed of 10 miles per hour on a level. Its height over all is only 40 inches and its gauge is 36 inches up. The 60 horse power motor is carried directly upon the axle of the machine, and is reversible. Its speed and traction are under the immediate

[1] This machine was illustrated in the WESTERN ELECTRICIAN of July 5, 1890.

frame and platform, and in strengthening all parts. In this respect [illegible] the weight is too often supplied by attaching otherwise useless masses of iron to the platform.

[illegible] vided for the overhead wire which guides the trolley wheel in the proper direction.

It is not an unusual occurrence in mines to find steep grades of more or less length, which, if they were to be surmounted by the locomotive, would require that it be of large capacity for hauling ordinary loads on level stretches; to do this work by such machines would therefore be uneconomical. [illegible] beg to call your attention to the electric hoist (see WESTERN ELECTRICIAN, page [illegible]) rope haulage upon the grades is operated, running [illegible] and doing the work of a locomotive in raising the cars. This hoist consists of an especially designed motor, waterproof in construction, [illegible] one bedplate with a hoisting drum, and geared to it through a friction clutch. This motor is like the one used in the mining locomotive, reversible, and its speed controlled by a rheostat. A strap friction brake is applied by a foot lever. This clutch is operated by the hand lever, and the rheostat and reversing switch are manipulated by a third lever. The whole machine is compact and simple, having few moving parts and requiring no skilled labor for its operation.

The following are some figures upon the 15 horse power hoist: Total weight, 1,435 pounds; speed of motor, varying between 700 and 1,200 revolutions per minute; speed of winding drum, varying between [illegible] revolutions per minute; efficiency of the hoist, 60%.

When you consider that this figure of efficiency takes into consideration all the mechanical and electrical losses, such as friction of gears and of rope, you will I think, admit that it is high.

I leave it to you as practical men to weigh [illegible] tric hoist against the steam hoist with all the small details of piping and valves which the name implies, and I feel certain that the latter will be found wanting.

The electric hoist is, moreover, a probable successor to the steam winch at the top of the mine shaft, used for raising cars and buckets.

Montreal Convention.

Secretary Beane of the National Electric [illegible] ation writes enthusiastically of the coming Montreal convention. He says that [illegible] papers on subjects have been promised from [illegible] C. Warren of Chicago, Captain [illegible] H. Ward Leonard of New York, Prof. Weston, C. J. Field of New York, [illegible] Buffalo, William Stanley of Pittsfield, [illegible] Tesla has also promised that [illegible] time, he will give an evening [illegible] recent researches.

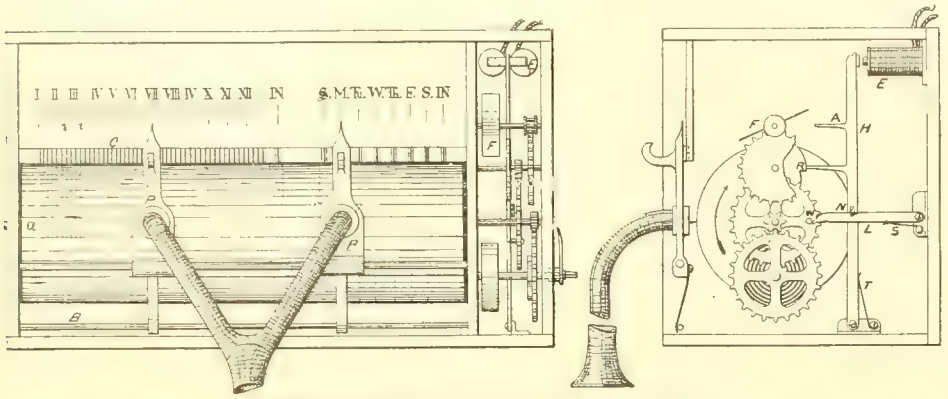
The American River Syndicate of [illegible] Cal., will operate a [illegible] by a 25 horse electric motor. This company now has a 100 horse power Brush generator, and a [illegible] Electric power will also [illegible] pumping works.

Phonographic Telephone Signaling Apparatus.

The accompanying cut is a front and end view of a novel telephone signaling instrument designed so that it may be set so as to automatically send back through the telephone most any verbal message that it is desired to dispatch to those ringing up a subscriber during his absence. It is also claimed for the device that it may be made to register the number of calls made at the telephone, and that by mutual agreement between users of telephones, the number of times the telephone is rung up may constitute a signal showing the importance of the call that has been made at the telephone.

The apparatus is a combination with the telephone, of a phonograph and a mechanism of such construction that the ordinary "ringing up" signal starts the phonograph, and a spring operates and automatically stops it.

The arrangement of the clock-work in connection with the phonograph will be readily understood from the illustration. Before explaining the operation, however, the indicating portion of the apparatus must be described.



PHONOGRAPHIC TELEPHONE SIGNALING APPARATUS.

Two pointers, *PP*, are fitted on the horizontal bar *B* so that they may be easily moved along and made to point to any particular set of the letters or figures. The row of notches, *C*, keeps the pointers exactly in place.

The surface of the phonograph cylinder may be considered as being divided into three portions. Upon the portion to the left, parallel and vertically arranged lines of words are impressed as indicated by the dotted lines *a*. For instance, the one of the lines which is nearest to the end of the cylinder may contain the words "One o'clock," or 'Out till one o'clock." The next line will say "A quarter-past one." The third line will say "Half-past one." The fourth line will say "A quarter to two," and the next succeeding line will say, "Two o'clock;" and so on with all the hours and quarters of the hours shown by the clock.

Upon the portion of the cylinder to the right on the opposite side of the cylinder, the hours are indicated by the dotted lines *b*. Upon the middle portion of the cylinder, the minutes are indicated by the dotted lines *c*. The cylinder is rotated by the mainspring, *S*, which is connected in the circuit of the telephone, so that when the telephone is rung up the signaling current magnetizes it. This moves lever *H*, so that its arm *A* releases the fan *F* and permits the mainspring to revolve the gear-wheels and the phonograph cylinder. The arrangement of the instrument is such that for every pull of the magnet the cylinder will make just one revolution and then stop automatically until the telephone is rung up again. This action will be understood from the following description: The lever *H* when attracted by the magnet swings on its pivot till its pin *N* engages with the notch in the lever *L*, which is constantly forced upward by the spring. When the ringing of the telephone bell ceases, the magnet lets go the lever *H* and the spring *T* will drive the arm *A* of the lever *H* into a stopping-contact with the fan. To prevent the latter movement from taking place before the roller has made one revolution and to secure just one revolution of it, the engagement of the pin *N* with the lever *L* is depended upon to retain lever *H* near the magnet until the pin *W* engages with the free end of the lever *L*, and swings the notch away from the pin *N*. This done, the lever *H* is so far at liberty to swing back and engage with the fan *F*, but, as this would stop the instrument, the circular edge of the cam *R* holds in place the lever until pin *W* has passed the free end of the lever *L*, when the arm *A* reaches the fan and stops every part of the instrument in the proper position.

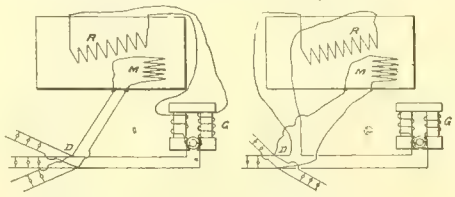


FIG. 2 AND 3. HERING'S DEVICE FOR MAINTAINING A CONSTANT POTENTIAL.

Hering's Device for Maintaining a Constant Potential.

The difference of potential of a dynamo, or at the poles of incandescent lamps supplied by a dynamo, is dependent the armature, the variable amounts of current, the resistance of the leads, the position of the brushes, and in shunt or compound wound machines the heating of the field magnet coils.

The object of the device illustrated diagrammatically herewith, which is an invention of Carl Hering of New York, is to automatically compensate for the effects of such irregularities in the difference of potential and thus maintain the difference of potential constant.

The regulator, Fig. 1, consists, essentially, of a "detector" and an adjustable resistance. The object of the former is to detect any changes, and when they exist to adjust the resistance. This resistance is so connected with the circuit of the machine that it will control the difference of potential at the points where it is to be kept constant.

The apparatus, Fig. 1, may be connected into the circuits of a shunt-wound machine, as shown in the diagram of connections, Fig. 2. *G* is the shunt wound generator feeding a system of lamps from a center of distribution *D*. The coil *M* is connected to the point *D*, where the potential is to be kept constant. The resistance R is placed in the shunt-magnet circuit. Should the potential at *D* rise or fall, the detector will increase or decrease the resistance *R*, which in turn will vary the field current accordingly, which will again adjust the potential. The coil *M* is connected to the center of distribution, in order that it may correct for variable losses of potential in the leads. When the changes of potential are so rapid that the magnetism of the field magnet does not respond quickly enough on changes of the resistance *R*, or when the generator is a battery, the resistance is connected directly in the main circuit, as shown in Fig. 3. This method is especially applicable to lighting from storage batteries or to dynamos driven by gas engines or other engines whose speed pulsates rapidly.

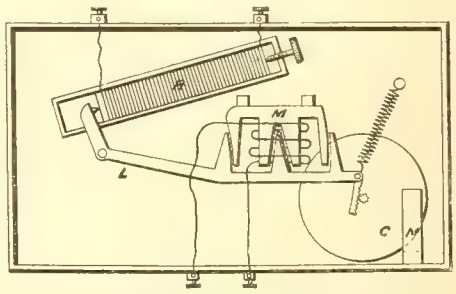


FIG. 1. HERING'S DEVICE FOR MAINTAINING A CONSTANT POTENTIAL.

The electro-magnetic damper *C N* may be attached to prevent too rapid motion. This latter device consists merely of a copper disk geared, as shown, to the lever and revolving between the two poles of a U shaped magnet. When the lever moves currents are generated in the disk and the motion is retarded.

It will be noticed that the detector magnet *M* is of peculiar design. This construction was employed to obtain a magnet of "long pull."

In Fig. 3 is shown an improved arrangement of the same device, through which, it is claimed, a magnified effect may be secured. In this arrangement, as will be seen from the diagram, a relay is introduced.

[illegible] CITY'S RAILWAY [illegible] THE EFFECT.

Sioux City's New Railway.

Probably the new electric line at Sioux City, Iowa, which was formally opened with much enthusiasm on the 19th of last month, may claim the honor of being the most picturesque electric railway in the country. At least everybody in Sioux City thinks it is, and all visitors have come away impressed with a similar idea—a view borne out by the glimpses of the line shown in the accompanying illustrations.

The road, which is known as the Riverside Park railway, is about nine miles in length, beginning at the center of Sioux City and terminating at North Riverside. The lat-

SIOUX CITY'S NEW RAILWAY.—THE DEEP CUT.

ter suburb contains a large number of factories and is evidently destined to be a manufacturing center. In addition to the main line traffic, the company is building up a large business in carrying people to Riverside Park. This beautiful pleasure ground contains about 400 acres and lies along the Sioux river, which here separates Iowa from South Dakota. Good boating facilities abound, and the railway company owns several steam launches and about one hundred row-boats.

Starting at the center of the city the line is double-tracked to Floyd creek, from which point the remainder of the road consists of single track. The overhead construction consists of single poles on one side of the track, with brackets supporting the trolley wire. Although the line has some thirty-eight curves, ranging from four to twenty degrees, yet it was found unnecessary to use curve brackets or curve appliances, the special trolley hangers being sufficient to admit the trolley wire conforming to the alignment of the track.

Owing to the nature of the ground cuttings and fillings are frequent. From fifty to one hundred thousand yards of earth were removed and filled in, in building the line. Beautiful bits of scenery, with here and there river glimpses, can be found at every turn, and the road [illegible] to achieve popularity if scenic attractions can assure it. The pictures give a better idea of this. The long trestle is one of the most prominent objects encountered in a ride over the line. It is 634 feet long, having a 19 curve of 300 feet and a rise of four per cent. The upper end of the trestle is 34 feet above the Chicago, Milwaukee & St. Paul track, which is seen passing underneath. On the right of the illustration is a corner of the power house, beyond which is the confluence of the Sioux and Missouri rivers. The view afforded while riding upon this trestle is very fine. The excavation in the "deep cut," also shown, is 70 feet deep.

The power house is located at Riverside. It is a brick building 62 by 95 feet. The steam plant, furnished by Westinghouse, Church, Kerr & Co., consists of Worthington pumps, Krochell heater, Hancock inspirators, four sets of steam loops and two Westinghouse compound engines of 125 horse power each. The engines are belted directly to two 100 horse power Westinghouse generators, which are run at 300 revolutions per minute. The switch-board is polished sycamore with marble face, on which are placed all the instruments necessary for manipulating the three circuits.

The car house is situated a short distance from the power station. It is 50 by 150 feet and contains four tracks the entire length of the building with ample pit room. An elaborate system of car switches is laid out in front of the car house, switch signal lights being used on this line, which is run on steam railroad principles.

Two 30 horse power Westinghouse motors are mounted on each motor car. A speed of twenty-five miles an hour was easily attainable, and later on, when the cars get limbered up and the track is in better condition, higher speed than this is confidently expected. The six motor cars and six trailers were built by the Northern Car company at Minneapolis. The motor cars are vestibuled and very handsome. Their length over all is 36 feet. The trail cars, which are open, are of similar length, and have seating capacity for 78 persons. The trucks for these cars were furnished by the McGuire Manufacturing company of Chicago and are of their latest pattern, designed for the high speeds required. All the overhead material was furnished by the Electric Merchandise company of Chicago.

B. F. Jones, electrical engineer for the Westinghouse Electric & Manufacturing company, had entire charge of the electrical installation, and he performed his work in a most satisfactory manner. The line is well built and well equipped.

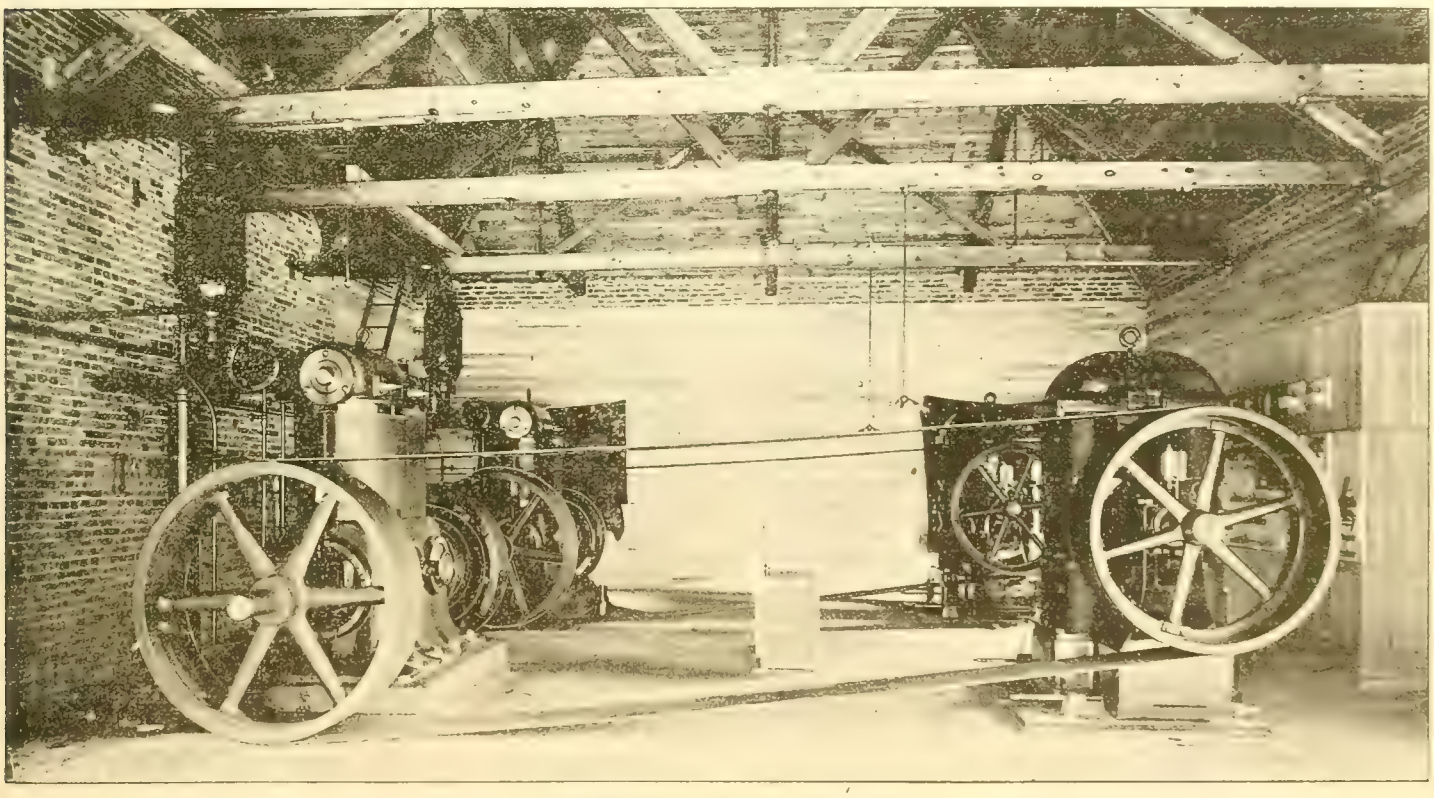
After the formal opening, J. Livingston Barclay and J. M. Atkinson, representing the Westinghouse company, entertained at the Hotel Garretson the gentlemen interested in the road, representatives of the press and several visitors. Among those present were President Chas. W. Hornick, Secretary England of the Electric Merchandise company B. F. Jones, C. F. Dodge, C. F. Coombs and others.

Order of Railway Telegraphers.

In a [illegible] this paper as chosen at the St. Louis convention of the [illegible] to serve on the grand executive committee are D. G. Ramsay, St. Louis; A. [illegible] Indiana; [illegible] tucky; F. R. Eckhard, Illinois, and J. M. Clark, Texas. Through his position as assistant grand chief, Daniel G. Ramsay of St. Louis is the chairman of the grand executive committee. It was decided to hold the next convention in Chattanooga during the second week in May, next year. The insurance features of the order were abolished altogether.

SIOUX CITY'S NEW RAILWAY—[illegible] AND ST. [illegible]

The constitution embodying the protective or strike clause having been unanimously adopted, but little opposition was expected to the proposition to federate the Order of Railway Telegraphers with the Federated Order of Railway Employes. The grand chief telegrapher, in calling the matter up for final action, said that most of the time of the convention had been given to discussion on this matter. In the discussion that followed and in which many members took part, it was asserted that the railway corporations were [illegible] protection clause, permitting strikes, the order would be useless. With the strike clause in their constitution, and their order affiliated with the other skilled labor of the railroads, they would be greatly benefited. When the result of the ballot was announced it was found that all but six members had voted for federation. The grand secretary was instructed to apply at once to the Supreme Council for admission to the Federated Order of Railway Employes. The result of the vote on federation was loudly applauded, and the convention adjourned with enthusiasm.



SIOUX CITY'S NEW RAILWAY.—LOWER PLANT.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - }
F. L. PERRY, - - - - - - - - - - } Associate Editors.
W. E. KEILY, - - - - - - - - - - }
J. L. BAKER, - - - - - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK

W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted.

This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers: in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application

CONTENTS OF THIS NUMBER.

PAGE.

Electric Power Transmission Plant at Aspen, Colo. Illustrated 1, 2
Electrical Department World's Fair 2
Recent Developments in Electric Mining Apparatus, by J. W. Kirkland. Illustrated (General Mining Association of the Province of Quebec) 2, 3
Montreal Convention 3
P[illegible]graphic Telephone Signaling Apparatus. Illustrated 4
Hering's Device for Maintaining a Constant Potential. Illustrated 4
S[illegible] City's New Railway. Illustrated 4, 5
[illegible] Railway Telegraphers 5
Editorial 6
Wilhelm Eduard Weber's Death 7
[illegible] Transit for Detroit 7
Electric Wires in Rochester, N. Y. 7
Proposed Electric Railway for Chicago 7
The Electric Light in the Service of the African Explorer. Illustrated 8
Tesla's Method of Producing Light by Means of Currents of High Frequency. Illustrated 8
Instrument for Measuring the Strength of Magnetic Fields. Illustrated 9
[illegible] on the "R[illegible]." Illustrated 9
[illegible] Illustrated 9
[illegible] for Mines and Mills. Illustrated 9
[illegible] the Westinghouse Company 9, 10
[illegible] Electric Tramway for Mines. Illustrated 10
[illegible] Lighting 10
[illegible] 10
[illegible] 11

DEPARTMENTS.

[illegible] 11, 12, 13
[illegible] 13
[illegible] 13
[illegible] 13
[illegible] 13
[illegible] 13
[illegible] 14
[illegible] 14
[illegible] 14

[illegible] begin [illegible] has gained for [illegible] paper. But [illegible] not acquired [illegible] of time [illegible] Moreover, [illegible]

[illegible]

partment of the electrical industry is represented in its pages.

All this has been duly recognized by the electrical interests, and they have signified their approval by substantial patronage. On our part we have endeavored to increase this confidence, and have introduced many improvements.

Hereafter the WESTERN ELECTRICIAN will publish fourteen pages every week. It will be noticed that the front of the paper has been somewhat changed, though the old familiar form is retained. Smaller type has been adopted, but as it has a bold, clear face we trust the change will be recognized as a marked improvement. Another change, and one that we trust will be welcomed by those who appreciate the importance of the little details that go to make up a handsome journal, is the discontinuance of the use of column rules, and the employment of a finer texture of paper. This will enable us to secure even better results than heretofore in presenting the fine illustrations which have been a prominent feature of the WESTERN ELECTRICIAN.

The electrical industry, though still new, has settled down to a solid basis. It is larger and more extended in its operations than ever before. It has greater need of and is better able to support a strong, influential and widely circulated newspaper than in the past.

It shall be our aim not only to maintain our position in the front rank, but also to increase our scope of usefulness.

A larger staff will be maintained and an eastern editor will hereafter be stationed at our New York office.

THE addition of the electric search light to the already most complete outfit of the modern man-of war at the present time would cause little or no comment. But when one hears of a dynamo being hauled on a wagon into the wilds of Africa where it is made to furnish current for a lamp utilized as a means of defense against savage marauders, there arises, naturally, the inclination to ask, "What next?" A year ago we first heard of the electric light having been employed in Bavaria to aid, in the destruction of the forest bug; then we learn that even the worms beneath the paving stones are unable to resist the effect of its seductive rays; and now through its aid, the poor heathen is deprived of his natural rights. Think what was the predicament of the denizen of the "Dark Continent," as he sought to steal softly away but found himself bathed in the light from a 10,000 candle power arc lamp! 'Tis a "deadly" light, indeed, and if man continues to apply it in the manner described in another column, Africa may yet prove to be a promising field of operation for that particular type of individual to whom all currents are "deadly"—that is, when it is best to have them so to suit his purpose.

THE announcement that the Order of Railway Telegraphers, at its recent convention in St. Louis, amended its constitution to permit strikes and decided to join the Federation of Railway Employes will not be received with unmixed satisfaction by the friends of the organization outside the pale of its membership. The men who are responsible for the transmission of telegraphic orders to the conductors and locomotive engineers of trains occupy positions of peculiar responsibility. It is no exaggeration to say that the lives of thousands of human beings are daily dependent on their skill and vigilance. It is not pleasant, therefore, to contemplate the fact that at any time these telegraphers may be "ordered out," with the result of paralyzing the railway service of extensive sections of the country, or else jeopardizing the lives of the traveling public by placing inexperienced and nervous operators at the stations. It must be admitted that the telegraphers have the same right to abandon their employment granted to other wage-workers, and it can hardly be denied that the conspicuous parsimony of some railway corporations seems to furnish sufficient provocation; but, for all that, it is in every way to be regretted that the order has abandoned the conservative and manly course by which it has hitherto commanded the respect and confidence of the public. [illegible] by public opinion, the telegraphers could hardly have failed to be successful in all just [illegible] by the peaceful methods of agitation [illegible] But now [illegible] the rights of rail[illegible] from the [illegible] to [illegible] re[illegible] successful [illegible] especially has this been the case in railroad strikes, and the utter collapse of the general telegraphic strike of a few years ago will be remembered in this connection. We fear that, should the occasion unfortunately arise, the Order of Railway Telegraphers will be unable to prove itself an exception to the rule, and that its new departure is not dictated by wisdom or sound judgment.

COMPARED with other large American cities, Chicago is lamentably deficient in the matter of electric street railways, which are fast coming to be acknowledged as the best of all surface roads in cities. The *Chicago News* graphically presents the situation as follows: "In 1893 world's fair visitors will inspect in the transportation building models of elevated railroads, electric roads, automatic guard gates and the hundreds of other devices for the safety and convenience of passengers. They will then turn to the streets of Chicago and what will they see? Grade crossings with rickety apologies for gates and one-legged watchmen; antiquated horse cars with filthy seats and trappings on all but the principal streets; on the latter a cable system that breaks down when it is most necessary that it should go, and that becomes absolutely useless in case of the slightest accident. These will be the first evidences to the world's fair visitors that Chicago's metropolitan pretensions are entirely theoretical in some important respects. They will see hundreds of miles of public thoroughfares given over to cable and horse-car monopolies that cling to these antiquated methods of transit because it is most profitable in their estimation to be non-progressive. They will see tens of thousands of passengers—and they will be lucky if they are not among the number—fighting for the privilege of standing for miles on the foot-boards of dangerously overcrowded cars, because the monopolies are too mean to provide decent accommodation and the city authorities are either too weak are too corrupt to compel them."

This discloses a sad state of affairs, but the description is a strictly accurate one. Electric roads have been allowed to operate only in the suburbs on the ground that electric wires of any sort could not be allowed in the streets in the central portion of the city. The result is as the *News* has stated. For the most progressive city in the Union, Chicago is most conspicuously behind in the matter of street railways. It is time she woke up to the possibilities of modern improvements in urban passenger traffic.

THE majority of the readers of the WESTERN ELECTRICIAN are doubtless by this time familiar with the effects obtained by Nikola Tesla in his recent experiments with currents of high frequency, performed before the Institute of Electrical Engineers. As a matter of course, these experiments have been much talked of and there has been considerable conjecture as to what might be their value from a practical standpoint. On this account the description of a lighting system devised by Mr. Tesla, and presented in this issue will be read with interest. As was demonstrated by the Institute experiments, a single carbon rod, or filament, inclosed in a bulb from which all air has been exhausted may be brought to incandescence, when connected with only one terminal of a source of currents of very high frequency. In the system described, advantage is taken of this electro-static effect, and Mr. Tesla outlines a method through which he claims to be able to apply the effect in a practical manner. To secure currents of very high frequency and potential, he resorts to the condenser and utilizes its oscillatory discharge in a primary circuit to produce working currents in a secondary. His lamps may have but one terminal and light will be produced by what may be termed an electrical radiation towards the walls of the room. It will be noted, though, that each lamp is in itself virtually a small condenser.

From all accounts Mr. Tesla's exhibition in New York was a most brilliant one and it is to be hoped that further work will lead to a more thorough development along the line indicated in the system which we have described. It would seem, though, that these experiments were more startling than wonderful. From what can be learned they consisted in the main merely of exaggerations of effects already well known. It may be mentioned, too, that there is a similarity between a number of the Tesla experiments and those described in an article under the head of "Experiments with a Ruhmkorff Coil and Incandescent Lamp," presented in the WESTERN ELECTRICIAN August 9, 1890. It is not our object to attempt to belittle Mr. Tesla's experiments, as through them, undoubtedly, there will be given an impetus to research in what is virtually a new path. Our object in calling attention to the experiments with the Ruhmkorff coil and lamp is that, through their employment, the inquisitive reader may be tempted to make a few personal tests.

Wilhelm Eduard Weber's Death.

A cablegram received last week announced the death of Wilhelm Eduard Weber at Goettingen. The accompanying portrait and sketch of the eminent scientist is taken from "Derivation of Practical Electrical Units" by F. B. Badt

Wilhelm Eduard Weber was born at Wittenberg, October 24, 1804 In 1831 he was professor of physics at the University of Goettingen, and in 1843 was professor at the University of Leipzig. In 1849 he is found again at the University of Goettingen. He published, with Gauss, in 1836-'41 the results of observation of the Magnetic association. In 1840 he published the "Atlas of the Earth's Magnetism." From 1846 to 1878 he compiled "Electro-Dynamic Measurements." In this latter work Weber introduces the system of absolute units.

In the earlier stages of the science several units were introduced for the measurement of quantities dealt with in electricity. In illustration may be mentioned the wire of Jacobi (25 feet of copper wire weighing 345 grains), the mercury column of Siemens (1 meter long with a section of a square millimeter), which at given temperatures furnished units of resistance, and the Daniell cell, which furnished the unit of electromotive force. Jacobi's current unit was based on the electrolytic decomposition of water. One cubic centimeter of oxy-hydrogen gas is formed each minute. All these units were perfectly arbitrary, and there was no connection of any kind between them. The introductionof a rational system of unitation, based on the fundamental units of time, mass and length, was one of the greatest achievements of modern times. The impulse came from the famous memoir of Gauss, "Intensitas vis Magneticæ Terrestris and Mensuram Absolutam Revocata," in 1832. In conjunction with Weber, he introduced his principles into the measurement of the earth's magnetic force.

To Weber belongs the credit of doing a similar service for electricity. He not only devised three different systems of such units—the electro dynamic, the electro-static and the electro-magnetic, but he carried out a series of measurements which practically introduced the last two systems.

The practical units which are in use to-day are simply certain multiples of the absolute or Centimeter-Gramme-Second (C. G. S.) units. The absolute units are either too great or too small for practical use, and for convenience the "practical units," were adopted, to which the names of the most famous electricians are given.

Weber was the most illustrious among the successors of Ampere. He greatly improved the construction of the galvanometer and invented the electro-dynamometer. To these instruments he applied the mirror scale and telescope method of reading, which had been suggested by Poggendorf and used by him and Gauss in magnetic measurements about 1883. In 1846 he tested by means of his improved apparatus the fundamental laws of Ampere. The result of his researches was to establish the truth of Ampere's principles, as far as experiments with closed circuits could do so, with a degree of accuracy far beyond anything attainablewith the simple apparatus of the original discovery. Applying his improved instruments he alsoobtained accurate verification of the laws of induction, which by this time had been developed mathematically by Neumann and himself. The experiments of Weber must be considered as experimental evidence establishing the theory of Ampere and as such they form one of the corner stones of electrical science. Clausius and Siemens proposed the term Weber for the practical unit of the strength of the magnetic pole. This unit is equal to 10^8 C. G. S. units. The term has not yet been generally adopted as a practical unit. The term Weber was formerly employed to designate the unit strength of current. This term is now replaced by the ampere,

Rapid Transit for Detroit.

The city council of Detroit, Mich., and the street railway companies last week held a conference regarding the problem of rapid transit. Several ordinances have been before the council. These ordinances are alike in providing for an extension of the franchise to 30 years, and in requiring the adoption of "cable, electric, or other mechanical power, including steam," in lieu of animal power. An exception is made of Woodward avenue, on which, in accordance with the wishes of the Woodward Avenue Improvement association, the cable system is specified. Mr. Currie read the ordinance to the committee, saying that the Jefferson avenue line, already having the heavy rails, would be equipped within six months, with the overhead wire system, if the ordinance should be adopted, and if the Woodward avenue people like it, then there would be time for the council to amend the ordinance, if desired, and sale [illegible] The company would be willing to accede to the change any time before the contract for the cable line may have been signed. The companies may desire to extend their lines in many directions, and establish new lines. They express a willingness to do this and give first-class service, introducing the electric system on all their roads, provided their franchises are extended 30 years.

The Grand River avenue street railway ordinance prescribes the overhead wire system, provides for a double track on Myrtle street, does away with one track on Woodward avenue north of Fort street, and extends its track from its present terminus at Jefferson avenue to the foot of Woodward avenue. The tracks on Woodward avenue shall be used by the Detroit City railway and the Grand River avenue railway in common.

The Fort Wayne and Elmwood company's proposed ordinance provides for a double track on Champlain street, from Mt. Elliot avenue to Van Dyke avenue, and also on Fort street west from Clark street to the westerly limits of the city.

In all cases the maximum speed is to be 20 miles an hour, so that in the business portion of the city the cars may run slowly and yet average 10 miles an hour.

Electric Wires in Rochester, N. Y.

Attention has heretofore been called to the effort being made at Rochester, N. Y., to compel the electric companies to bury their wires. The committee on electricity of

WILHELM EDUARD WEBER.

the city council and City Electrician Barnes have taken the matter up, and last week there was a conference between the representatives of the city and the electrical companies. It is believed that something will come of the present agitation, as much interest is manifested. Those who recollect the "late unpleasantness" between the telephone company and its Rochester subscribers will be inclined to believe that the present movement will be continued and may possibly give the electric companies considerable annoyance.

City Electrician Barnes says that the electric system of Rochester has been so greatly developed that a standing committee of the council has become necessary to supervise it. He called attention to the interference with the successful working of the system caused by the induction from the electric railway wires. He suggested that metallic circuits would remedy this trouble.

Frank J. Amsden, secretary of the old Citizens' telephone committee, which conducted the war on the Bell company, appeared before the conference and said he had heard numerous complaints. The committee looked to the council to afford some relief. In 1888, he said, the telephone users had agreed to pay a certain rental rate for a good service He knew that metallic circuits would cost much money, and make rentals somewhat higher. He believed that some arrangement could be made between the company and the users of the telephones, and that the latter might be willing to pay a small increase.

George Weldon, a director of the telephone company,

[illegible] wires and to make it a misdemeanor to interfere with or take down wires

[illegible] says: "Since the extension of the system of electric lighting and the introduction of the new street car service, the danger to persons and property from the overhead wires has been increased greatly, and there can be no doubt of the necessity for careful supervision of all electrical systems by the authorities. Wires of all kinds have been strung about the city, in some instances carelessly, without proper consideration for the safety of human life, and in disregard of existing laws. Some of the telegraph and electric light poles are rotten and liable to fall at any moment; and in the aggregate, there are miles of "dead" wires—none of them of any use to the companies that put them up, and all of them a constant source of danger.

"It would be fortunate if all telephone, telegraph and electric light wires could be put underground, particularly in the business portions of the city. They are not only unsightly and dangerous, but are great impediments to quick and effective work by the fire department, for they must be cut before ladders can be placed against the sides of burning buildings. The electric light companies say no satisfactory system of underground conduits for their wires has ever been devised; but we think the experts can put the wires below the surface of the streets and make them work all right if enough money is furnished. At any rate, this is a question to which the committee ought to give its careful consideration, making investigations in other cities, and employing experts of its own.

"Great improvements are possible in the telephone service. Ever since the electric cars began running the telephones have worked very unsatisfactorily on account of the induction.

"Of course, the construction of metallic circuits would be a heavy expense to the telephone company; but the service would be infinitely better, and the people would be willing to pay higher rentals. Not only that, but many persons who refuse to use telephones now because of the poor service would put them in; so that, in the end, the company would be better off in every way."

Proposed New Chicago Electric Road.

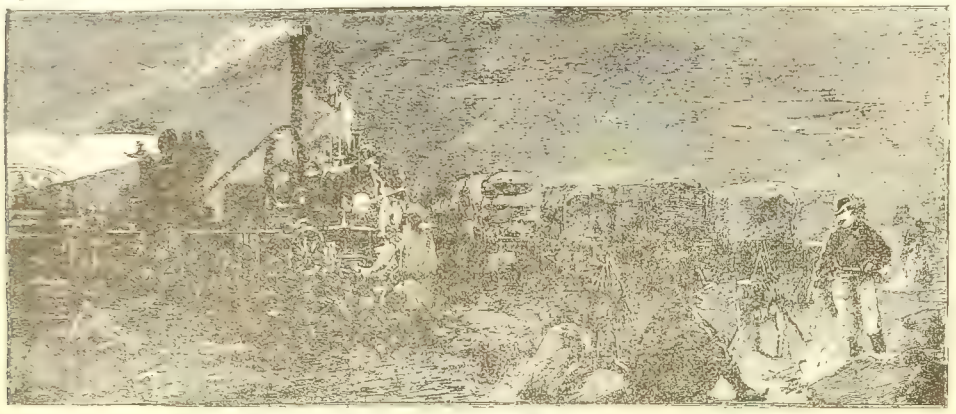
An ordinance giving a franchise to the Calumet Electric Street Railway company was introduced at the last meeting of the common council of Chicago. The ordinance is a most comprehensive one, as it is proposed to occupy nearly every important north and south and cross street in that part of Chicago south of Eighty seventh street with an electric road track and provides for a loop extending from Eighty-seventh street along South Chicago avenue and Stony Island boulevard and Sixty-seventh street, bending westward on the latter thoroughfare to Cottage Grove avenue, and thence south on that street to Eighty-seventh street, with a cross-section on Eighty-seventh street. It is thus intended to bring the extreme southern and eastern sections of the city from the Indiana state line and Fernwood up to the gate of the World's Fair. At least one line of track is to be in operation within eighteen months. The overhead trolley system is to be used. The ordinance, which is accompanied by a petition of the owners of abutting property on the several streets, was referred to the committee on streets and alleys south, and the petition was referred to the commissioner of public works for verification. The promoters of the road are now the owners of a few miles of electric road in the Calumet region, who are interested in the development of the Chicago Canal and Dock company's property. At the head of the number are Columbus R. Cummings, Sydney Kent, W. B. Howard, Douglas [illegible]

A new electric light company has been incorporated in Pana, Ill., with a capital stock of $50,000. The company will operate an [illegible] incandescent lighting [illegible] street railway line.

A Washington dispatch [illegible] electric lighting apparatus for [illegible] and Texas, building at the Brooklyn and Norfolk navy-yards, were as follows: Edison General Electric company, New York—Generating sets, [illegible] closing spare parts, $[illegible] $11[illegible] company, Boston—Generating sets, $60,000; ditto, including spare parts, $[illegible] signal apparatus, $[illegible] about five months.

The Electric Light in the Service of the African Explorer.

In October, 1889, the charter granting the British South Africa company permission to occupy Mashonaland was signed, and immediately afterward steps were taken to raise a body of men to cut the road from the Macloutsie river, in Bechuanaland, to Mount Hampden, in Matabeleland. The whole force, inclusive of 180 men called the pioneer corps, numbered about five hundred. In April, 1890, the pioneers left Cape Town and made a short stay at Kimberley, where a portable six-horse power engine was taken off its original carriage and was built into a Cape wagon. The engine was used to drive a dynamo for an electric search light of 10,000 candle power, of the naval pattern, placed upon a stand high enough to throw its rays all over the country; for it was generally supposed that if the column were attacked by the Matabele they would get as close as possible by night, and at daylight would rush the camp.



THE ELECTRIC LIGHT IN THE SERVICE OF THE AFRICAN EXPLORER.

The Tuli river was reached without mishap in June. At this place a strong position was taken up; the machine guns and seven pounders and the search light were taken to the top of a commanding hill, and the camp was formed immediately beneath. Every precaution was taken and the column rested here some few days. On September 12th the pioneers arrived at their destination. Here another fort was built, and on September 30th the column was disbanded.

The illustration, which is a view of the search light as used at night at the camp near the Tuli river, is from a sketch made for the *Illustrated London News* by Lieutenant W. Ellerton Fry of the pioneer corps.

Tesla's Method of Producing Light by Means of Currents of High Frequency.

From the cuts presented herewith the reader will be able to obtain an understanding of a lighting system devised at incandescence. To express the idea in Mr. Tesla's own words: "Any body capable of conducting the high tension current described, and properly inclosed in a rarefied or exhausted receiver, may be rendered luminous or incandescent, either when connected directly with one terminal of the secondary source of energy or placed in the vicinity of such terminals so as to be acted upon inductively."

These effects referred to, which are generally attributed to "molecular bombardment," "condenser action," etc., Mr. Tesla claims to be able to utilize in the following manner:

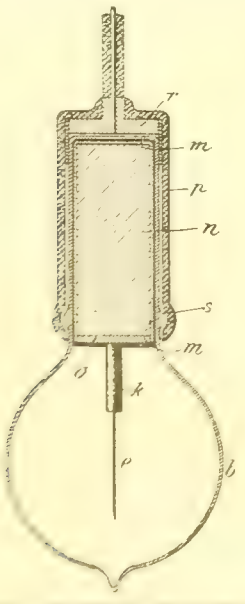
In order that the reader may have a clear idea of the system, it should be explained that the required current of high frequency can be produced by a specially constructed dynamo run in connection with an induction coil. In order, however, to overcome the mechanical difficulties which in such cases become practically insurmountable before the best results are reached, the principle of the disruptive discharge may be resorted to. By means of this latter plan a greater rate of change in the current can be secured. The current for the system illustrated herewith is, therefore, obtained by the oscillatory discharge from a condenser arranged as shown in Fig. 1. In this diagram *G* is the primary source of current, which, it may be assumed, is an alternating current generator of comparatively low

INSTRUMENT FOR MEASURING THE STRENGTH OF MAGNETIC FIELDS.

electromotive force. Under such circumstances the potential of the current is raised by means of an induction coil having a primary *P* and a secondary *S*. By the current developed in this secondary, a condenser *C* is charged and this condenser is discharged into a circuit *A*, having an air gap *a*, or, in other words, a means for maintaining a disruptive discharge. By this method a current of enormous frequency is produced. The next step is to convert this arrangement into a working circuit of very high potential. To do this there is connected up in the circuit *A* the primary P^1 of an induction coil having a long fine wire secondary S^1. The current in the primary P^1 develops in the secondary S^1 a current or electrical effect of corresponding frequency, but of enormous difference of potential, and the secondary thus becomes the source of the energy to be applied to the purpose of producing light.

The light giving devices may be connected to either terminal of the secondary S^1. If desired, one terminal may be connected to a conducting wall *W* of a room and the other arranged for connection with the lamps. In such case the walls are to be coated with some metallic or conducting substance in order that they may have sufficient conductivity.

The light-giving devices may be ordinary incandescent lamps; it is preferred, however, to use specially designed lamps, such for instance as are illustrated in Fig. 2. This lamp consists of an exhausted globe *b* formed with a cylindrical neck, within which there is a tube *m* of conducting material on the side and over the end of a plug *p* of insulating material. The lower edges of this tube are in electrical contact with a metallic plate *o*, secured to the plug *p* and all the exposed surfaces of the [illegible] are carefully coated and [illegible] The light-giving body *r*, in this [illegible] is electrically connected [illegible] of the globe fits into a socket [illegible] with a more or less complete metallic lining *s*, electrically connected by [illegible] to one pole from the generator. The metallic lining *s*, and [illegible] condenser.



Another form of lamp is illustrated in Fig. 3. In this cut *b* is a rarefied or exhausted glass globe in which there is a conductor *e*. To this electrode is connected a metallic conductor *f*, which passes through and is sealed in the glass wall of the globe. Outside of the globe, it is united to a copper wire *g*, by means of which it is electrically connected to one pole or terminal of the source of current. Outside of the bulb, the conducting wires are protected by a coating of insulation *h*. Inside the globe, the supporting wire is inclosed in and insulated by a tube *k* of a refractory insulating substance, such as pipe-clay or the like. A reflecting plate *l* is shown applied to the outside of the globe. This form of lamp is a type of those designed for

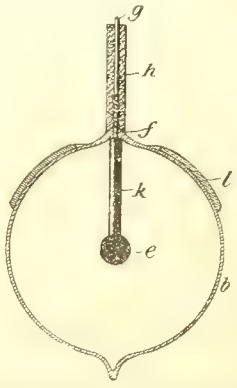


FIG. 3. TESLA'S METHOD OF PRODUCING LIGHT BY MEANS OF CURRENTS OF HIGH FREQUENCY.

direct electrical connection with one terminal of the source of current; but it is asserted that there need not be a direct connection, for the carbon or other illuminating body may be rendered luminous by the inductive action of the current. It may be mentioned that it is considered as necessary, by Mr. Tesla, that care be taken to reduce to a minimum the opportunity for the dissipation of the energy from the conductors intermediate to the source of current and the light-giving body. For this purpose the conductors should be free from projections and points and well covered with a good insulator.

Instrument for Measuring the Strength of Magnetic Fields.

According to a correspondent at the Frankfort Exhibition, the display of Hartmann & Braun is devoted largely to its electrical measuring instruments, which are a specialty of this house. There are shown numerous and important novelties, among which is an instrument for measuring the intensity of a magnetic field. The principle of this device which is illustrated in the cut, rests on the alteration in resistance that a wire of bismuth undergoes when placed in a magnetic field. A thin insulated wire of this metal is wound bifilarly into a spiral, the ends being connected with the terminal screws of a vulcanite handle. The thickness

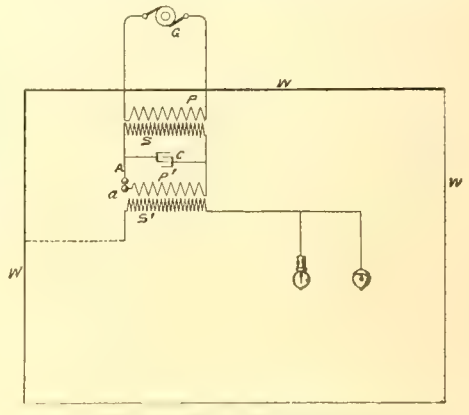


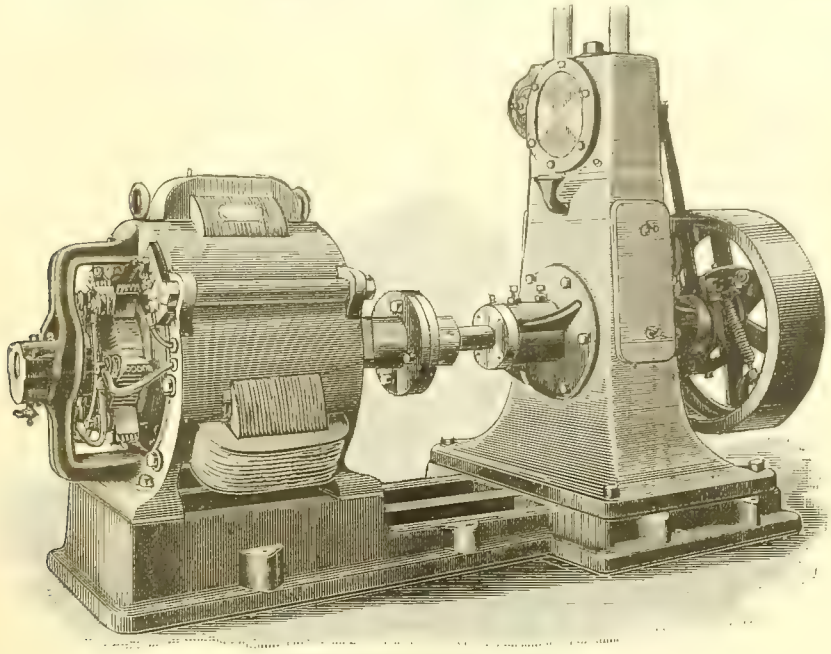
FIG. 1. TESLA'S METHOD OF PRODUCING LIGHT BY MEANS OF CURRENTS OF HIGH FREQUENCY.

of the spiral is only about .04 inch, so that it can be inserted in very narrow spaces, as, for instance, the air-gaps of dynamos. The variation in the resistance is a measure of B, and 1000 lines per square centimeter correspond to a [illegible] per cent. variation, a more exact correspondence is to be seen from the gauge curve of the instrument.

About the first appearance of the Prince of Wales since the baccarat scandal in his character as a patron of science was at the celebration in honor of the centennary of Faraday's birthday on June 17th. That the spell of his influence has been but little abated, however, is shown by the fact that all the newspapers reported the prince's remarks verbatim and nearly all summarized in a few lines the really remarkable oration delivered by Lord Rayleigh in honor of the great electrician.

Perret Dynamo on the "Romola."

The accompanying cut shows the plant recently installed by the Elektron Manufacturing company of Brooklyn, N. Y., on the steam yacht "Romola" belonging to Joseph Pulitzer, proprietor of the New York *World*. The dynamo is an 85 light slow speed Perret machine of the usual construction, waterproof and connected by a flange coupling to the shaft of the steam engine, running 585 revolutions per minute. The combination is placed on a substantial bracket in the side of the engine room, and runs without any appreciable vibration.



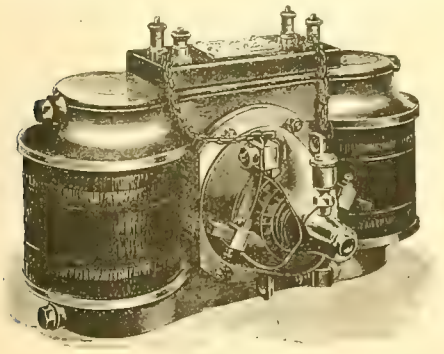
PERRET DYNAMO ON THE "ROMOLA."

The yacht, which is 170 feet long, is well lighted in the evening by the dynamo direct and by storage batteries during the day, or when the dynamo is not running.

Where it is desirable to be very economical in floor space a different style of coupling is used by the Elektron Manufacturing company, and the space between engine and dynamo may be shortened up considerably.

Prentice Dynamo.

The dynamo represented in the accompanying cuts is the invention of Napier Prentice, an English electrical engineer. It is claimed to have an efficiency of 90 per cent. The armature core is made up of disks of soft charcoal iron. It is claimed that the system of winding is peculiarly effective—so much so, in fact, that a high electrical efficiency can be obtained at the comparatively slow speed of 500 revolutions per minute. The armature is protected from injury by metal cases at each end, which entirely cover and inclose the wires and commutator connections, and by strips of fiber or bone placed over the wires and filling up the spaces between the iron projections on the circumference. The field magnet coils are protected by zinc cases, which are securely soldered to the metal flanges at each end of the coil. The commutator is built upon an iron sleeve so that it can be readily replaced by a new one if necessary. The dynamos are very light. One giving an output of 150 amperes at 100 volts only weighs about half a ton and runs at the low speed of 800 revolutions per minute. The illustrations were reproduced from *Electricity*, London.



PRENTICE DYNAMO.

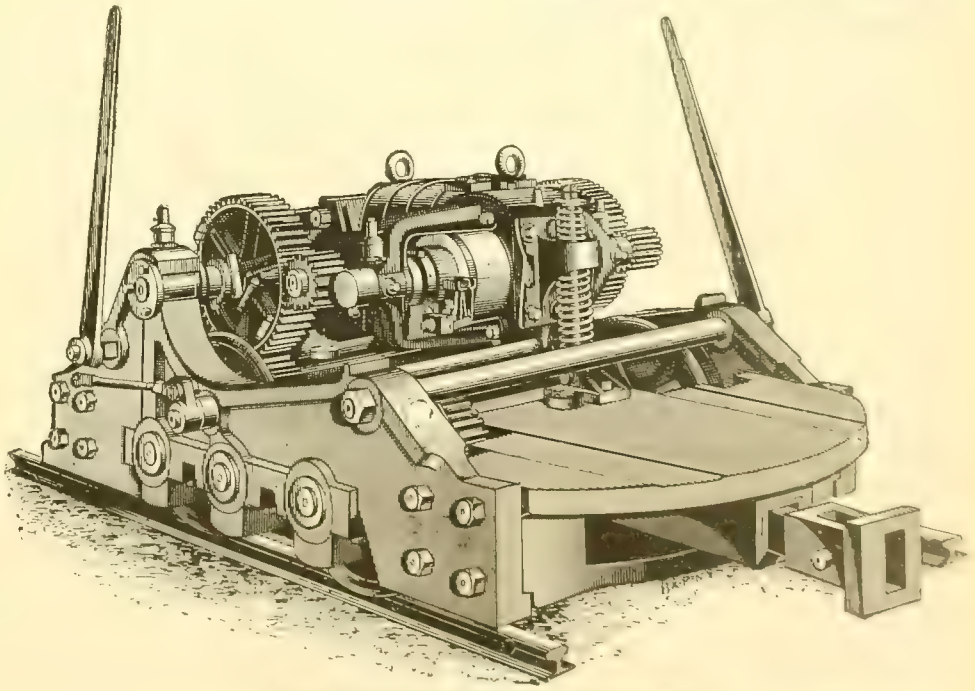
Cedartown, Ga., has voted to bond itself to the extent of $50,000 to erect an electric light plant and water works.

Edison Electric Locomotive for Mines and Mills.

In the accompanying cut is shown a new form of electric locomotive for mill and mine work placed on the market by the Edison General Electric company.

The motor is protected by a metal housing arranged to give ready access to the commutator and brushes. By simply lifting a slide and removing four bolts and raising the main cover, the whole motor is exposed to view, as shown in the cut.

By this arrangement the motor is protected and at the same time access to the working parts may be gained. A 15 horse power motor is used, one end of which is hung to a support on the frame, and the other flexibly suspended after the street railway practice. The motor is connected to both axles by direct gearing. There is a seat at either end for the engineer, within easy reach of the lever of a hand brake, and a switch of the street railway type, the latter having one lever by which the motor is brought to a standstill, started up or reversed, and the speed regulated according to requirements.



EDISON ELECTRIC LOCOMOTIVE FOR MINES AND MILLS.

In the construction of this locomotive care has been taken to distribute the weight so that all four wheels will bear evenly, to insure a maximum traction as both axles are driven from the same motor.

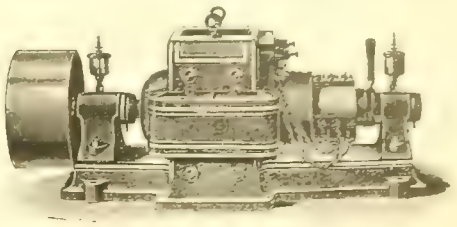
Trouble has been engendered between the Pittsfield, Mass., Electric company and the city authorities and citizens generally. It is charged that the company set its poles wherever it wished, cutting down trees and disregarding the wishes of the people.

Reorganization of the Westinghouse Company.

The reorganization of the Manufacturing company is completed and the directors met on [illegible] to settle all the details connected with the project.

The stockholders of the company held another meeting last week Tuesday, but an adjournment was once more decided upon. Mr. [illegible] company, being absent, Mr. [illegible] acted as chairman and announced that almost three-fourths of the stock of the company had already been sent to the Mercantile Trust company, the stockholders assenting to the proposed plan of reorganizing the company; that the plan had met with general approval everywhere, and that at the next meeting the reorganization of the company would take place. He also announced that Mr. Westinghouse and others, whose presence was necessary at the final meeting, were now in the East. Mr. Bannister suggested that the meeting adjourn until July 15th, which was done after the report had been accepted.

The work of reorganizing the Westinghouse Electric & Manufacturing company has now been in progress for over six months and during that time, in spite of hampered facilities, the management has been able to continue the business. The shops have not been idle a single day. This year the number of workmen was greatly reduced, yet, it is claimed, the capacity has been more than doubled, and to-day about seven hundred workmen are employed in the several departments. One or more electric street railway companies have their cars equipped with the Westinghouse system in the following named cities: Des Moines, Ia.; Lansing, Mich.; Champaign, Ill., Salt Lake City, Utah; Springfield, Mo.; Merrill, Wis; Moline, Ill.; Lincoln, Neb.; Pittsburg, Kan.; Cleveland, O.; Greensburg, Pa., Glen Echo, D. C.; Dayton, O., Richmond, Va [illegible] Lebanon, Mo., Reading, Pa., Terre Haute [illegible] lay, O.; Dallas, Tex., Maysville, Ky., Sandusky, O.; Seattle, Wash.; Helena, Montana; Waco, Tex.; Portland, Ore; Burlington, Ia.; Flushing, L. I.; Louisville, Ky.; Nashville, Tenn., [illegible] Pa., Washington, Pa., Austin, Tex., [illegible] den, Utah; Pittsfield, Mass.; Ottawa, Ont.; Baltimore, Md.; Glens Falls, N. Y., [illegible]



PRENTICE DYNAMO.

The Westinghouse roads in these cities are in actual operation, and in many cases orders have been received for an increase of the equipment. The other departments of the

works have been equally diligent in meeting the demands of the central station incandescent as well as arc lighting. A fan motor which can be attached to incandescent circuits has been placed on the market. It has proved very successful. Much of the success of the plans of the Westinghouse company under these difficulties has been due to the excellent judgment of the present manager.

Thomson-Houston Electric Tramway for Mills.

In the accompanying illustration is shown an electric tramway recently installed by the Thomson-Houston Motor company of Boston at the works of the Pittsburg Plate Glass company, Ford City, Pa. This installation is especially interesting owing to the peculiar conditions under which it is working. The tramway is used to transfer the immense plates of glass in process of manufacture from one part of the works to another.

Four locomotives, one of which is shown in the accompanying illustration, are in use, each being equipped with a twenty horse power Thomson-Houston motor. This machine is used not only to propel the locomotive, but also to drive a hoisting drum, which, by means of special gearing, is thrown in or out at will.

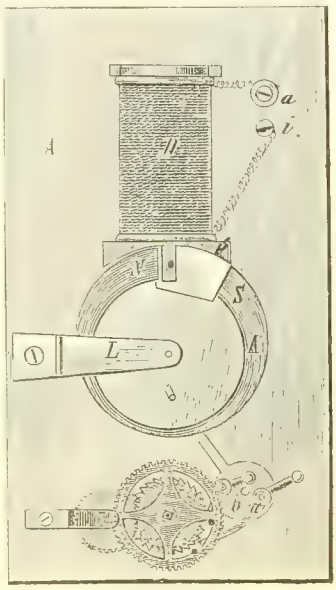
Glass is loaded on cars which run on tracks at right angles to the main track, and the hoisting apparatus mentioned is used to pull these cars up to the tow-cars, which run on the main track and are hauled by the locomotives. The tow-cars are ordinary platform trucks. The grade on the main track is such that the platforms of the trucks are on a level with the side track, and the cars when loaded are placed on the trucks and then transferred to any desired point.

There are two lines of main track, both of which are entirely inside the works and each of which is about 700 feet in length. The gauge of the road is nine feet and ten inches, which is probably the broadest gauge ever used in tramway work. The overhead single wire construction is used and the current for the operation of the motor car is secured from a 500 volt Thomson-Houston generator.

Protection against Lightning.

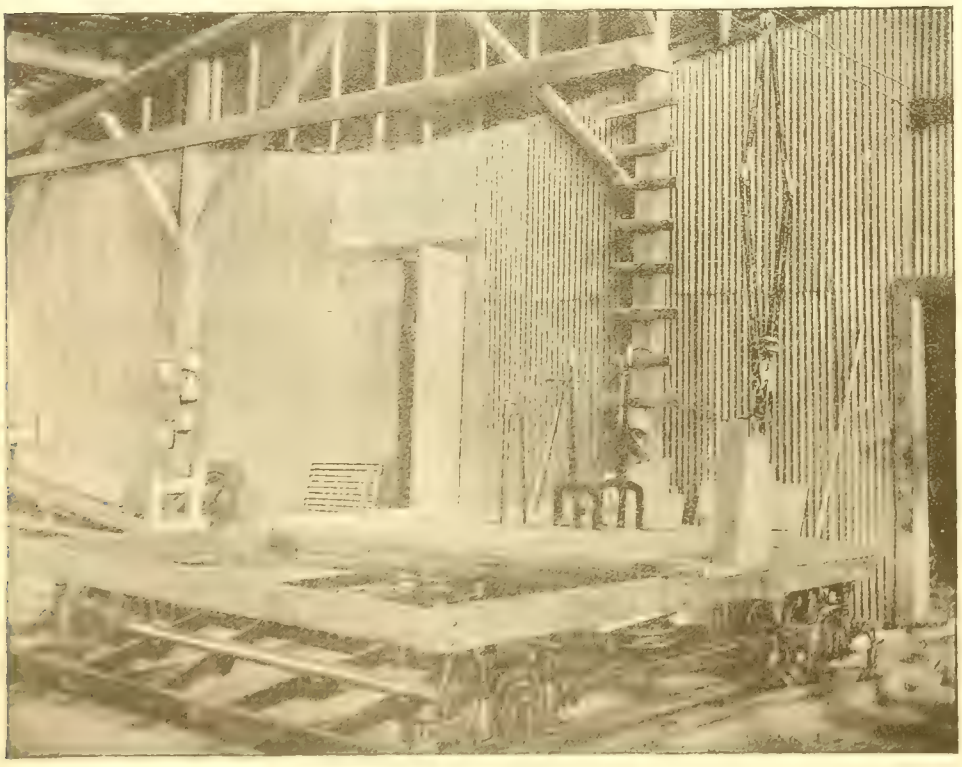
Prof. Henry A. Rowland of the Johns Hopkins University is reported as follows in the Baltimore *Sun* in an interview on the subject of protecting buildings against lightning.

"Recent scientific study has swept away some of the old Hopkins University is protected from lightning by the roof and spouting. You can safely class all patented lightning rods as being of little value beyond conducting rods that any man can put up himself, because the simple principle underlying all is that the lightning will follow the best conductor. The idea so largely adopted in the erection of lightning rods, that a small band of glass will prevent the electric current from passing to a better adjacent conductor, seems playful. While it is true that lightning is attracted to an elevated point or angle, when you cast your eyes over a city like Baltimore and see the large number of such points and angles, the use of pointed rods fades into insignificance as compared with the method of roofing with a good conductor. This was well illustrated by the incident of lightning striking the great monument in Washington several years ago. The monument is capped with a piece of aluminum, which has metallic connection with the ground by means of the iron work of the interior, but the lightning did not strike the top of the cap. It descended to some



ELECTRIC CLOCK.

copper fixed in the side of the pyramidal top, some distance from the apex, burst a portion of the stone, and, running along the copper into the interior, leaped without any metallic connection to the iron framework and passed to the ground. A framework of copper rods covering the angles and crossing the sides of the immense cap was recommended by me at that time for the future protection of the



[illegible] erected. The ground [illegible] the interior iron work spoken [illegible] to the method is that of the Peabody [illegible] connected with the [illegible] on a stone foundation which [illegible] of lightning, has been connected [illegible] conductor, and no danger [illegible] of a building to strike [illegible] center of a roof and while it

runs along the surface of a body, the body may be broken or crushed by the enormous pressure brought to bear upon it, in the same manner that an explosion of dynamite or nitro-glycerine would cause a fracture. I have some fragments of a church spire struck by lightning which are bound together in their former relative positions, but exhibiting all the fractures produced by the concussion. There is a vast difference between the quantity of electricity and what is known as electrical pressure. This is illustrated in a simple manner by the compression of air. A small quantity of air can be compressed to the same degree to obtain as great an expansive force as a large quantity. The quantity of electricity in a stroke of lightning is not nearly as much as passes along almost any electric wire on the street, but the voltage or electrical pressure of the street wire is rarely 3,000. A volt is the basis on which the pressure is estimated. The voltage of the lightning stroke is roughly estimated at 6 000,000,000 volts. In addition to this appalling difference it may be said that the current of the wire is constant and continuing, while the lightning dart is delivered in the one two-hundredth part of a second. Such an astounding force is capable of doing many strange things."

In speaking of places of safety during an electrical storm Dr. Rowland said that probably as safe a place as any other would be an iron bedstead, provided the ground connection is perfect, this being in line with the above theory, that the lightning would follow the best conductor.

Electric Clock.

The accompanying illustration shows a new design of electric clock in which an alternating current through a single magnet works the escapement.

On a base plate *A* is fastened an electro-magnet *D*, the windings of which are connected to the two binding posts. On the lower end of the magnet core there is a pole piece, or shoe, *P*, which is mounted as shown on a stopper in the center. For the armature there is employed a steel magnet *K*, bent into the shape of a ring and fastened to a brass disk, which is centrally pivoted on a bracket *L*. The motion of this balanced armature is such that the two poles, *N* and *S*, alternately strike against the stopper on the pole shoe of the magnet, as the polarity of the electro-magnet changes with the current. This oscillating disk armature is geared to the escapement of the clock movement in such a way that each swing of the armature moves the escapement wheel one tooth.

These clocks are operated in the same way as other electric time systems. A regulator at the station operates a pole changing device and the clocks are joined in series. Clocks operated on short circuits, with magnets of 3.6 ohms resistance require .08 ampere of current and those for long distance service with magnet of 10.8 ohms resistance take only .04 of an ampere.

This clock, which is manufactured by Georg Kesel, of Kempten, Bavaria, is in operation in Munich, and is said to have given good satisfaction, as shown by the recommendations of the Polytechnic Society of Munich.

The illustrations are reproduced from the *Elektrotechnischer Anzeiger*.

Electric Organs.[1]

By James Swinburne.

The idea, and to some extent the application, of electricity to the mechanism of organs is not new. Gauntlett proposed to build models of various celebrated organs at the London exhibition of 1851, and to connect them all to one console. Barker, the inventor of the pneumatic pallet, worked out what was probably the earliest practical system of electrically controlled organs.

An organ consists essentially of three or four independent instruments. Each instrument is composed of sets of pipes, called stops, arranged in rows, say, crosswise, on what is known as the "soundboard," probably because it is not a soundboard. The pipes are also arranged in rows from back to front, each row corresponding to a key on the keyboard belonging to that organ. Each key commands a valve, or pallet, letting wind into a channel under all the front to back row belonging to it. Each stop has a long perforated slip or slider running under it, which can be moved so that the holes correspond or not with those leading to the pipes. These sliders are controlled by the draw-stops. A fourfold organ has one pedal and three manual keyboards, called "great," "swell" and "choir." Further mechanism is necessary to connect various keyboards, and to admit of rapid changes of the arrangement of the draw-stops. This appears very simple, but when an organ has about forty stops and over fifty draw-stops it becomes very complicated. The first trouble is that it soon becomes almost impossible for the fingers of the left hand to work air valves or pallets large enough to control the wind for twenty or thirty large pipes, even if equilibrium valves are used. I am, as far as possible, using engineering, and not organ building, nomenclature. To get over this, the air relay, or pneumatic pallet, has been adopted in large organs. The finger then controls a tiny equilibrium valve, which controls an air bellows that does all the work. When this system is applied to the great organ of a small instrument, it is generally arranged to work the "choir" and "swell," too, when coupled to the "great."

There is still another difficulty. In large instruments

[1] London *Electrician*.

the pneumatic pallets frequently have to be a long way from the player, and the connections are apt to alter in length and get out of adjustment. In All Saints' Church, Manchester, there is, or was, an organ played from near the reading desk, placed high up on each side of the chancel 70 feet off. It has mechanical connections, but they are not heavy, and seem to work very well. Generally, an arrangement like that used in pneumatic bells is used, and known as the tubular pneumatic system. Barker, however, controlled his little air relay valves electrically, and realized the advantages of electrical connections in admitting of great simplicity in coupling and key mechanism, as well as ease in connecting distant organs. The electric action, as it is called, has developed especially abroad. Messrs. Bryceson have done a great deal, and many English organs have electric connection. In France there are a large number of these combined electric and air relay mechanisms. M. Carre describes several in a valuable article in *La Lumiere Electrique*. Roosevelt, in America has not only developed pneumatic actions thoroughly, but has employed electricity too. The three manual organ at Trinity Church, Boston, has not only pneumatic action for the keys, but a pneumatic stop action which admits of an exceedingly convenient composition pedal arrangement. The pedal on being pressed and hitched down draws its corresponding set of stops, and shuts them off again when allowed to rise, without interfering with any arrangement that has already been made. There is also an electric solo organ, but it was out of order when I tried the instrument. There is a concert organ by the same maker in Boston with a set of composition pedals, each with a complete set of draw-stops, which can be arranged beforehand, and come into use when the pedal is pressed. I believe the new Riga organ is electrical.

Mr. Hope-Jones has recently paid great attention to the subject of electric actions. Being an electrical engineer and an organist, he is well fitted for tackling such a difficult subject. The console of the organ of St. John's Church, Birkenhead, where Mr. Hope-Jones is organist, is worthy of consideration. Instead of draw-stops at the side of the player there are rows of little tumblers just under the music. A touch at the top or bottom puts the stop in or out. This organ, if arranged in the ordinary way, would have about forty draw-stops. By the use of electric gear, Mr. Hope-Jones produces an organ which has the same effect as an instrument of fifty-three, with the ease of manipulation of one of twenty draw-stops. In addition, it has a whole host of composition buttons, crescendo arrangements and other accessories.

So far electricity seems to have been used to work an air relay only. The use of electricity may easily have been carried very much farther than this. The difficulty has been the supply of electrical energy, and batteries have been used. Mr. Hope-Jones, who has had experience in telephone work, has probably reduced the energy needed to a minimum. It seems obvious, however, that to use electricity to work an air relay for working a valve needing a pull of a pound or two through half an inch is absurd; and our electrical readers may well study the question, as given, say, twenty watts available, the whole mechanism of the ordinary organ might be swept away, and an infinitely more convenient and less costly instrument devised. It is easy to get the power. In England the blower, who does the whole of the work when air relays are used, works a thing like a pump handle up and down. In France he works two levers with his feet. Sometimes the blower is a water motor or a gas engine. All that is wanted is rotary motion. Even if rotary motion is provided, by means of hand cranks, water motors or gas engines, the feeders are generally on the principle of a smith's bellows. We would suggest that such a machine as the Baker positive blower would be very much cheaper and better, giving a uniform supply without beating. The electric power can then be supplied by a very small magneto machine. This need have no commutator; it may supply alternating currents of low enough frequency to be silent. There is then nothing to get out of order, and owing to hysteresis, if closed circuit electro magnets be used, there is practically no sparking at the various contacts. Organ music is limited entirely by the mechanism of the organ, and develops with it. In Germany they have only one sort of organ music, of which the works of Merkel, Rheinberger and perhaps Mendelssohn may be taken as examples. This needs no accessory mechanism, and even modern German organs have, we believe, little as a rule. The well-known organ at Tyne Dock, by Schultze, has no composition pedals, and, if I remember aright, no couplers. In France the organ intersperses showy scraps during church service; and many of the organs are not designed for solid playing. The large organ at St. Eustache, for instance, has the pedals so arranged that the player cannot reach them without sliding along the seat. They have all sorts of arrangements for meretricious effects—tremulants, fancy reeds, and "effets d'orage." In England and the United States organ playing has got as far as it can without a change in organ construction. The average church organ spends its time in the monotonous accompaniment of hymns and chants, but the concert instrument plays German fugue music, German chorale organ music or the resulting German organ sonata; then it plays Guilmant and light French music; and then it indulges in a development which is essentially English, the organ arrangement. As much of an orchestral movement as can possibly be compressed into the region of ten fingers and two feet is crammed on three staves, and the organist has to change his stops as best he can. It is probably only in England and America that such things as the overtures to "Der Freischuetz" or "A Midsummer Night's Dream" are played on organs. It is only because the mechanism does not give the right combinations quickly enough, if at all, that the overture to "Tannhauser" does not figure on recital programmes.

It is difficult to think of all that can be done easily and cheaply by direct electric mechanism. If each key makes circuit with a set of small electric valves one to each pipe, and if the returns to each stop are controlled by what corresponds to the draw-stop, all the ordinary mechanism of pneumatic pallets, expensive soundboards—which sometimes warp—trackers, sliders, rollers, etc., may be swept off. It may be remarked parenthetically that the abolition of pneumatic pallets is itself most desirable. Apart from expense, they tend to develop a bad style of playing. The organist cannot accent a note by playing it louder, so emphasis is given to it by clipping the note before it a little short. Phrasing thus depends on perfect instantaneousness of the action, which is not always found with the air relay. In a cathedral organ music gets mixed up into a sort of roar, which rolls down the aisles in a way poets like, and slovenly phrasing does not matter; but in a concert room an organist accustomed to a large instrument generally bears evidences of it. With electric mechanism, any stop may be drawn on any manual, or pre-arranged for any manual and composition button. Any grouping may thus be adopted. In orchestral music, though there are about twenty staves in the score, the instruments fall roughly into a few groups. It should be easy to group the corresponding stops on the organ in the same way for playing orchestral music. This can be done by electricity. Again, in playing from the ordinary piano score of oratorios, there are four lines of voice parts, which demand one keyboard, and two lines of condensed accompaniment, which demand one or two keyboards, which must be coupled instantly to the voice keyboard when there are no hands available to play them. Existing organs generally meet these last requirements. Electric action admits of still another development. In a medium sized hall, one manual may be an ordinary grand piano. A piano could not be combined with an ordinary organ, because the touch is different; but if the console is detached from the organ so as to give breathing room for the piano, the addition of the contacts to the keys will not interfere with the touch of the piano at all. This suggestion will strike many as odd, some may say barbarous, but the harp may almost be considered part of the modern orchestra, and apart from concertos, the piano might also be absorbed too, especially if it were more portable, and several could be employed together.

Enough has been said to show the enormous advantages of simple organ mechanism. One great difficulty will probably be in organ builders themselves. They are often too apt to regard electric action as complicated, untrustworthy and expensive. It must be remembered that electric work has advanced enormously within the last few years; and if electricity can sweep away the whole of the rest of the action mechanism from organs, it is certainly worth consideration. The excellence of the organ at Birkenhead points to the advisability of organ builders going to electricians to get the electrical part of their actions put right, instead of designing it themselves, and then rejecting it as costly or untrustworthy.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 27.—"Four more persons, all women, suffocated by gas from an open burner. Three accidents in one, with a suicide added. How long before the ever ingenious but sometimes dilatory Yankee inventor shall come to our rescue by adding a tell-tale or self-snuffer, so to speak, to every gas burner?" This mournful plaint was uttered by one of the great metropolitan dailies at the head of its editorial columns this week. That such a shocking occurrence should have called forth even so much comment from the daily press is passing strange, because we are all accustomed to the deadly work of illuminating gas. Scarcely a week passes but one or more lives are thus silently snuffed out and nobody takes any notice, but four in one night is an unusual record. Imagine the columns of sensational matter that would have deluged our breakfast tables had the dynamos instead of the gas holder been to blame for this wholesale slaughter. The newsmongers of New York would have been satisfied with nothing less than the immediate electrocution of all the officers of the company, from the president down to the man in charge of the station. Yet nobody proposes to indict a gas director or superintendent, and Mayor Grant never even hints that he would like to pull up all the gas mains in New York until the burners are robbed of their murderous powers.

Those who talk so glibly of the "dangers of electricity" would probably be surprised to learn that there are twenty deaths in New York from gas to one caused by electricity. In New York there were more than 1,300 accidental deaths last year, of which just two were ascribed to electricity, while over forty were put down to illuminating gas. But suffocation by gas is a trite occurrence and can no longer be written up "artistically," while there is something novel and mysterious and sensational about electricity, so for a long time to come we shall continue to read of the 'dangers of electricity," and gas will go on insidiously committing weekly murders without provoking comment or protest.

The rapid transit question continues to crop up at various times and in various lights. The elevated railway people, balked in their endeavor to annex the best part of Broadway and the whole of the boulevard, throw cold water on the electric underground scheme whenever [illegible]

[illegible] electrical engineers will not be able to construct motors of [illegible] opment of electrical engineering, although at the same time it must be acknowledged that his opportunities of [illegible] very little attention to electrical engineering, and in fact manages to get along without it. Be that as it may, Mr. Gould disclaims all pretension to any such knowledge, stating that to him electricity is an "unfathomable subject" which he leaves entirely to experts. In that case it seems rather gratuitous on the part of Mr. Gould to venture on an opinion as to what "experts" can or cannot do, and just as valuable an opinion might have been obtained from one of Mr. Gould's messenger boys. The *Sun* supports Jay Gould, and Mr. Dana doubts whether a motor can be built to do the work. Mr. Sprague has challenged Mr. Dana to back his opinions to the tune of $50,000, but Mr. Dana preserves a discreet silence. Last year the venerable editor of the *Sun* spent his vacation in Spain, and he appears to have acquired some of that country's conservatism and opposition to progress; this year he would do well to make a tour of this country and see what electric motors are doing in many large towns. He will then think better of the motor than he appears to at present.

The engineers of the Rapid Transit commission have lately been engaged in sinking shafts along Broadway to discover at what depth bed-rock was to be found. The result of this work has been highly satisfactory, rock having been found at an average depth of about 100 feet for a considerable distance, the minimum being 78.8 feet at Dey street, and the maximum 163.5 feet at Duane street. It was prophesied that trouble would be met with at Canal street, where Broadway runs into a hollow. It was said that a subterranean creek existed here, containing nothing but soft mud, which would render tunneling practically impossible. The prophets were all wrong, however, as rock was struck at Canal street at a depth of 87.6 feet, the ground above consisting entirely of strata of coarse gravel and sand. The Rapid Transit commissioners are very much pleased with the results of the work, and they consider that it has been conclusively demonstrated that not only are many of the threatened difficulties absolutely nonexistent, but also that the lower section of the road can be constructed much more easily and cheaply than had at first been supposed. It is estimated that the tunneling through the sand and gravel that has been met with so far can be advanced at the rate of fifteen or twenty feet a day. The commission is now engaged in considering an East Side line.

The motive power in the tunnel which is being built under the North river by the Hudson Tunnel railway company, connecting New York city with Hoboken, will be electricity, which is conceded to be the most practical and economical. The electric locomotives used will be much after the style of those used in the London underground railways. The Thomson-Houston Electric company has taken the contract, it is claimed.

The Metropolitan Telephone company inaugurated this week the third of its model telephone buildings. The new exchange is at Spring street, and serves what is known as the dry goods district. It is equipped with a multiple switch-board of the latest type, embodying all the improvements known to telephonists. Not an overhead wire enters the new building, all the subscribers being connected through underground cables, and the change from the old office to the new was effected in a novel and effective manner entirely by means of underground cables. The old exchange was operated by the Chinese system and [illegible] its abandonment this system disappears from the telephone service of New York. The Metropolitan company has for some years past been doing very progressive work in reorganizing its general plant and equipment, and all the new exchanges are in buildings specially erected for the purpose. The amount of underground telephone cable lying beneath the streets of New York is now something prodigious, and is daily being added to. [illegible] time a circuit could be run the entire length of Manhattan Island from the Harlem River to the Battery exclusively through underground cables, without an inch of overhead wire and Steel Mayor Grant is now [illegible] he finds so few poles used for electrical work in the streets now that he is casting longing glances at the barbers' poles [illegible]

The subway deadlock will probably find a solution before very long. The electric light companies who have [illegible]

very first, owe the subway company large amounts for rental of ducts. No payments have been made on the ground that the rentals were excessive, and when the subway company threatened to cut the cables if a settlement of their little bills were not made, the electric light companies applied for an injunction to prevent the execution of such violent methods, which to them savored "of the earth, earthy." A temporary injunction was granted, but on a further hearing Judge Ingraham denied the motion, and refused to continue the injunction. The Supreme Court, General Term, has just affirmed the decision of Judge Ingraham, the opinion of the court being written by Presiding Justice Van Brunt and Justices Barrett and Patterson. This decision is, in vulgar parlance, a "facer" for the electric light companies, who will now have to pay up or submit to having their cables cut It is scarcely probable that they will be willing to incur the losses that would result from a general interruption of the lighting service, and presumably they will now at least pay something on account to the long suffering Subway company, which certainly must need the money bad enough.

The First Battalion of the Naval Militia of the state of New York was legally enrolled a few nights ago by Adjutant General Porter, and New York now presents a naval force of 201 men. Many electrical men are members of the battalion, and great interest has been taken in it among electrical circles in New York, especially since the publication of Lieut. Bradley Fiske's very able paper on "Electricity in Modern Warfare," read before the New York Electrical society last fall. The commanding officer of the battalion is Lieut. Commander Jacob W. Miller. The battery commanders are: First Battery, Lieut. S. Dana Greene; Second, W. Butler Duncan; Third, Louis Mowbray; Fourth, T. M. Forshen. The battalion will go on a cruise with the squadron of evolution on July 27th, when the men will be drilled in handling heavy guns and rapid firing guns, target practice, boat tactics and landing as a naval brigade to assist land forces.

News comes from Washington of an important omission in the specifications for cruiser No. 13. It appears that no provision has been made for that very necessary part of the equipment of a modern man-of-war, namely, the electric lighting plant. Nobody seems able to explain how the omission came about. The responsibility rests between the Equipment Bureau, which has charge of such matters as electrical appliances, and the office of the Judge Advocate General which superintends the preparation of the specifications. It appears that all the bids received for the construction of the vessel are so close to the appropriation that not enough money will remain to provide an electric light plant under a separate contract. The lowest bid leaves a margin of only $60,000, whereas the electric light plant would, it is estimated, cost $100,000. The secretary tried to get the contractors, who have sent in bids, to throw the electric plant in, but none would agree to do that. It is probable that the lowest bid, that of the Bath Iron Works, will be accepted, and the cost of the electric light installation limited to $60,000. W. L. H.

San Francisco, Cal.

SAN FRANCISCO, Cal., June 26.—Dr. Thomas Addison, district manager for the Thomson-Houston Electric company, was closed a contract for the equipment of the San Francisco & San Mateo Electric road with Thomson-Houston apparatus. The initial plant will consist of six 80 kilowatt generators and 30 cars, 15 of which are to be 16 foot, single track cars, each carrying two 15 horse power motors, and the remaining 15 cars are to be of the latest 32-foot, double track pattern, each truck carrying a 25 horse power motor. It is hoped that the first division of the [illegible] completed in October next.

The closing of this contract means that the Thomson-Houston company will equip what is to be perhaps the nearest approach to an electric trunk line of any road in [illegible] San Francisco & San Mateo company has [illegible] for the line from San Fran- [illegible] towns of San Bruno, Millbrae, [illegible] Belmont to Redwood City, a [illegible] Southern Pacific route, [illegible] for an extension of the [illegible], and through [illegible] to San Jose, a [illegible] It is evident, [illegible]

[illegible]

motor and 56 storage cells of the 23 M type, manufactured by the Accumulator company, New York. The normal speed of the craft will be from 6 to 8 miles per hour, and it is capable of spurting at the rate of 12 miles per hour. It will run about 70 miles on one charging, and, in addition to the usual incandescent lamps necessary for its illumination, it is to be provided with an electric search light and an electric fog horn. The accumulators are to be charged by means of a 4 horse power gasoline engine and a 2.5 kilowatt Edison dynamo. The Storage company also reports the sale during the week of a 160 light incandescent plant to the San Jose Fruit Packing company of San Jose, and the closing of the contract for the wiring of the Reid boarding school at Belmont for 150 lights, preparatory to the placing of a storage plant.

The California Electrical society has removed from its former rooms in the Murphy building, and is now quartered in the new Academy of Sciences building. The rooms are nicely fitted up and are lighted by electricity.

The San Francisco *Chronicle* of June 17th contained the following:

"At the close of the executive meeting of the Pacific Underwriters' Association last evening the doors were thrown open, and members of the Insurance Clerks' association were admitted. The object of the meeting was to hear a lecture on 'The Advantages and Possibilities of Electricity,' delivered by George P. Low, electrical inspector of the Pacific Insurance Union.

"The paper was long and very interesting, and is to be supplemented by another one on the 'Dangers of Electric Wires,' to which last evening's lecture was introductory. Mr. Low stated the importance of a knowledge of electricity to the underwriter, and in an easy, entertaining manner pointed out what is known in the abstract of the subtle force of electricity. He compared it to gravity, and suggested that the five senses may owe their action to electricity. Magnetism and electricity were compared and their interconvertible nature was touched upon.

"Taking up the more practical side of the subject, Mr. Low explained the fundamental principles of the dynamo, and figured out that electrical industries of the value of one-quarter of a billion dollars have been built up in the United States through it. The comparative efficiency of the steam engine and the motor, to the great advantage of the latter, was mentioned, and the prophecy was made that all our railroad lines will one day be operated by electricity. What has been done was summed up neatly, and then the possibilities of electricity were referred to, closing a most entertaining paper."

The Pacific Postal Telegraph company has completed the changing of the terminus of its cable between San Francisco and Goat Island to the end of the Clay street wharf. At the same time a new cable was laid and in about ten days a similar cable will be laid from Goat Island to Seventh street, Oakland. The cost of the cable just laid was over $25,000. It consists of ten separate conductors, covered by an armor of 18 No. 2 galvanized iron wires. The cable proper was made in England, but the armoring was done by the Roeblings.

S.

Detroit, Mich.

DETROIT, Mich., June 30.—The Supreme Court of the State of Michigan has affirmed the decision of Circuit Judge Reilly in the suit of the Detroit City Railway vs. M. B. Mills and others, property owners on Mack avenue, this city, arising from the construction of an electric street railway on that avenue. The Mack avenue electric line was built by a corporation and sold to the Detroit City Railway company. M. B. Mills, one of the largest property owners on the street, aided in cutting down the poles supporting the electric wires. The company secured a temporary injunction, and the trial of the suit occupied several weeks. The property owners claimed: First that the act under which the complaint was instituted was unconstitutional, second, that the company had no right by its franchise to use electricity as a motive power, third, that the company in the erection of poles trespassed on the private property of the defendants.

The court held that the claim of the unconstitutionality, of the act under which the company was organized was not sustained. The second contention, that the city does not possess the power to permit operation of cars by electricity, is disposed of by the answer that it is a matter between the company and the state, and that the defendants are not in a position to raise the issue. The mere usurpation of corporate power does not confer upon the individual the right to bring suit to restrain the unlawful exercise of authority. If the state choose to raise it, or by its silence permit the action, no others can complain so long as the personal or property rights of the individual are not invaded or affected. The court also finds it unnecessary to discuss the proposition that the right of the company was not conferred in the original act, as subsequent mandatory acts conferred such right, which was, however, to be used under authority of the council. The opinion also holds that the use of streets for street railway purposes does not impose new burdens and servitude beyond the power of the city to authorize without additional compensation to adjoining lot owners. The court holds, however, that the tracks cannot be constructed in a street too narrow to admit the passage of cars and other vehicles at the same time. The road bed and track must be built substantially with the level of the street so as to permit vehicles to cross without difficulty, and the poles must be placed so as not to interfere with the right of ingress and egress to abutting property. Justices Morse and Grant dissent from the opinion. This decision of the Supreme Court removes an objection which the Detroit City railway has claimed to be an obstacle to using electricity as a motive power.

The Detroit Electrical Works contemplate putting up one of the most extensive electrical manufacturing establishments in this country. The new works will include a machine shop, foundery, pattern shops, finishing shops, steam forges, erecting shops, carpenter shops, and laboratories, and possibly a large power plant capable of furnishing an electric current for the motors of the whole manufacturing establishment. The present works will be utilized for manufacturing electrical supplies and machinery. The machine shop of the new works will be a large structure, and each department of the work will be entirely separated from the others. The various buildings, while not taking up the whole space of the land, will occupy a large share of it, and they will be so arranged that additions can easily be made. All of the shops will be fitted up with overhead electrical traveling cranes. The intention for the next year's work is to turn out at least five complete steel car electrical equipments per day and one complete generator of a capacity of not less than 100 horse power. The cost of the buildings is estimated at $200,000 to $300,000 including the additional machinery. The plans and specifications are not yet complete, but they are expected to be finished so that work may be commenced in July, and the works ready for operation by January 1st. The purchase of the property was consummated last week. All the machinery will be operated by electricity, and the shifting and hauling of cars about the ground will be done by means of an overhead trolley system. There will also be passenger cars operated by electricity and electric locomotives, thus giving visitors an excellent opportunity to examine the company's system completely. At present the works are now running three hours overtime, beside employing the facilities of the Dry Dock Engine works in turning out the different mechanical parts of new equipment.

Louis Warfield, lately with the Pennsylvania Railroad company, is now general manager and treasurer of the company. The other officers are: President, Hugh McMillan; vice-president, William A. Jackson; secretary, William H. Wells.

The first electric cars to run regularly in Bay City were started June 1st. The cars were greeted with cheers all along the route. The majority of citizens herald this as the beginning of a change over the whole street railway system of Bay City.

President Hugh McMillan and General Manager Warfield of the Detroit Electrical Works have recently returned from an extended trip through the East in the interest of the company. Frank B Rae, electrical engineer of the Detroit Electrical Works, was in Springfield and Decatur, Ill., and Grand Rapids, Mich., last week on a tour of inspection.

The Detroit Electrical Works have changed the shape of the channel bars of their street car truck so that the motor rests directly over the frame instead of being suspended from it. The cross bar is bent so that it is only necessary to open the trap door in the car floor and take out the armature.

Brownlee & Co. a few days since shipped a carload of cross arms to Pedras Negras, consigned to the Mexican government.

The final details of the purchase of the Brush Electric Light company's plant by the Peninsular Electric Light company have at last been completed, and the new corporation has elected officers. The pecuniary consideration of the sale is a round $600,000, or $25,000 more than the stock of the old Brush company. The new corporation assumes all the Brush company's indebtedness, gives a bond and mortgage back on the plant, and agrees to keep up the plant and business of the old company, making such improvements from time to time as are necessary to hold and increase its business. The assets of the old company comprised real estate, 150 towers, 600 miles of lines and

as complete a plant for incandescent and arc lighting as can be found in the United States. Among other conditions of the sale was a settlement and discontinuance of the law suits pending between the Brush company and the Fort Wayne Electric company. Without going into the details of the litigation over tower and double carbon lamp patents, it may be stated that the Detroit Electric Light and Power company will now be able to use double carbon lamps without further dread of injunctions, but its towers will probably be taken down and the Brush towers used instead. For president the stockholders have selected R. T. McDonald of Fort Wayne, Ind., who is also president of the Fort Wayne Electrical company; J. L. Edson is vice-president, Edward Hathorne of Boston, secretary and treasurer, and H. L. Wilton, formerly of the Brush company, is assistant secretary. Mr. Hathorne has been traveling auditor of the Fort Wayne company and is one of the best expert accountants in the country. G.

Pittsburg, Pa.

PITTSBURG, Pa., June 27.—There are probably few parts of the country where electricity is so rapidly taking the place of mules or horses as the motive power for street railways, as in Western Pennsylvania. Even in the coke regions the people are after the modern form of rapid transit, and in Connelsville the ground is now being broken for an electric road. The line is to extend from that point through New Haven and Leisenring toward Uniontown, and when it is finished it will be over five miles long. The contract for the building of the road and the furnishing of the motors and dynamos has just been let to a Pittsburg company. The first electric road ever built in the coke region was put down at Uniontown last year, and since it has been in operation it has been running very successfully. This new line from Connelsville will eventually connect with the Uniontown road, and a great deal of interest has been awakened among the people of that district in electrical rapid transit.

August Belmont, Chas. Fairchild and Brayton Ives, the reorganization committee of the Westinghouse Electric & Manufacturing company, have issued the following notice to the stockholders of that company: Inasmuch as holders of considerably more than two-thirds of the stock of the Westinghouse Electric & Manufacturing company have assented to the plan of reorganization, the reorganization committee has decided to limit to July 8th, inclusive, the time in which stockholders may deposit their stock with the Mercantile Trust company. Notice is hereby given that after that date stock will only be accepted subject to such additional conditions as the committee may impose.

At the last meeting of the Allegheny councils the management of the Pittsburg, Allegheny & Manchester Traction company asked permission to have the time for the completion of the road extended until November, because it will be impossible to finish the work any sooner. This was granted.

In the Pittsburg councils the ordinance compelling the telephone, telegraph and electric light companies to put their wires underground came up a few days ago. Representatives of the different companies of this city interested in this ordinance were present at the meeting of councils, and the result was a very spirited discussion on the subject. Mr. Campbell of the Postal Telegraph company stated that it was impossible to put all the wires underground for the reason that the telegraph companies had so many district messenger wires running into the offices of the business houses, which, being only transient wires, could not be put underground, and he thought that the ordinance should be modified to meet that case. He admitted that the main cables could be easily placed beneath the surface of the streets, but he held out for poles for the smaller wires. Mr. Metzgar, the general manager of the District Telephone company, asked to have the ordinance amended so that each company would be allowed to have one pole to each square. Several gentlemen present also stated that they could not see the fairness of the councils in demanding the wires of the telephone and telegraph companies to be put underground when the street car companies, whose wires were really more objectionable than any others, were allowed to leave their wires on the streets. The discussion was postponed at last with the promise on the part of the Department of Public Safety to extend the time for putting the wires underground until November, 1892.

The factories of the Pittsburg Plate Glass Works at Ford City, Pa., are to be lighted by electricity. In addition the company has made a contract for the installation of a power plant to run an electric tramway. The tramway is to convey the glass from the polishing tables to the various departments in the factory. This is the first electric tramway used for that purpose in the world.

B. L. W.

PERSONAL.

J. L. Blackwell, general manager of the Baxter Electric Motor company of Baltimore, Md., was in Chicago Monday.

Gerald E. Fish, who recently resigned from the superintendency of the Chicago Arc Light & Power company, has been appointed superintendent of lighting at Little Rock, Ark.

W. D. Allison manager of the main office of the Chicago Telephone company, has severed his connection with the company. Mr. Allison had been with the company twelve years

C. D Crandall has been appointed to succeed Chas. E. Brown, as manager of the Western Electric company, Chicago. Mr. Crandall will enter upon the duties of his new position at once.

NEW INCORPORATIONS.

West Lexington Land company, Lexington, Va.; capital stock, $80.000; light, heat, power, etc., electric works, waterworks.

Plattville Electric Light & Power company, Plattville, Wis.; capital stock, $10,000; supplying electric light and power at Plattville, Wis.

Milwaukee & Wauwatosa Electric company, Milwaukee, Wis.; capital stock $75.000; to operate street railroad between Milwaukee and Wauwatosa.

Columbia Mining & Land company, Columbia, Va.; capital stock, $250,000; electric light, heat, power, etc., mining, gas works, manufacturing.

Canajoharie Electric Light company, Canajoharie, N. Y.; capital stock, $10,000; manufacturing and using electric light for lighting and heating purposes.

Star Light company, Oakland, Cal ; capital stock, $2 500,000; to manufacture, produce, sell, distribute and supply electric power and electric light, and other artificial light.

Union Electric company (incorporated in W. Va), New York, N. Y.; capital stock, $2,500; manufacturing, selling, renting and using electrical appliances of all kinds.

Winters Electric company, Chicago, Ill.; capital stock, $10,000; to manufacture, construct, purchase and sell all kinds of electrical and magnetic apparatus and appliances.

Laclede Power company of St. Louis, St. Louis, Mo ; capital stock, $75 000; to make and furnish electric power for mechanical and manufacturing purposes, also electric lights.

Inter-state Complete Electric Construction company, St. Louis, Mo ; capital stock, $10,000; to construct and operate waterworks, gas and electric plants for furnishing heat and power and light.

Enterprise Construction & Supply company (limited), New Orleans, La.; capital stock, $50,000; buying, selling and manufacturing all kinds of electrical machinery and supplies, engines, boilers, etc.

Waterville & Fairfield Light & Railway company, Waterville, Maine; capital stock, $200,000. To operate the Waterville & Fairfield Railway and electric light companies at Waterville and Fairfield.

Illinois Judson Power company, Chicago, Ill.; capital stock, $1,000,000; to manufacture, own, use, lease and sell machinery and other appliances for making, using, furnishing and selling power for general purposes.

Topeka Water & Electric Power company (incorporated in Colorado) Topeka, Kan. capital stock, $500,000; to utilize water power from the Kansas River in Shawnee county, Kan., for electric purposes, etc.

Pana Modern Electric Light, Power & Street Railway company, Pana, Ill., capital stock, $50,000; to furnish light and power for city, commercial and mining purposes, and for any other use to which electricity may be applied.

Anderson Electric Street Railway company, Anderson, Madison county, Ind ; capital stock, $200,000; constructing, owning, maintaining and operating a street railway in the city of Anderson, Ind., and in the vicinity thereof.

Mattoon & Charleston Street Railway company, Mattoon, Ill.; capital stock, $300,000; to construct, operate and maintain a system of dummy, tramway or street railroad to be operated by electricity or other motive power.

Chattanooga Water & Electric company (incorporated in W. Va), Chicago, Ill.; capital stock, $50,000; owning and operating electric light plant, waterworks, hotel property and pleasure resort in and near the city of Chattanooga, Tenn.

Portable Electric Light & Power company (incorporated in W.Va). New York, N. Y.; capital stock, $1,000,000; manufacture and sell electrical accumulators, secondary batteries, primary batteries, electric light plants and everything pertaining to electricity.

ELECTRIC LIGHTING.

El Paso, Tex., has a new electric light company.

Football by electric light is said to be the latest Philadelphia fad.

A new electric light company has been organized at Flemingsburg, Ky.

The Leesburg, Fla , Electric Light & Water Power company has been incorporated with a capital stock of $50,000.

The H[illegible] Electric Light company [illegible] [illegible] plant at West Toronto Junction, Canada. This company [illegible]

The litigation between the Rochester, N. Y., Electric Light company and the [illegible] been settled by agreement [illegible] owners of water power [illegible] a dispute arose as to their rights on adjoining property.

ELECTRIC RAILWAY.

Work has been begun on the new electric street railway at Jackson, Mich.

Electricity will be used as the motive power of the Lake street railway of Waxahachie, Tex.

The West End Railway company of Savannah, Ga , has obtained a franchise to build an electric road.

It is stated that the Austin, Tex., Street Railway company will soon operate its lines by electric power.

It is proposed to build an electric road from Santa Barbara, Cal., through Montecito to the Hot Springs.

The Houston, Tex., City Street Railway company, which operates electric lines, will extend its system.

The Detroit Electrical Works are equipping in New England six street railway systems as follows: The Lawrence electric street railway at Lawrence, Mass.; the Black Rock & Salisbury Beach railway at Amesbury, Mass ; the Augusta. Hallowell & Gardner electric street railway at Augusta, Me.; the Newburyport street railway at Newburyport. Mass , and the Gloucester street railway at Gloucester, Mass.

The Kanawha City and Charleston Electrical Railway company has been chartered in West Virginia for the purpose of building a railway line from Charleston to Kanawha City. The length of the line will be about two miles beside the turns about the streets of the two cities. The road will be operated by electricity, and will carry light freight and passengers. The company has a capital stock of $100,000, and will build as soon as possible.

ELECTRIC MINING.

A mining engineer of Sydney, New South Wales, has invented an electro-chlorination process for the reduction of gold ore.

MISCELLANEOUS.

The electric fountain at Lincoln park, Chicago, is in operation every Tuesday and Saturday evening.

Electricity is said to be the latest fashionable resource as a cure for tippling by wealthy men in Paris and London.

June electrical storms did considerable damage throughout the country. At St. Paul, Minn., on the 27th, lightning struck a car on University avenue, destroyed the line overhead and ruined the motor. A similar accident occurred on West Seventh street. The house of Peter Rusan, residing on Wyoming street, near Oakdale, was also struck. The current, descending the chimney, struck Mrs. Rusan, who was siting near it, and severely burned her down the head and neck and partially paralyzed her lower limbs. Two children who were on the floor were slightly burned. The house was considerably damaged. During the same storm at Archibald Malcom's farm near Oak Lake, Manitoba, a bolt of lightning killed a team of horses and a Frenchman standing near, while the driver was unhurt.

TRADE NEWS.

The excessively hot weather last week is what electrical people call "good fan weather." The Central Electric company reports large sales of motor fans. It keeps a variety of this class of goods for its customers to select from.

J. F. Hockett was appointed general manager of the Card Electric Motor & Dynamo company of Cincinnati, O., June 15th, in place of H. H. Walter, resigned. This company is reported to be in a most flourishing condition and it is contemplating increasing the factory facilities within the next sixty days.

Ingenious conceits and unctuous touches of humor characterize the advertising matter of the Electrical Supply company, Chicago, in a marked and pleasing degree. Several bright originalities of this character distinguish a recent circular setting forth the merits of the Shield Brand moisture proof wire This "dry subject" is handled in machine-made blank verse and with various diagrams and pictures, the whole making a unique combination.

The almost constantly increasing demand for a compact simple and economic arrangement for isolated electric lighting has led L. J. Wing & Co., of New York and Chicago, to introduce a combination of a Dake steam engine and a Riker dynamo, the former being a small high-speed engine and the latter a low-speed dynamo, and both mounted on a single base. The machine is especially adapted for use on locomotives for lighting trains, and at the same time for ventilating and cooling the cars with electric fans It is also valuable in lighting and ventilating yachts, steamships, factories, etc., requiring minimum care and attention, and giving maximum light for power used. It may be employed for arc and incandescent lighting, or for either separately and is made [illegible] sizes corresponding to the power desired. The light produced by this arrangement is constant and steady.

A. D. Lundy, of the firm of Sergeant & Lundy, arrived from the East a few days since, and has taken [illegible]

work connected with the new enterprise. Mr. Lundy is well known in Chicago electrical circles, particularly in connection with electric street railway interests, having served for several years as chief engineer of the Sprague Electric Equipment company, during which time fourteen roads were built and equipped. During the past year he has [illegible] southern district of the Edison General company with headquarters at Atlanta. His connection with the early work of electric street railway building has given Mr. Lundy a valuable experience that will be of a special value to him in his present duties. Mr. Sargent needs no introduction in Chicago, having served a long apprenticeship with the Edison companies, and at present holding a responsible position with the department of construction of the World's Columbian Exposition as electrical engineer. The new firm is a strong one, and in the specialty which it purposes making prominent, that of the complete equipment of power plants, using the McIntosh & Seymour engines, its influence will undoubtedly be speedily felt.

BUSINESS.

The Cincinnati Engineering company is bringing out a new electric freight and passenger elevator that has many novel features, and which will undoubtedly attract attention when ready to be shown.

The Moore Electrical Manufacturing company, 652 and 654 Hudson street, New York, calls attention to its improved Leclanche Disque battery.

Louis Blatz, 103 West Monroe street, Chicago, is adding new machinery to his brass foundry, and when completed will have the best, or one of the best, equipped establishments of the kind in the city. Mr. Blatz will make a specialty of castings for electrical work.

The Cleveland Wheelbarrow Manufacturing company, Cleveland, Ohio, has purchased the business, including real and personal assets, of the Cleveland Wheelbarrow and Truck company. E. F. Wright has been succeeded by J. W. Hornsey, secretary and treasurer.

Some idea of the extent of the use to which the fan motor is being put for ventilating purposes can be gained from the fact that Jones Bros. of Cincinnati have over 300 in use on a central station circuit supplying 3,800 incandescent lamps and covering a radius of less than one half mile All but a very few of these motors have been installed since May 1st. The demand for additional power has compelled them to put in a new 150 horse power Porter engine in order to get sufficient current during the day without running the large Hamilton-Corliss engine which they have in place for their customary work.

Geo. Cutter has had three teams during the past week constantly engaged in hauling weather-proof Simplex wire from his warehouse to the various freight depots for shipment. Mr. Cutter has also shipped direct from the factory during the past week a large slate switch-board for use in a Detroit theater that is being refitted. He is also receiving large orders for his new magnetic cut-out for railway use, 28 having been shipped recently to one road. Cutter's lamp supporting pulley is growing in popularity. It is claimed for it that it is thoroughly sleet-proof and will hold the lamp securely even if the hoisting rope slip.

The Union Electric Works, 506 Springer Building, Chicago, have recently added to the capacity of their factory, and are now ready to manufacture small electric appliances for the trade, or they will take special care in the developing of any electric device, and when the same is completed they will manufacture it on a royalty, or they are prepared to purchase it outright from the inventor. This company is provided with an able corps of electrical and mechanical engineers, who are fully competent to pass upon the value of any device or application offered, and it is believed that this department will prove of great benefit to young inventors and to any others that wish to dispose of their productions.

L. A. Spaulding, Chicago, has just secured letters patent on a decidedly novel application of the electric current. His device provides for the playing of a game of pin pool on an ordinary pool table, minus the pins, and [illegible] of the count in a game of 15 ball pool. In the former game sensitive push buttons are arranged in the center of the table under the spots usually occupied by the pins, and the balls, in passing over them, [illegible], which is recorded by an ordinary annunciator placed for convenience in the wall near [illegible] table the buttons are arranged in front of the pockets, the count being shown in the same manner The invention is certainly novel, and will undoubtedly attract attention.

[illegible] company is showing some very [illegible] Okonite cable. The [illegible] has increased so lately that [illegible] to go into its manufact[illegible] the product in the West [illegible] company, which is the general [illegible] some flattering contracts and will soon be in the field as an active [illegible] company an[illegible] [illegible]

[illegible]

S. Merrill, C. H. Sewall and R. B. Cone. The company is engaged solely in the business of furnishing steam and electric equipment materials. No construction work is attempted, although the lowest figures can be obtained for the construction of steam power plants and electric railways. The Engineering Equipment company has its chief offices in the Central building, 143 Liberty street, New York. It is the sole eastern selling agency for patent cotton leather belting and belting specialties, manufactured by the Underwood Manufacturing company, and for the Boston trolley and line materials, made solely by Albert & J. M. Anderson. It has also the United States and Canadian selling agency for the indurated fibre pipe, produced only at Mechanicsville, N. Y., and for the Kellogg steel center and side poles made by the Kellogg Iron Works of Buffalo, N. Y.; also Eastern selling agents for Habirshaw wire, cables and cores, and general agents for the machine tools manufactured by Edward Harrington, Son & Co. Many large orders have been filled by the company to the complete satisfaction of customers.

ELECTRICAL PATENTS.

Issued June 23, 1891.

454,450. Brake Mechanism for Street Cars. Norman C. Bassett, Lynn, Mass.

The last claim follows:

"7. The combination of a truck having an electric motor geared and supported thereon, so that the tractive power of the wheels upon the different axles is rendered unequal, with brakes for both sets of wheels, and a pull rod or chain connected at one end to the brake apparatus for the loaded wheels and at its other end to a lever connected both with the truck-frame and a brake apparatus for the light wheels and means for adjusting the connection of the rod relatively to the lever for varying the braking pressure applied to the last named wheels."

454,462. Electric Elevator. Rudolf Eickemeyer, Yonkers, N. Y.

454,467. Belt Controller for Dynamos. William A. Foote, Battle Creek, Mich.

454,470. Signal Device for Telephone Pay Stations William Gray, Hartford, Conn.

454,475. Electric Regulator for Constant Potential. Carl Hering, Philadelphia, Pa.

454,476. Electric Regulator for Constant Potential. Carl Hering, Philadelphia, Pa.

454,485. Electric Arc Lamp. Herman Lemp and Merle J. Wightman, Hartford, Conn.

In this lamp the arc is formed by the main circuit magnet, which, as soon as the arc is formed, no longer plays any part in the operation of the lamp, the actions thereafter being under the control of the derived circuit magnet.

454,486. Overhead Electric System. Charles A. Lieb, New York, N. Y.

454,487. Car House Hanger. Charles A Lieb, New York, N. Y.

454,488. Commutator for Dynamos or Motors. Charles A. Lieb, New York, N. Y.

This invention consists in the combination of commutator bars or sections containing aluminum and a brush of carbon. The sections of aluminum will not alter in size materially when heated or cooled, consequently the sections or bars will not become loosened.

454,496. Limit Switch. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works.

454,500. Mining Machine. Elmer A. Sperry, Chicago, Ill.

454,503. Signal Attachment for Telephones. Alfred D. Sundeen, Swan B. Molander and Gustaf W. Anderson, Mora, and Andrew M. Carlsen, St Paul, Minn.

454,504. Signal Attachment for Telephones. Alfred D. Sundeen, Swan B. Molander and Gustaf W. Anderson, Mora, and Andrew M. Carlsen, St Paul, Minn.

The first of the seven claims reads:

"The combination, with a telephone, of a phonograph and an electro-magnet connected in the circuit of the telephone for releasing the phonograph by passing an electric current over the line from other stations, means for conducting the sound of the predetermined speech from the phonograph to the transmitter of the telephone to which the phonograph is attached, and means for stopping the phonograph after it has given the distant station the predetermined information."

454,522. Trolley Pole Mechanism. George H. Larkin and James Tomkins, St Paul, Minn.

454,529. Coin Freed Weighing or Similar Machine. George E. Rutter, London, England.

454,532. Trolley for Railway Cars. Edmond Verstraete, St. Louis, Mo.

454,536. Electric Car Trolley. William Duncan, Allegheny, Pa.

454,541. Speed Regulator for Dynamo Electric Machines, Erastus L. Winkley, Lynn, Mass.

454,546. Electric Conductor. Alfred W. Sperry, Hartford, Conn.

454,547. Insulating Material. Alfred W. Sperry, Hartford, Conn.

[illegible] Compound for the Manufacture of Insulators. Packings, etc. Alfred W. Sperry, Hartford, Conn.

454,555 Magnetic Separator for Paper Pulp. Charles H [illegible], Mass.

To the upper surface of the bottom of the trough is applied one or more metal bars which extend across the [illegible] and which are connected [illegible] the trough. The pulp in flowing through the trough is opposed in its passage by the magnetized bars and the iron particles are then separated.

454,558. Incandescent Electric Lamp. Thomas A. Edison, Menlo Park, N. J.

Between the leading in wires is sealed a third, which extends and is attached to the center of the carbon by electroplating thereto. The current is divided between the two limits of the carbon, thus causing the latter to be in multiple arc.

454,570. Walking Automaton. George R. Moore, Westford, Mass.

454,573. Electrical Pessary, Walter N. Sherman, Merced, Cal.

454,584. Switch-board for Telegraph Lines. Frank T. Viles, Hyde Park, and Nicholas Young, Boston, Mass.

454,598. Galvanic Battery. Philip Hathaway, New York, N. Y.

454,604. Electric Search Light. Gaston Sautter, Paris, France.

454,622. System of Electric Lighting. Nikola Tesla, New York, N. Y.

Claim seven reads:

"In a system of electric lighting, the combination, with a source of currents of enormous frequency of excessively high potential, of lighting devices, each consisting of a conducting body inclosed in a rarefied or exhausted receiver and connected by conductors directly or inductively with one of the terminals of said source, all parts of the conductors intermediate to the said source and the light giving body being insulated and protected to prevent the dissipation of the electric energy."

454,625. Electric Signal for Railway Trains. Francis P Lenahan, Wilkesbarre, Pa.

454,626. Electric Motor. Frank B. Rae, Detroit, Mich.

This invention provides for an automatic switch that shall operate to break the connection between the main line and the motor in the event of any interruption or variation of the circuit.

454,627. Electric Motor. Alexander B. Roney, Chicago, Ill.

This motor is a combination of two or more auxiliary motors placed upon arms at right angles to the driving shaft. These auxiliary motors are adapted to travel around the plane of a circle, and upon a circular field magnet by means of rubber wheels attached to the radial arms and bearing against said field magnet. The rate of speed is controlled by a network of levers, which thrust the auxiliary motors out or draw them toward the center, thus diminishing or increasing the speed.

454,630. Telegraphy. Benjamin C. Toye, Toronto, Canada.

454,643. Electric Signal-Receiving Instrument. George L. Foote, Brooklyn, N. Y.

454,650 Regulating Electric Lights and Power. Isaac Herzberg and Abram Herzberg, Philadelphia, Pa.

454,669. Electric Hose Coupling. Joseph B. Strauss, Cincinnati, Ohio.

454,671. Lightning Arrester. Elihu Thomson, Swampscott, Mass.

454,672. Lightning Arrester. Elihu Thomson, Lynn, Mass.

454,673. Lightning Arrester. Elihu Thomson, Swampscott, Mass.

454,698. Method of an Apparatus for Heating Bars by Electricity. Edwin E. Angell, Somerville, Mass.

In this mode a metallic bar or blank is inserted in a circuit, then another is inserted in parallel in the same circuit, side by side with the first blank, and then withdrawing one of said bars from said circuit, the other bar or blank remaining in circuit during such withdrawal.

454,717. Insulator for Marine Condensers. Peter Decker, Norwalk, Conn.

454,724. Galvanic Battery. Julius Emmner, Jr., Washington, D. C.

454,746. Electrical Fire Alarm Brunswick W. Leonard, Saybrook, Conn.

454,782. Lamp Cut-out and System. Elihu Thomson, Lynn, Mass.

We quote claim three:

"The combination with an incandescent electric lamp of an auxiliary normally idle wire or conductor extending into the vacuous or exhausted receiver, which contains the incandescing conductor of the lamp and connected outside of the lamp with the circuit thereof, and a cut out device for short-circuiting the lamp, operated by the passage of an abnormal current in said idle wire or conductor upon rupture of the filament or incandescing conductor."

454,794. Electric Connection. John H. Bickford, Salem, Mass.

454,815. Electric Light Hanger. George W. Smith, Union City, Ind.

454,816. Electric-Circuit Closer. John H. Ward, New York, N. Y.

454,818. Electrode for Secondary Batteries. Boyd Anderson, Texarkana, Tex.

454,832 Electro-Magnet Clutch. Erastus S. Bennett, Denver, Colo., Horace F. Parshall, Baltimore, Md.

In this device, electro-magnetic force or attraction is made to arrest motion having the function of a brake or to transmit motion, the power acting in each case without the interposition of friction.

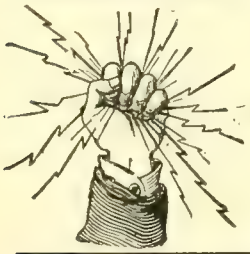
EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,



Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and **is guaranteed to be waterproof, and will not deteriorate, oxidize or crack,** and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS FANS

FOR ELECTRIC MOTORS.

MANUFACTURED BY

THE TURNER BRASS WORKS,

4 LaSalle Ave., Chicago.

Write us for prices.

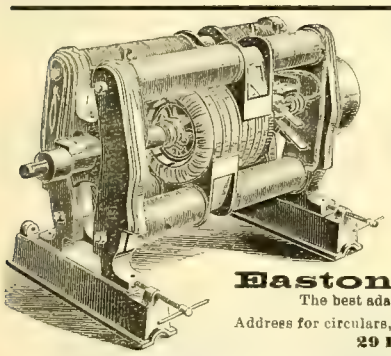
J. W. MASON,

DEALER IN

GENERAL ELECTRICAL SUPPLIES,

Poles, Pins, Brackets and Cross-Arms. Glass and Porcelain Insulators.

WRITE FOR QUOTATIONS. 527 Delaware Street, KANSAS CITY, MO.



THE EASTON ELECTRIC CO.

CAN SUPPLY

An Arc Light Plant complete for - $300
An Incandescent Light Plant complete for 200
A combined Arc and Incandescent Light Plant for - - - - - - - 400

MANUFACTURERS OF THE

EASTON UNIVERSAL ARC LAMP

(Adapted for any dynamo of any system)

AND OF THE

Easton X Arc Lamp,

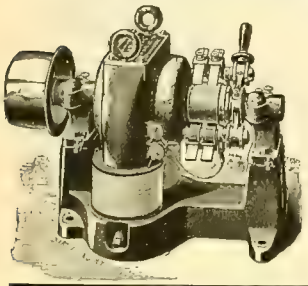
The best adapted for use in incandescent circuits.

Address for circulars, prices and information,

29 BROADWAY, NEW YORK CITY.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

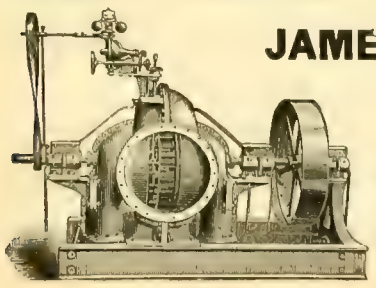
Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.



UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

Electric Billiard and Pool Table.

Patent Number 453,674.

The owner of the patent wishes to correspond with parties interested in electrical appliances with the view of putting the device in use.

Address, S. L. A., Care WESTERN ELECTRICIAN

WANTED.

A Specialty to Manufacture [illegible] preferred. [illegible] Machine Plant on easy [illegible]

C. C. PAIGE,

Eagle Iron Works. Oshkosh, Wis.

CHICAGO

The Electrical Construction Co.

U.S.A.

C. A. HARTER, Manager. Telephone, 1718.

FOR SALE.

Small Electric Plant. Complete outfit. Excellent Dynamo. Six H. P. Boiler, Steam Pump and Steam Damper, Regulator and Four 4 H.P. Engines. Capacity, 24 16 C. P. 110 Volt Lamps. Address

Box 902,

New Haven, Ct.

MICA.

I SELL NO OTHER.

Send for Samples and Prices.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

73-75 W. Jackson St.

RELIABLE

WE ARE FITTED WITH RELIABLE Machinery and Tools, And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N.Y.**

TRIPOD BOILER

Three Points of Superiority Guaranteed: **Safety, Economy, Low First Cost**

Repeated tests prove that it is absolutely **Non-Explosive** and the most **Durable** ever made.

Strong testimonials from hundreds of users, in all parts of the country.

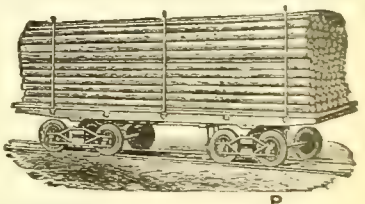
Sizes 10 to 1,000 H. P.

For full information address,

HAZELTON TRIPOD BOILER CO.

809 Monon Block., CHICAGO, ILL.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS POLES ARMS

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

STANDARD ELECTRICAL MEASURING INSTRUMENTS

FOR EXPERIMENTAL AND PRACTICAL WORK.

We make a great variety of Testing Instruments such as Ammeters, Voltmeters, Galvanometers, Resistance Boxes, Photometers—in fact everything that an electrician requires in making measurements of current, E. M. F., resistance, insulation, efficiency, etc.

Correspond with us before placing your orders, and send for our illustrated catalogue No. 1-66.

QUEEN & CO., PHILADELPHIA.

Bare and Insulated Wires.

(COPPER, IRON AND STEEL).

Supplies of Every Description

FOR ELECTRIC LIGHT, POWER, RAILWAY, TELEGRAPH AND TELEPHONE USE.

Quotations Cheerfully Furnished and Correspondence Solicited.

The Empire City Electric Company,

15 & 17 Dey Street, NEW YORK.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. Co.

No 180 MAIN St.
FITCHBURG, MASS, U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

ROSE POLYTECHNIC INSTITUTE.

TERRE HAUTE, INDIANA.—A SCHOOL OF ENGINEERING. Well endowed, well equipped departments of Civil, Mechanical and Electrical Engineering, Chemistry, Drawing. Extensive Shops and Laboratories. Expenses low. For catalogue address H. T. Eddy, Pres.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

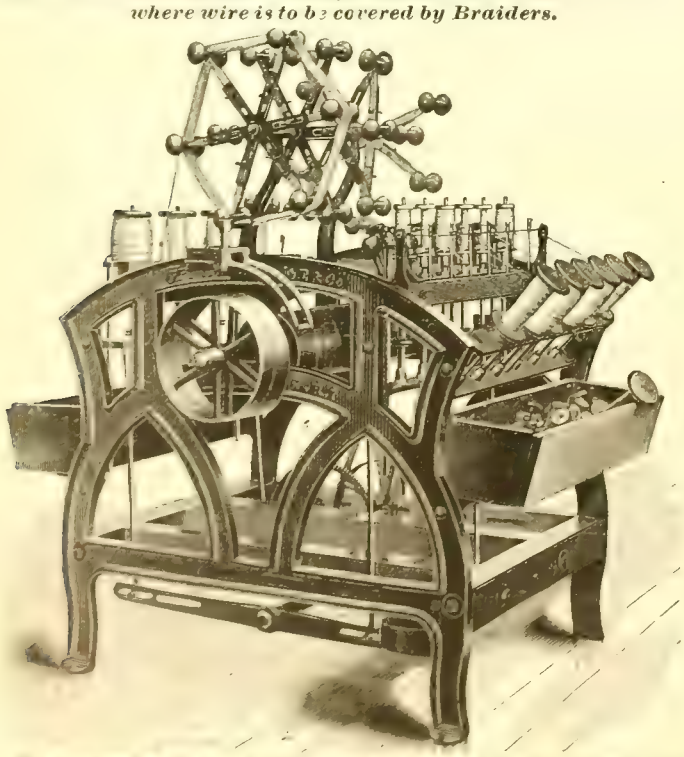
JAS. McLAUGHLIN, Mfg. Electrician,
50 N. Clinton St., Chicago.

GEORGE W. PAYNE & CO.,

MANUFACTURERS OF

BRAIDER SPOOLERS,

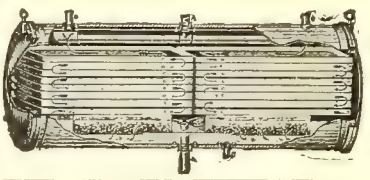
Used in connection with Braiding Machinery for Electrical Work where wire is to be covered by Braiders.



Machines built when required to double two or more ends, with drop motions to stop spindle when end breaks, also when bobbin is full.

Works 102 Broad St., PAWTUCKET, R. I.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

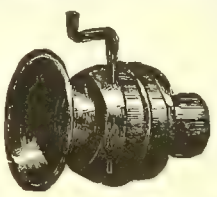
Experimental Work in Anything Electrical.

FREEMAN, COLEMAN & CO.,

53 and 55 South Jefferson Street, - - CHICAGO, ILL.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

Binders FOR THE Western Electrician $1.00.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

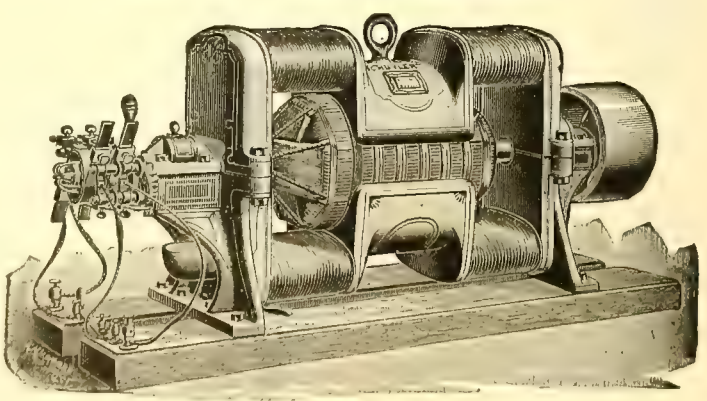
WILMINGTON, DEL.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

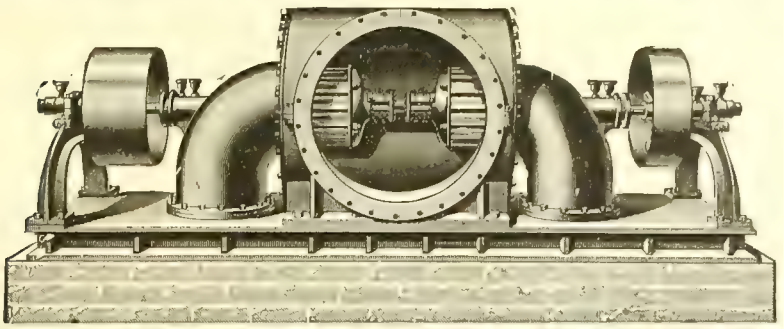
Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to the **CELEBRATED WATER WHEEL** on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** being **double** the **Power** of [illegible] number of the leading electric companies using [illegible] ical use of water it is without an [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with [illegible] Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO.
CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ALUMINUM

IN ALLOYS 75c. PER POUND.

Aluminum in alloys equal in purity to any on the market 75c. per pound for the contained Aluminum.

Cowles Pure Aluminum in ingots is offered as low as that of any American concern, quality guaranteed. The statement made by The Pittsburgh Reduction Company that customers buying Aluminum of us at less than $1.50 per pound are liable therefor is as silly as it is malicious. Aluminum is not a patented article, and therefore can be freely dealt in by all.

THE COWLES
Electric Smelting & Aluminum Co.,
LOCKPORT, N. Y.

HARRISON CONVEYOR
FOR HANDLING
Grain, Coal, Tan Bark, Seeds, Etc.

Will convey all kinds of grain without mixing. Will carry two different kinds of material in opposite directions at the same time.

Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illus. Catalog. **BORDEN & SELLECK CO., 48 and 50 Lake St., Chicago, Ill.**

J. C. TEMPLE,
(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,
Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,
Consulting and Constructing
ELECTRICAL AND MECHANICAL ENGINEERS.
Complete Equipment of Electric Railways. Steam and Electric Plants.
47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

PURE ALUMINUM
IN
Castings, Ingots, Sheets, Rods, and Wire.

ALUMINUM BRONZE
IN
Castings, Ingots, Sheets, Rods and Wire.
—SEND FOR PRICES.—

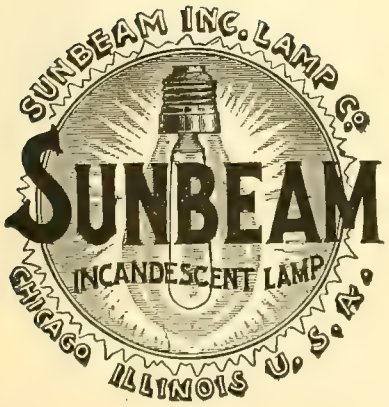
THE CLEVELAND ALUMINUM CO.,
Atwater Building, **CLEVELAND, O**

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.



Prompt Shipment.

First-Class Lamps.

Fit all Bases and Systems.

THE SUNBEAM INCANDESCENT LAMP CO.,
805 Chamber of Commerce Building, Chicago.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

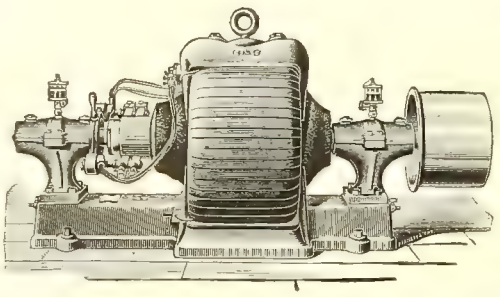
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS.

WIRES.

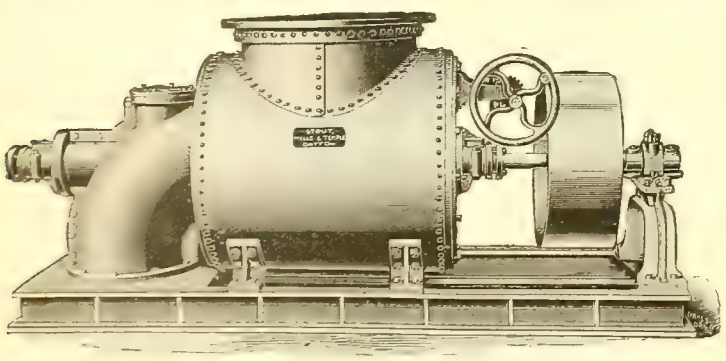
You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK.

G. H. MEEKER, Western Manager.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.

JOHN STEPHENSON CO.,

LIMITED,

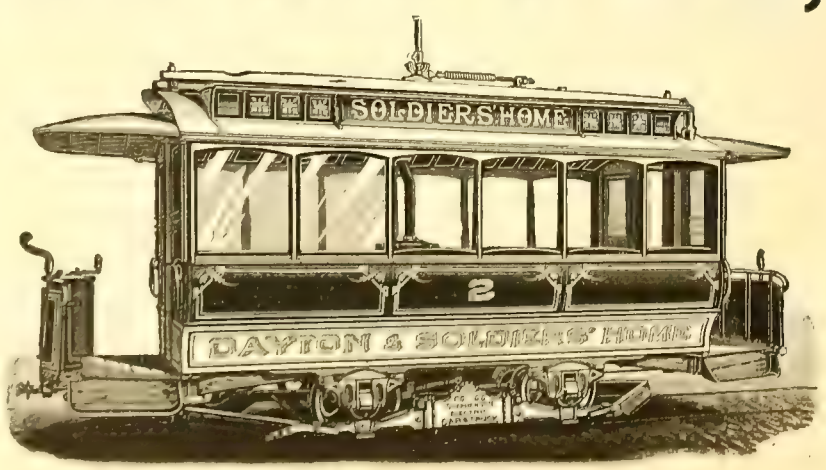
NEW YORK.

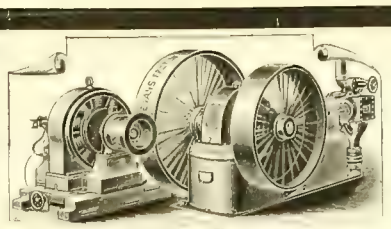
STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.



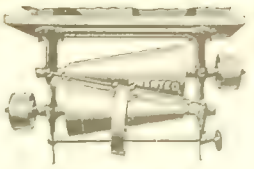


For Driving Dynamos.

The Bridgeport Electric Light Co., Bridgeport, Conn., have thoroughly tested and have adopted the Evans System of Driving Dynamos.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

JUNE, JULY AND AUGUST.

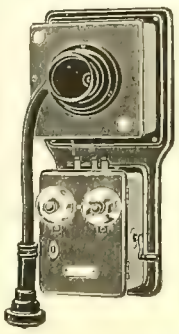
The most charming Summer Resorts, of which there are over three hundred choice locations, are to be found in Wisconsin, Iowa, Minnesota, South Dakota and the Peninsula of Michigan, along the lines of the Chicago, Milwaukee & St. Paul Ry. Nearly all are located near lakes which have not been fished out.

These resorts are easily reached by railway, and range in variety from "full dress for dinner" to the flannel shirt costume for every meal.

SEPTEMBER AND OCTOBER.

The finest shooting grounds in the Northwest are on and tributary to the lines of the Chicago, Milwaukee & St. Paul Ry. The crop of Prairie Chickens will be exceptionally good this year; also Ducks and Geese. In Northern Wisconsin and the Peninsula of Michigan splendid Deer shooting is to be had.

Full information furnished free. Address GEO. H. HEAFFORD, Gen. Pass. Agt., Chicago, Ill.



THE STANDARD

TELEPHONE!

Non-Electric, and only one Adjustable to Atmospheric Changes.

SOLD OUTRIGHT with "PEERLESS INSULATORS."

For Private Short Lines, For Connecting Factory and Office, Residence and Store, Stable, etc., etc.

Plainest Speaking! Superior to Others! Highly Recommended!

Intending purchasers will do well to investigate it before buying elsewhere.

THE BOSTWICK & BURGESS MFG. CO.,
NORWALK, OHIO, U. S. A.

ACTIVE MEN AND BUSINESS HOUSES can secure valuable territory in which to take orders and put up lines.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

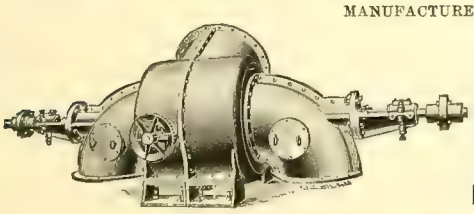
TURBINE WATER WHEELS,

Horizontal AND Vertical.

MANUFACTURED BY

RODNEY HUNT MACHINE COMPANY,

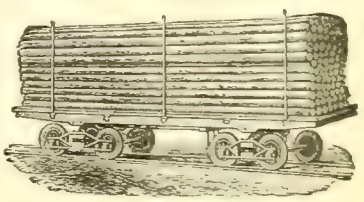
SPECIALTIES FOR ELECTRIC LIGHT AND POWER.



Double the power of most wheels. **High speed. Belting** directly to dynamo. **Efficiency,** .9050. Holyoke Testing Flume. **Easy working gate. Even speed.** Excellent workmanship, great durability. **Moderate prices** and satisfaction in every respect guaranteed. 1,800 wheels sold in New England. One party has 87 of these wheels in use; another 6,800 h. p.; another 7,200 h. p., etc., etc. Large number of wheels furnished for Electric Lighting. All giving perfect satisfaction. Write for catalogue and estimates on proposed plants.

Boston Office, 70 Kilby St. Main Office and Works, ORANGE, MASS., U. S. A.

CEDAR POLES.



If in want of Poles, save money by getting my prices.

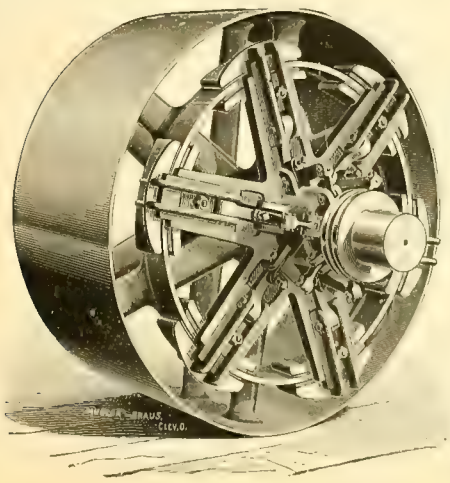
W. C. STERLING,
Monroe, Mich.

THREE GOOD BOOKS.

DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO, ILL.

ONE DOLLAR EACH.



HILL

Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: MINNEAPOLIS:
28 So. Canal St. 305 Kasota Building.

KANSAS CITY:
1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY CO.,

823 Locust St., ST. LOUIS, MO.,

Okonite Wires AND **Cables.**

AGENTS FOR THE CELEBRATED PACKARD LAMP.

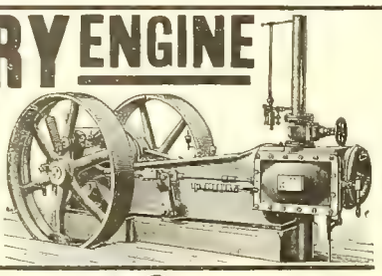
Made to Fit any Socket.

We also have a full stock of Sockets made to fit any Lamp.

SEND US A TRIAL ORDER.

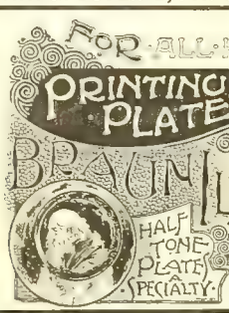
THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC HIGH SPEED STEAM ENGINE for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE.
Catalogues sent on application.



STEARNS MANFG. CO. ERIE, PA.

FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO.



HALF TONE PLATES A SPECIALTY.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,

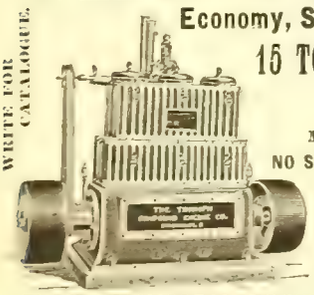
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

THE TRIUMPH

Economy, Simplicity, Durability, Silence.

WRITE FOR CATALOGUE.



15 TO 300 HORSE-POWER.

COMPOUND AND VALVELESS.

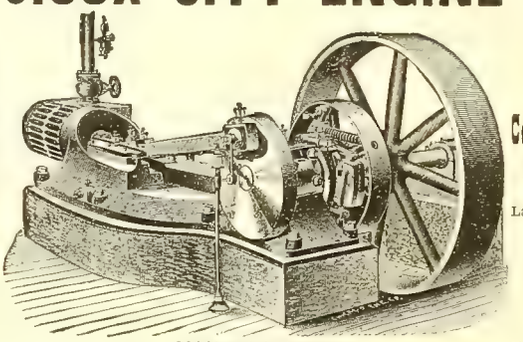
Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.
NO ECCENTRICS. NO STUFFING BOXES.
NO PISTON RODS.
INTERNAL FRICTION A MINIMUM.
ALL PARTS INTERCHANGEABLE.

The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO., SOLE BUILDERS,
211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.
FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

SIOUX CITY ENGINE WORKS.



Giddings' Automatic.

Builders of High Grade
AUTOMATIC ENGINES
from 30 to 500 H. P.
OF BOTH THE
Corliss and Giddings' Types.
Boilers and complete Steam Plants erected. Send for circulars and estimates.

Largest Engine Works west of the Mississippi River at
SIOUX CITY, IOWA.

S. K. GREGG,
Manager Chicago Office,
48 S. Canal St.

C. S. LEWIS, Agent,
708 Market St., St. Louis, Mo.

REMEMBER That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

WESTINGHOUSE ENGINES

USED BY THE FOLLOWING GOVERNMENTS.

UNITED STATES.

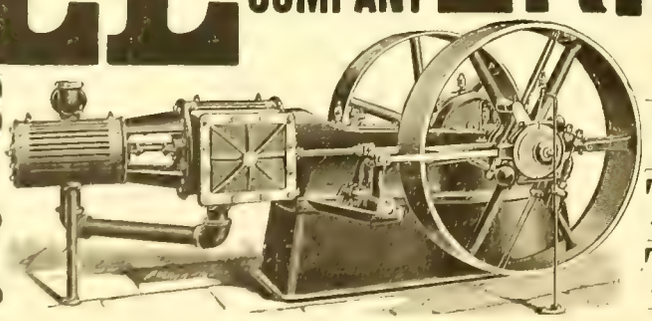
U. S. Torpedo Station, Newport, R. I., 43 H. P.
U. S. Army Department, San Antonio, Tex., 50 H. P.
U. S. Engineer Corps, St. Louis, Mo., 8 H. P.
U. S. Military Post, Fort Canby, Wash., 4 H. P.
U. S. Government Quartermaster Department, Vancouver, Wash., 62 H.P.
U. S. Government Quartermaster Department, New Orleans, La., 15 H. P.
U. S. Senate, Washington, D. C., 150 H. P.
U. S. House of Representatives, Washington, D. C., 75 H. P.
U. S. Government Ice Factory, San Antonio, Tex., 4 H. P.
U. S. Navy Yard, Norfolk, Va., 125 H. P.
U. S. Navy Yard, Brooklyn, N. Y., 125 H. P.
U. S. Government, Ellis Island, N. Y., 120 H. P.
U. S. Dispatch Boat "Lucerne," Norfolk, Va., 50 H. P.
Washington Monument, Washington, D. C., 25 H. P.
MEXICAN: State of Guerrero, 15 H. P.
JAPANESE: In Government Coal Mines, 150 H. P.
HOLLAND: Government Physical Laboratory of Leiden, 15 H. P.
RUSSIAN: Moscow Imperial Technical School, 10 H. P.
NEW SOUTH WALES: Government of New South Wales, 160 H. P.
TASMANIAN: Alexandria Battery, Hobart, 75 H. P.
ENGLISH: Number unknown. Details not reported. Over 30 engines.

Many others sold by agents, but not reported.

THE WESTINGHOUSE MACHINE COMPANY.
EXCELSIOR AGENT PITTSBURGH, PENNA. U.S. OF A.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE



Standard.
Cross Compound.
Triple Expansion.
Tandem Compound

ENGINES for ELECTRIC RAILWAY and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

SELLING AGENTS: E. T. COPELAND & CO., 106 Liberty St., NEW YORK; J. W. PARKER, 38 So. Fourth St., Philadelphia, Pa.; COOLEY & VATER, 224 Washington Ave. Minneapolis, Minn., W. B. PEARSON, Room 403 Home Insurance Bldg., Chicago, Ill.; DARVO & BLACK, 804 Lewis Block, PITTSBURG, PA.

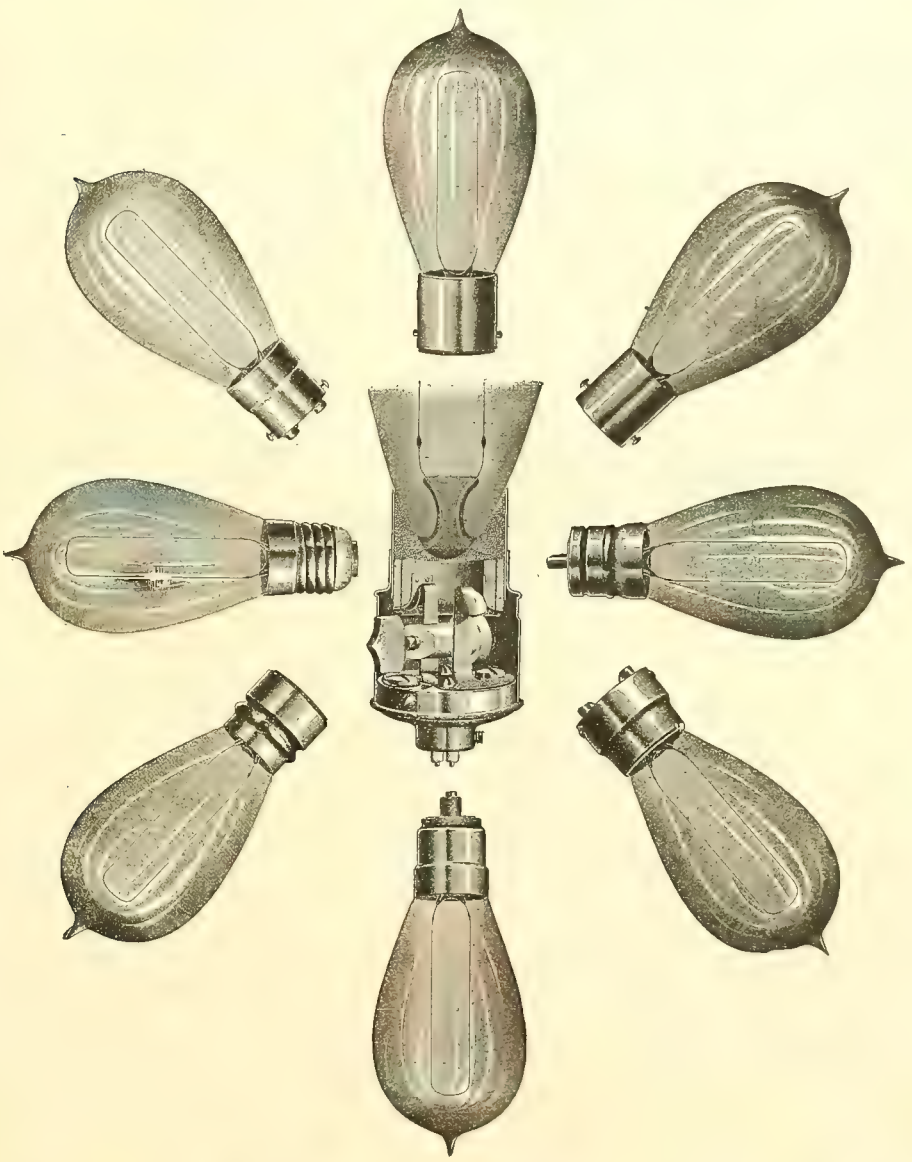
THE KNAPP ELECTRICAL WORKS,

General Western Agents for

THE PERKINS ELECTRIC LAMP CO.

HIGH EFFICIENCY.

ANY VOLTAGE.



ANY CANDLE POWER.

LONGEST LIFE.

S-A-F-E-T-Y

WIRES, CABLES AND CORDS FOR INSIDE, UNDERGROUND AND SUBMARINE USE.

MANUFACTURERS OF

Street Railway, Electric Light, Telephone, Telegraph and Electrical House Goods.

PROMPT SHIPMENTS. LOWEST PRICES.

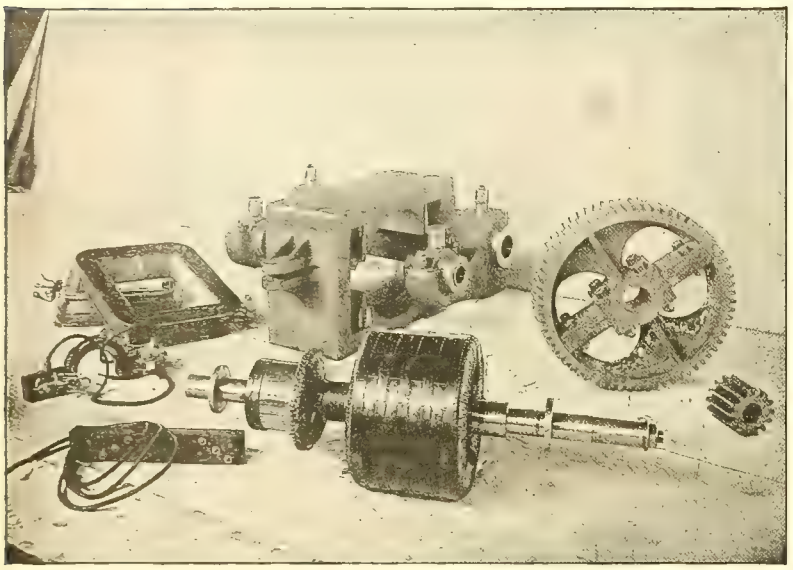
54 AND 56 FRANKLIN STREET, CHICAGO.

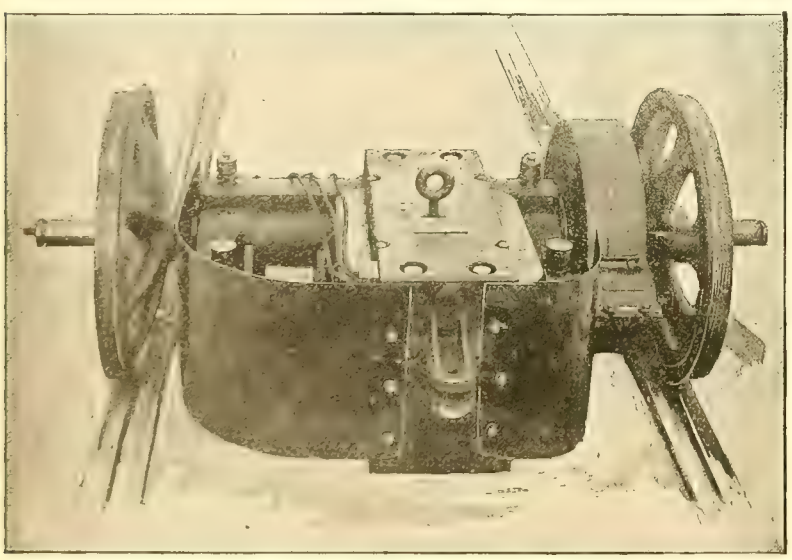
SEND FOR CATALOGUE.

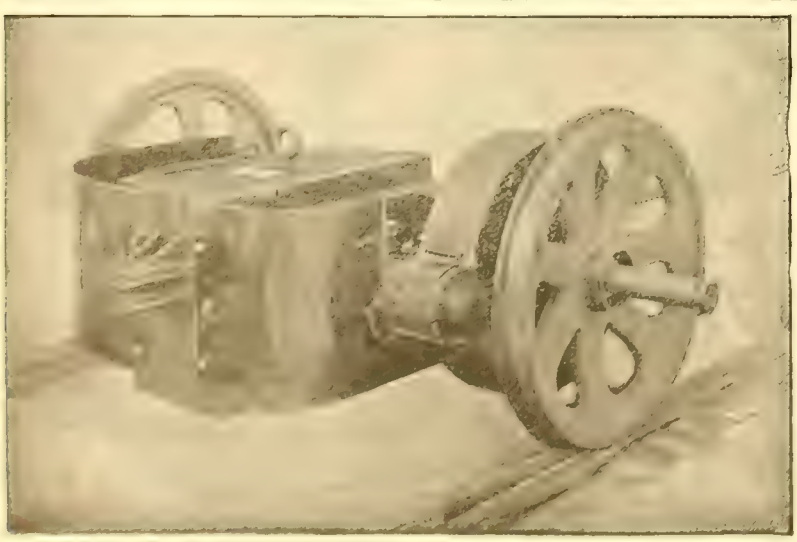
A MARVELOUS INNOVATION

THE THOMSON-HOUSTON ELECTRIC COMPANY

Has Revolutionized the Electrical Equipment of Street Railways.







The Intermediate Shaft, Pinion and Gear have been discarded.

The Armature Pinion and Axle Gear are now enclosed in a dust-proof case filled with oil.

Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

The construction of the Armature avoids the possibility of a burn-out, except by malicious carelessness, and when damaged, can be readily repaired by a novice.

Don't make a mistake by contracting for Railway Equipment before seeing or understanding this marvelous machine.

Prices for Repairs, Parts and Supplies materially reduced.

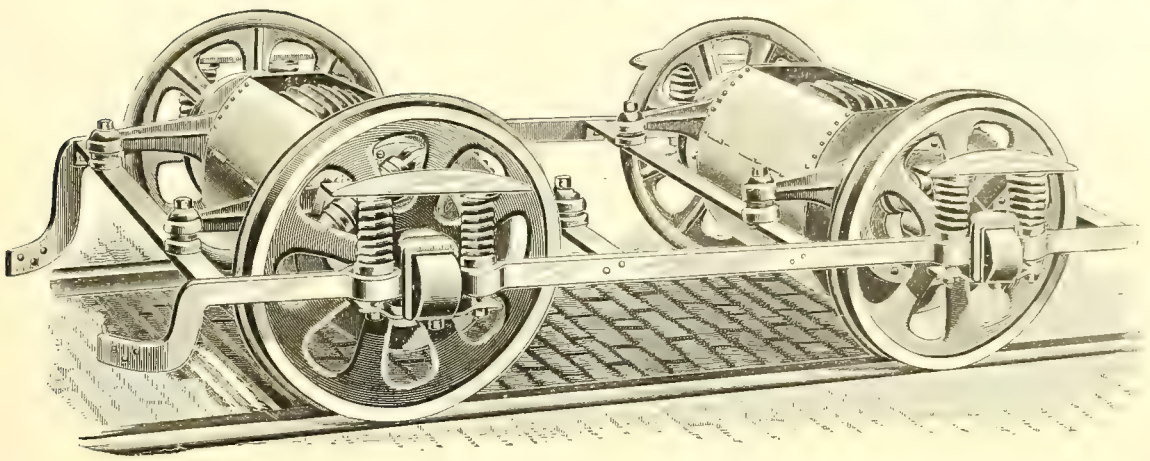
Information, Prices and Literature furnished on application.

Thomson-Houston Electric Co.

CHICAGO OFFICE:
148 Michigan Avenue.

BOSTON OFFICE:
620 Atlantic Avenue.

NO GEARS.
NO NOISE.
NO REPAIRS.



We have ELIMINATED from the street railway motor

ALL gears and pinions.
ALL armature and intermediate shafts.
ALL brass bearings, except the axle brasses.
ALL oil cups.
ALL box caps.
ALL useless nuts and bolts.
ALL mud and dust pans.
ALL dust curtains.
ALL hanger bars and bolts.

The motor is supported entirely upon springs, thus preventing the hammer blow, which flattens rail joints and loosens fish plates.

IT WILL SAVE YOUR TRACKS.

The speed of the motor armature has been reduced from 1,000 to 100 revolutions per minute, and the weight of the motor is not increased.

The Short Electric Railway Co.,

CLEVELAND, OHIO.

THE ELECTRICAL SUPPLY CO.
171 RANDOLPH ST.
102-104 Michigan Avenue, CHICAGO.
FACTORIES:
Ansonia, Conn.

"AND DID THAT EVER OCCUR TO YOU?"

The superintendent of a United Electric Light and Gas Co. was much annoyed on account of the gathering of moisture in his gas pipes, causing partial, and at times entire, stoppage of gas flow. One day one of his electric light customers complained, through the telephone, that his lights wouldn't work. The superintendent replied, "Better get a plumber; your wires must be full of water."

SHIELD BRAND MOISTURE-PROOF

—WIRE—

Belongs to the Blue Ribbon Brigade, and is Warranted Not to GET FULL.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM,

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS
WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

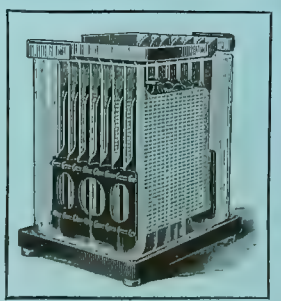
SLOW SPEED **STATIONARY MOTORS** For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

FACTORIES AND GENERAL OFFICES. BALTIMORE, MD.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
Central Station and Isolated Lighting.
Portable Lighting or Power.
Portable Electric Lanterns.
Electric Power for Motors.
Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR COMPANY,

224 and 226 Chestnut Street, Philadelphia, Pa.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 and 226 Chestnut St.
NEW YORK:—TRUEX & VAIL, 44 Broadway. CHICAGO:—WM. HOOD, 239 La Salle St.
SAN FRANCISCO:—THE PACIFIC ELECTRICAL STORAGE CO., 118 and 120 Pine St.
BOSTON:—THE HOLTZER-CABOT ELECTRIC CO., 111 Arch St.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, JULY 11, 1891. No. 2

STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE.

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes
Telephonic transmission through Our Cable an easy
CAME.

An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices. Standard Underground Cable Co., New York, Pittsburgh, Chicago.

Nuttall Trolley. Patents Pending.

THE BEST!

$30.00

WRITE US.

Electric Railway Specialty COMPANY,

29 Broadway, NEW YORK.

KELLOGG

COMBINATION STEEL CENTER AND SIDE

POLES.

ENGINEERING EQUIPMENT CO.,

SOLE AGENTS,

NEW YORK, 143 Liberty St.

BOSTON, 126 Pearl St.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.

F. CAZENOVE JONES, Manager of Factories.

The International **OKONITE COMPANY,** LIMITED.

13 Park Row, New York.

OKONITE TRADE MARK

INSULATED

WIRES AND CABLES,

For Aerial, Submarine and Underground Use.

Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

New York & Ohio Company WARREN, OHIO.

MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP

AGENTS

J. W. PEALE, 1 BROADWAY, NEW YORK
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

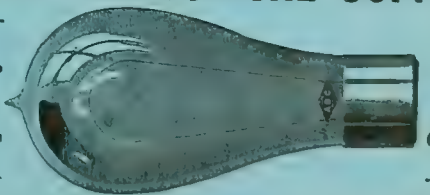
ALEXANDER, BARNEY & CHAPIN,

20 CORTLANDT ST., NEW YORK.

GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,

"A.B.C."



WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

5 and 7 Dey Street, NEW YORK,

MANUFACTURERS AND IMPORTERS OF AND DEALERS IN

ELECTRICAL SUPPLIES

OF ALL DESCRIPTION.

Telegraph, Telephone, Electric Light, Power and Railway Appliances, Construction Tools, and Line Material.

Standard Electrical Measurement Apparatus.

TEST INSTRUMENTS A SPECIALTY.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS

—FOR—

ARC-LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

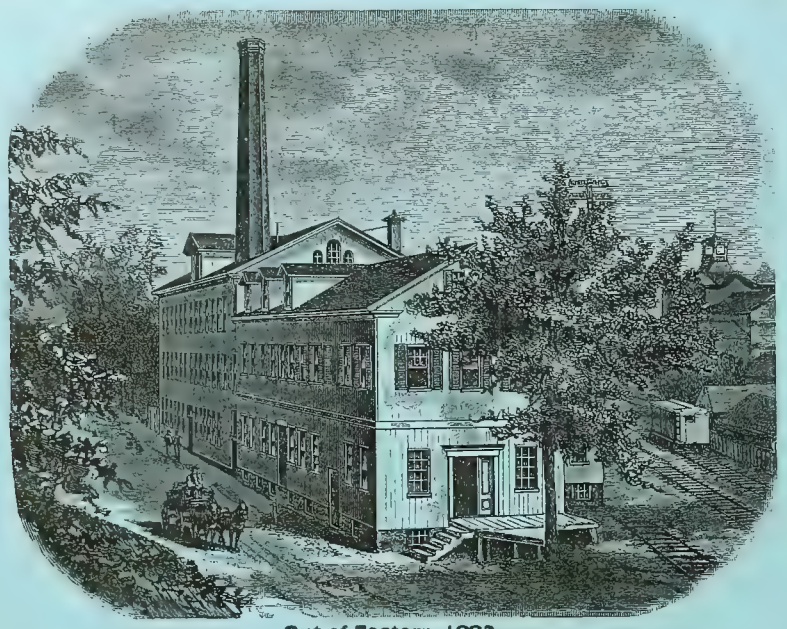
620 ATLANTIC AVENUE,

BOSTON, - MASS.

IS THE

THOMSON-HOUSTON ELECTRIC CO.'S

SYSTEM OF LIGHTING A SUCCESS?



Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, 1,653 Lamps.	None.	None.

Cut of Factory, 1888.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, 21,840 Lamps.	29 Companies, 11,275 Lamps.	None.

Read the Answer on Page xxii.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....——
Abendroth & Root Mfg. Co.....xv
Alexander, Barney & Chapin..i, ix
American Electrical Works.....xv
Automatic Switch Co.....ix
Andrews & Co., A. H.....xvi
Baggot, E.....xvi
Bain Electric Mfg. Co.....xii
Ball Engine Co.....xvi
Baxter Electric Motor Co.....xxvi
Bernstein Electric Co.....i
Blatz, L.....xv
Borden & Selleck Co.....xvii
Bostwick & Burgess Mfg. Co...xix
Braun Illustrating Co.....xx
Brownlee & Co.....xiv
Brookfield, Wm.....xiv
Brush Electric Co.....xxv
Buckeye Electric Co.....——
Butler Hard Rubber Co.....x
C. B. & Q. R. R.....xvi
C. & C. Electric Motor Co...xviii
Card Electric Motor & Dynamo Co.....xx
Central Electric Co.....vii
Chicago Electric Mfg. Co.....xvi
Chicago Insulated Wire Co.....xix
Cleverly Electrical Works.....iv
Colburn & Co., I. W.....xvi
Coolidge, Fuel & Supply Co....xix
Cowles Electric Smelting and AluminumCo.....xvii
Crocker-Wheeler Electric Motor Co.....xv
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co.xviii
Eastern Electric Cable Co.....xv
Easton Electric Co.....xv
Edison General Electric Co.,—Motor Dept.....viii
Edison General Electric Co., Wire Department.....ix
Electric Merchandise Co.....ix
Electric Railway Specialty Co.....i
Electric Construction & Sup. Co..x
Electrician Pub. Co.vi, xii, xvi, xix
Electrical Construction Co., The. xv
Electrical Engineering Co.....xv
Electrical Supply Co., The...xxiv
Elektron Mfg. Co.....xii
Empire City Electric Co.....xvi
Empire China Works.....xvi
Engineering Equipment Co.....i
Evans Friction Cone Co.....xix
For Sale.....xv
Fort Wayne Electric Co.....xxvi
Freeman, Coleman & Co.....——
Globe Carbon Co.....xvii
Greeley & Co., The E. S.....i
Hawkeye Electric Mfg. Co.....iv
Hay-Horn Mfg. Co.....xvi
Hazelton Tripod Boiler Co.....xv
Heisler Electric Light Co.....xix
Hill Clutch Works.....——
Hine Elimnator Co.....xiv
Holmes, C. H.....xv
Holmes, Booth & Haydens.....iv
Holtzer-Cabot Electric Co.....i
Hood, Wm.....xii
Hunt Machine Co.,Rodney.....——
India Rubber & Gutta Percha Insulating Co.....——
Interior Conduit &Insulation Co..xiv
International Okonite Co.....i
Kartavert Mfg. Co.....xiv
Knapp Electrical Works.....xxi
Leffel & Co., Jas.....xv
Loud, H. M. & Sons Lumber Co.....xvi
McLaughlin, James.....xvi
Mason, James H.....xv
Mason, J. W.....xv
Milliken Bros.....iv
Minneapolis Street Railway Co.....v
Monitor Electric Co.....xii
Munsell & Co., Eugene.....xv
Murphy, T. J.....xvi
National Carbon Co.....iv
National Electric Mfg. Co.....xi
N.Y.Belting & Packing Co.....xiv
New York Insulated Wire Co..xviii
New York & Ohio Co.....i
Northwestern Electrical Specialty Co.....iv
Ostrander & Co., W. R.....xvi
Paiste, H. T.....xiv
Page Belting Co.....——
Partrick & Carter Co.....xii
Payne & Co., Geo. W.....——
Pearson & Co., W. B.....i
Phoenix Glass Co.....——
Pond Engineering Co.....xx
Powell Co., Wm.....——
Queen & Co.....xv
Roeblings' Sons Co., Jno. A.....——
Rose Polytechnic Institute.....——
Sawyer-Man Electric Co.....xiii
Schieren & Co. Chas. A.....xiv
Schoonmaker, A. O.....xv
Schuyler Electric Co.....xxvi
Short Electric Railway Co.xiv, xxiii
Shultz Belting Co.....xx
Sioux City Engine Works.....xx
Southern Electrical Supply Co..xx
Standard Underground Cable Co....i
Stanley & Hall.....——
Standard Paint Co.....xiv
Stanley Electric Mfg. Co.....——
Star Iron Tower Co.....xix
Stearns Mfg. Co.....xx
Stephenson Co., Jno.....xviii
Sterling, W. C.....xvii
Stilwell & Bierce Mfg. Co..xvi, xvii
Sunbeam Incand. Lamp Co....xvii
Taussig, S.....xiv, xvi
Temple, J. C.....xvii
Thomson-Houston Electric Co. Lighting Department.....ii, xxii
Triumph Comp'd Engine Co.....xx
Turner Brass Works.....xv
Union Electrical Works.....xv
Union Hardware Co.....xiv
United States Electric Lighting Co.....——
Van Nuis C. S.....——
Vulcanized Fibre Co.....xvii
Wanted.....xv
Western Electric Co.....x
Westinghouse Electric and Mfg. Co.....xiii
Westinghouse Machine Co.....xx
Weston Electrical Instrument Co.....——
Woodbridge & Turner Engineering Co.....xvii
Worthington, Henry R.....——

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Stanley & Hall.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co.,The.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Stanley & Hall.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Stanley & Hall.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co.,The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
McLaughlin, Jas.
Temple, J. C.
Union Electrical Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Brush Electric Co.
Chicago Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Engineering Equipment Co.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Monitor Electric Co.
Southern Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Southern Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Colburn & Co., I. W.
Easton Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.
Union Electrical Works.

Electric Railways.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sioux City Engine Works.
Stearns Mfg. Co.
Triumph Compound Engine Co.
Westinghouse Machine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Easton Electric Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Stanley & Hall.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Butler Hard Rubber Co.
Central Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Empire City Electric Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Monitor Electric Co.
New York and Ohio Co
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica
Munsell & Co., Eugene.
[illegible]

Mining Apparatus, Electric.
[illegible]

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Standard Electrical Works.
Southern Electrical Supply Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electrical Supply Co., The.
Empire City Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Telephones, Non-Electric.
Bostwick & Burgess Mfg. Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Stanley Electric Mfg. Co.

Trucks, Electric Car
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.
Roebling's Sons Co., Jno. A.

THE NATIONAL CARBON CO

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

Cleverly
1018 CHESTNUT ST.
PHILA.

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

REMEMBER

That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY **MILLIKEN BROS.**

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K. K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

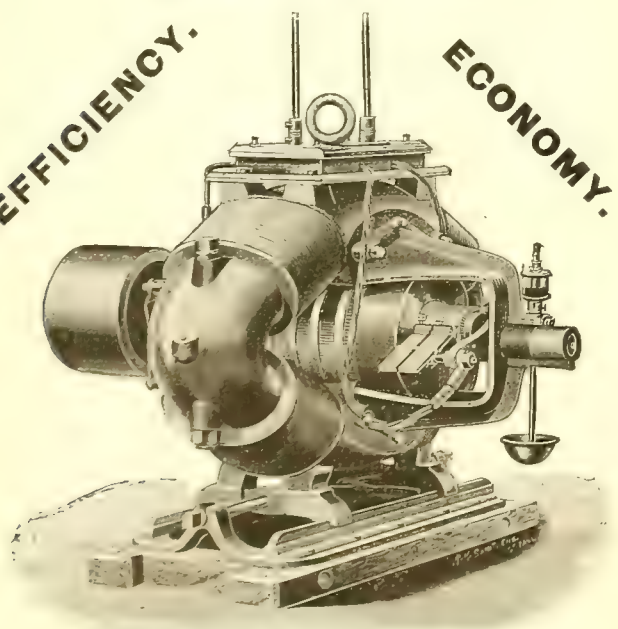
THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

THE HAWKEYE ELECTRIC MFG. CO.,

DAVENPORT, IOWA.

EFFICIENCY. ECONOMY.



Thone Improved Electric Machine for Light and Power.

Complete Central Station and Isolated Plants of Highest Efficiency at Lowest Cost.

ELECTRIC MOTORS

ANY VOLTAGE OR SIZE.

Reliable Agents Wanted. Correspondence Solicited.
Estimates Promptly Furnished.

2 MONTHS AGO

THE

ECONOMIC INCANDESCENT LAMP

Was practically unknown in the West. It is now in general use in 100 CITIES AND TOWNS west of and including Ohio.

POSITIVELY THE BEST LAMP FOR THE LEAST MONEY.

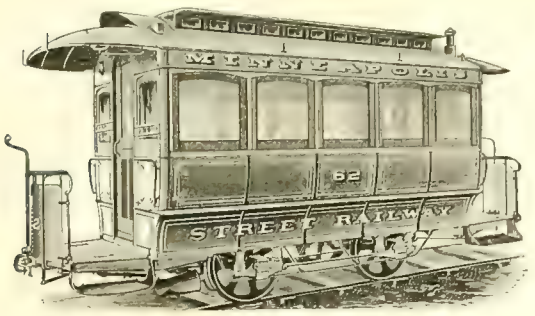
Further information cheerfully given by the

Northwestern Electrical Specialty Co.,

GENERAL WESTERN AGENTS,

1017 Chamber of Commerce, Chicago.

CEO. L. KIRKHAM,
MANAGER.



STREET CARS

FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

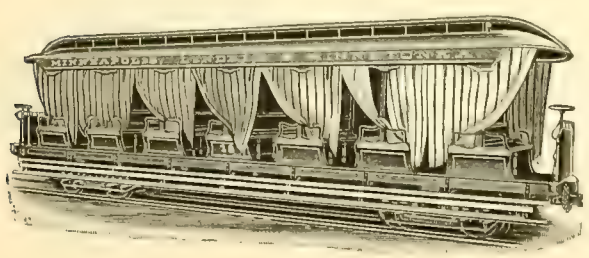
MINNEAPOLIS STREET RAILWAY CO.,

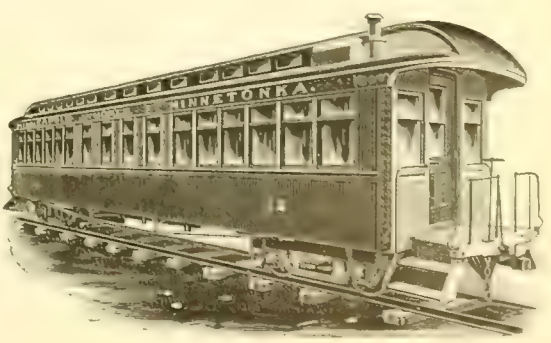
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





A NEW BOOK!

READY JULY 15.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

READY JULY 15. PRICE, $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

Our St. Louis Branch:
Southern Electrical Supply Co.,

OKONITE
TRADE MARK.

823 Locust St.,
ST. LOUIS, MO.

HEADQUARTERS

FOR ALL KINDS OF

Our Kansas City Branch:
Gate City Electric Company,

OKONITE
TRADE MARK.

522 Delaware St.,
KANSAS CITY, MO.

ELECTRICAL SUPPLIES

Besides being General Western Agents for

OKONITE

AND

Improved Candee Weather-proof Wires.
Bryant Switches.
Bryant Sockets.
Packard High Grade Incandescent Lamps.
Commercial Fire-proof Lamp Cord.

WE CARRY A FULL LINE OF

Railway Supplies, *Electrical House Goods,*
Electro-Medical Apparatus, *Etc., Etc., Etc.*

Our Omaha Branch:
Western Electrical Supply Co.,

OKONITE
TRADE MARK.

418 S. 15th St.,
OMAHA, NEB.

CENTRAL ELECTRIC COMPANY,
116 & 118 Franklin Street,
CHICAGO.

Connected by Private Wire with Postal Telegraph-Cable Company's System.

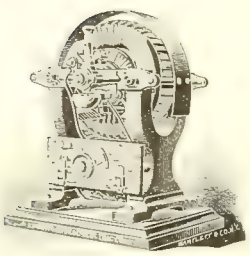
Our Denver Branch:
Electric Power Transmission Co.,

OKONITE
TRADE MARK.

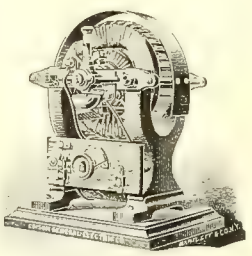
1722 Lawrence St.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.



NEW



ELECTRIC MOTORS.

MINIMUM OF ATTENTION AND REPAIR.

Highest Efficiency,
Slow Speed,
No Sparking.

H. P.	LIST PRICES.	PRICES TO USERS, 45 PER CENT. OFF LIST.
1-12	$ 40	$22.00
1-6	60	33.00
1-3	100	55.00
1-2	125	78.75

Independent Coils,
Improved Lubrication,
Mechanically Perfect.

SEND FOR DESCRIPTIVE CIRCULAR TO NEAREST DISTRICT OFFICE.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BUILDING, 20 Cortlandt St., NEW YORK.

VOLTMETERS. TRADE A.B.C. MARK AMMETERS.

ELECTRICAL SUPPLIES. | ARC AND INCANDESCENT LAMPS.

DYNAMO REGULATORS and RHEOSTATS
Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,
Both Hand and Automatic, of Superior Design and Construction.
Entire attention devoted to the manufacture and wiring of Rheostats.

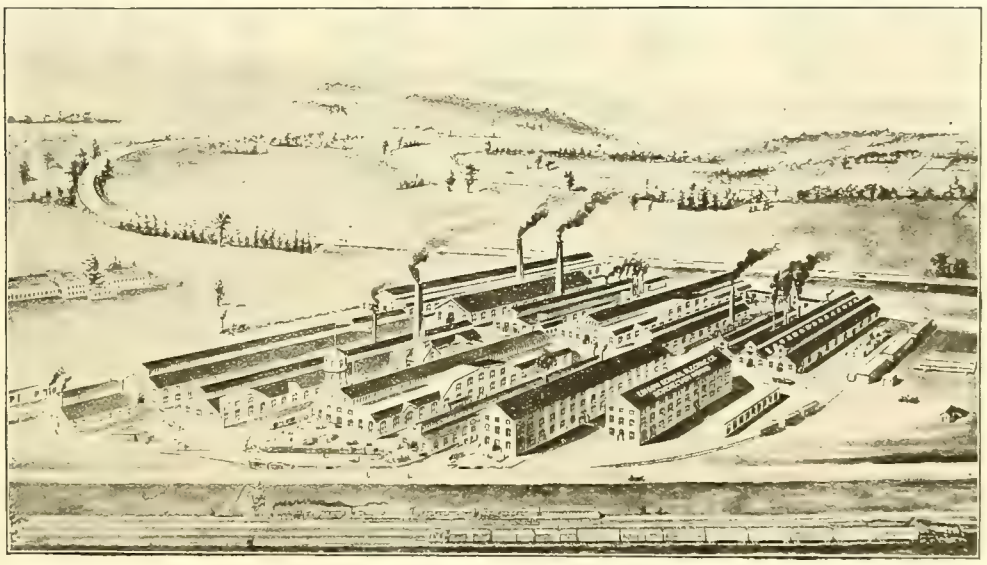
AUTOMATIC SWITCH COMPANY,
SOLE MANUFACTURERS OF THE
Whittingham Automatic Switch,
No. 8 Keyser Building,
BALTIMORE, MARYLAND.
SEND FOR CATALOGUE AND PRICE LIST.

ELECTRIC RAILWAY SUPPLIES
For All Systems.
EXCLUSIVELY.
SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,
11 ADAMS STREET, CHICAGO.
W. R. MASON, General Manager.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,
BY
The Edison General Electric Company,
AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

To Electric Railway Companies:

We shall be pleased to make you quotations on Washburn & Moen's hard drawn copper trolley wire, and our own make of Weatherproof insulation feeder wires. Our Weatherproof wire is superior to any other wire of like character in the market.

WESTERN ELECTRIC COMPANY, CHICAGO. NEW YORK.

"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

We Guarantee our Lamps Electrically and Mechanically.

In corresponding please give full particulars and state voltage.

Electric Construction and Supply Co.,

Phenix Building, CHICAGO, ILL.

Established 1881.

18 Cortlandt Street, NEW YORK CITY.

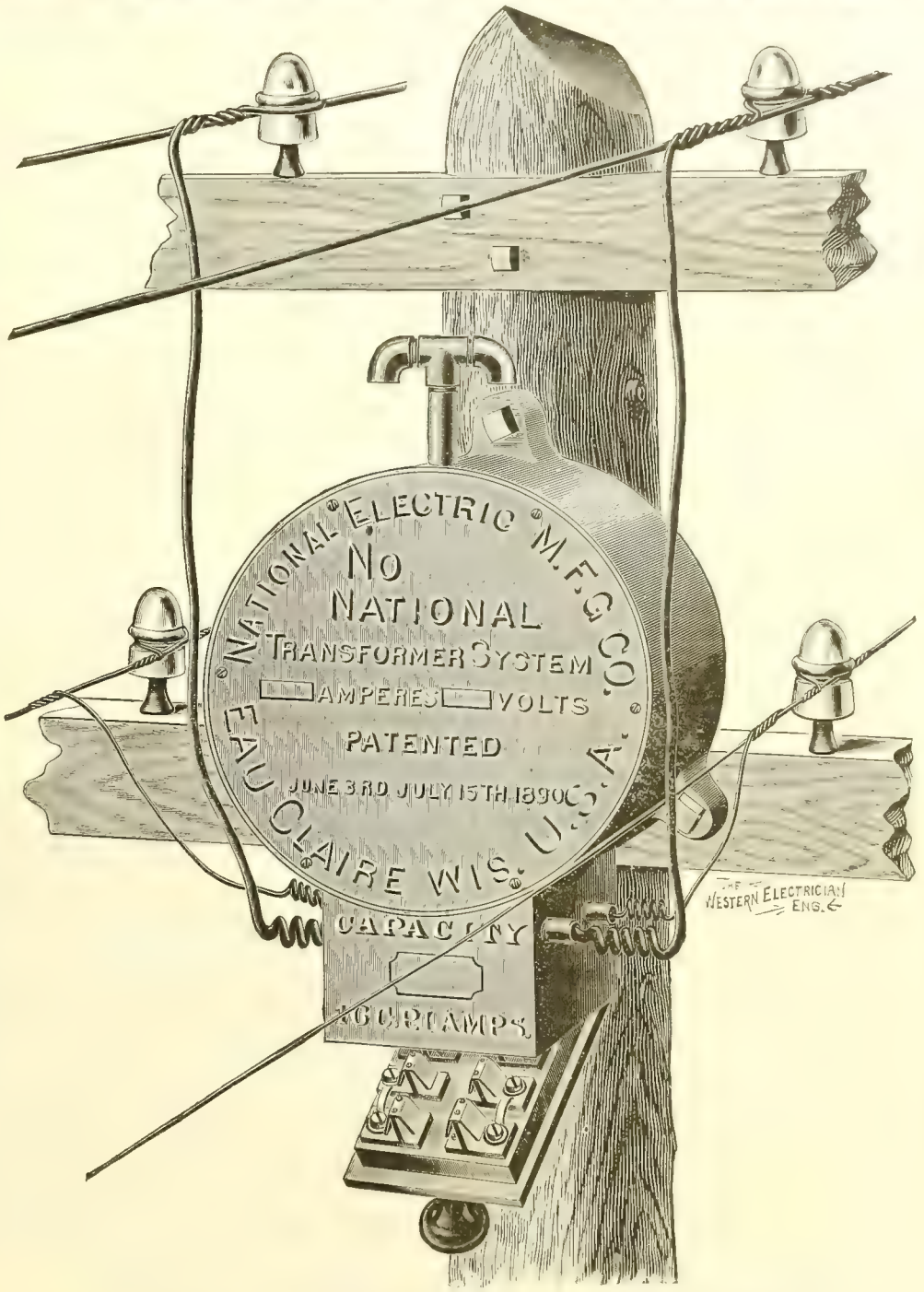
THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.

CONVERTER EFFICIENCIES.

It Will PAY YOU to throw out your present transformers and substitute OUR MAKE.

No more Accidents from Grounded Circuits.



Transformer on Pole Showing National Safety Fuse Box.

No more Burnt Fingers or Melted Screw Drivers.

They are the most efficient, 95.2%. They are absolutely safe. Their regulation is practically perfect.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

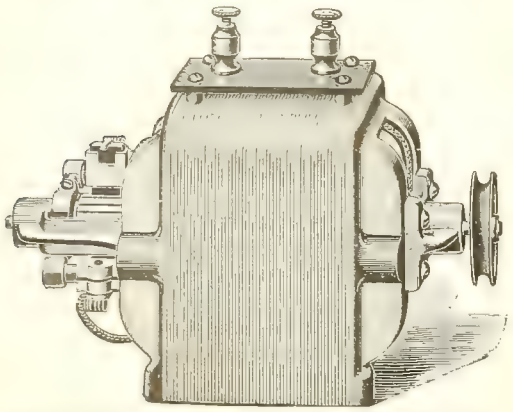
NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS.

GEO. B. SHAW, Gen'l Manager.

AGENTS:

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.
SAN FRANCISCO, CAL.,	National Electric Development Co.
KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
DETROIT, MICH.,	Commercial Electric Co.
DENVER, COLO.,	The Mountain Electric Co.
WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

MOONLIGHT SCHEDULE FOR 1891

IN THE NEW EDITION OF THE

Dynamo-Tenders' Hand-Book.

NOW READY. PRICE $1. SEND FOR IT.

ELECTRICIAN PUBLISHING COMPANY,

6 LAKESIDE BLDG.,

CHICAGO.

WONDERFUL!

WHAT?

The New Incandescent Lamp,

"THE JEWEL."

FOR ANY VOLTAGE. FOR ANY SOCKET.

For particulars apply to

WM. HOOD,

GENERAL AGENT,

239 LaSalle St., - CHICAGO.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1870.)

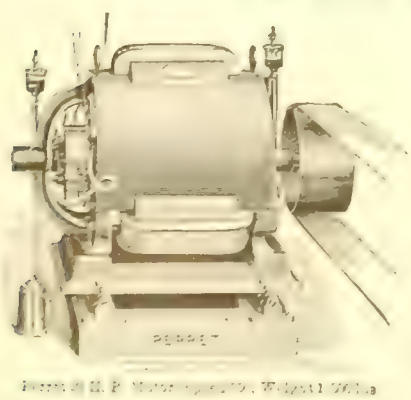
ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

—MANUFACTURERS OF—



Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. *Factories equipped throughout with Electric Power*
Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

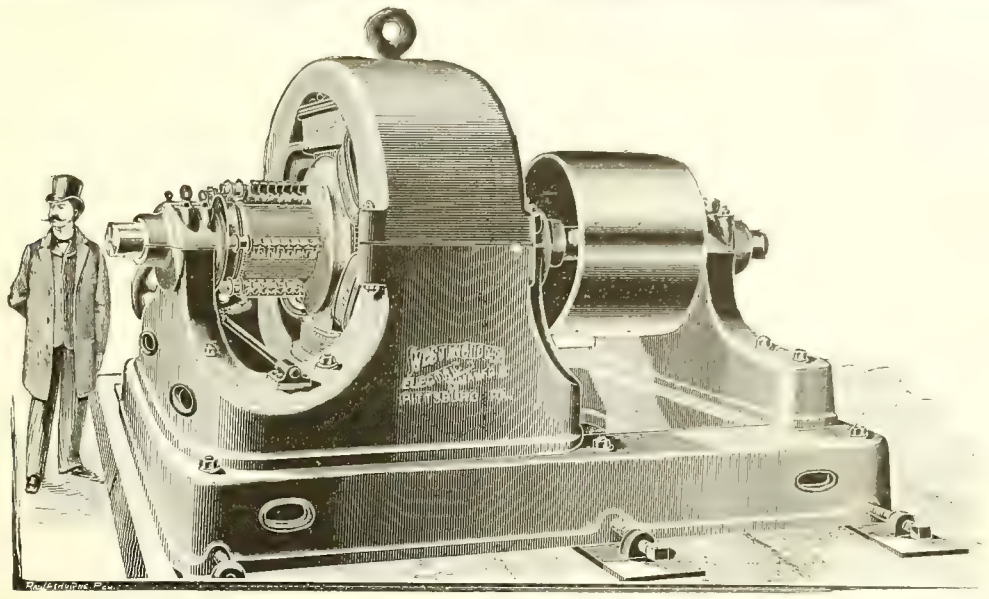
CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.

WESTINGHOUSE
MULTIPOLAR STREET RAILWAY GENERATORS.

COMPOUND-WOUND. SELF-EXCITING.

Perfect Self-Regulation.

High Electrical Efficiency.



Slow Armature Speed.

No External Magnetism.

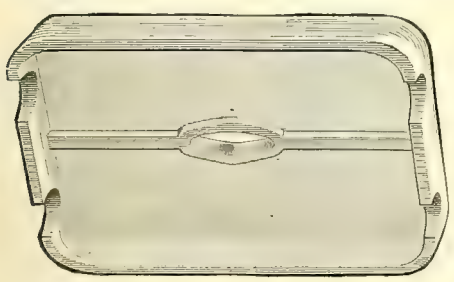
Self-Oiling Bearings.

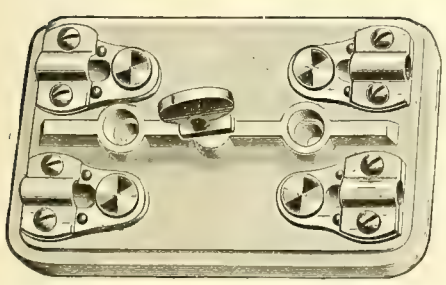
Descriptive Catalogues of Generators, Single-Reduction and Gearless Motors, and Power Station Appliances furnished upon application. Correspondence on all subjects connected with Electric Railways is solicited.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,

RAILWAY DEPARTMENT,

PULLMAN BUILDING, CHICAGO. PITTSBURGH, PA. 120 BROADWAY, NEW YORK.





CUT-OUTS,

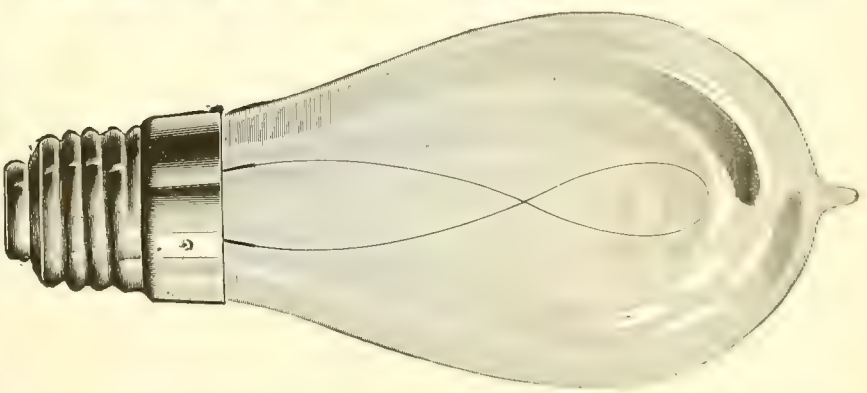
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

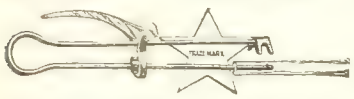
STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

STAR GAUGE GLASS CUTTER.



A necessary tool in every engine room. Sent by mail on receipt of price.

No. 1 Cuts over 5 inches $1 50

" 2 " " 3 " 2 00

S. TAUSSIG, 45 River St., Chicago. WESTERN AGENT

KNOW WHAT YOU'RE GETTING!

HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

A test of six of the best known Separators has recently been made at Cornell University. **Hine's Eliminator stands at the head.** The full report with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street, NEW YORK.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia.

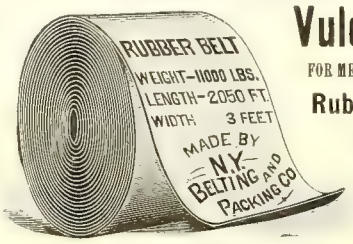
46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

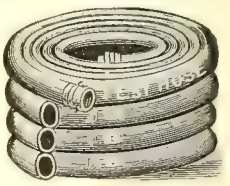
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 169 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 1624 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

THE ONLY GEARLESS MOTOR.

THE SHORT ELECTRIC RAILWAY CO., CLEVELAND, O.

THE NEW CATALOGUE

—OF THE—

UNDERGROUND CONDUIT SYSTEM

OF THE Interior Conduit & Insulation Company

IS NOW READY.

Copies mailed upon application to

INTERIOR CONDUIT & INSULATION COMPANY.

EDWARD H. JOHNSON, President.

WORKS, 527 to 531 W. 34th St. and 526 to 528 W. 35th St.

GENERAL OFFICES, 42 & 44 BROAD ST., NEW YORK.

H. M. UNDERWOOD, Gen. Western Agent, Rookery Building, Chicago.

B. FRANK JOHNSON, Gen. Agt. for Pa., Provident Bldg., Philadelphia, Pa.

THOS. DAY & CO., Gen. Agents for California, San Francisco, Cal.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

Subscribe for the Western Electrician.

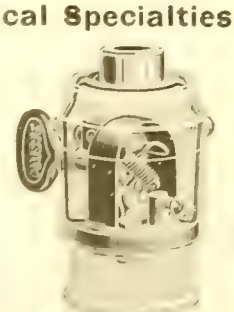
H. T. PAISTE,

MANUFACTURER OF

Paiste Electrical Specialties.

241 THE ROOKERY, CHICAGO, ILL.

Eastern Office and Factory: 1201 MARKET ST., PHILADELPHIA, PA.



PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.

REMEMBER

That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

P. AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, JULY 11, 1891. No. 2

The First Electric Pipe-Welding Plant in Chicago.

From the accompanying views there may be obtained a good idea of the general arrangement of a pipe welding plant which has been recently installed by the Thomson Electric Welding company, in the factory of the Marinette Iron Works, Chicago. This plant which was started a few weeks ago, is the first one of the kind to be put into practical operation in Chicago and is said to be the fourth pipe welding installation in the United States.

The equipment is used to join 1¼ inch and 2 inch extra heavy iron pipe. At the present time the apparatus is applied in the work of welding 2 inch pipe for cold storage and ice machines, the Marinette company having a large contract for the Cold Storage Exchange, Chicago.

The views presented herewith show the current generating plant and the welder in practical operation joining the sections of the coils.

Besides the apparatus just mentioned there is a portion of the equipment which does not appear in the cuts. The outfit referred to is in reality a part of the welder proper, but in this case it is placed on the wall across the room from the welding machine. This apparatus consists of a reactive coil for regulating the current in the welding circuit, a make-and-break switch which is operated by a light wire cable leading from a treadle at the welder, a register in which is recorded the number of welds made and the usual fuse boxes and switch.

The view of the engine room, Fig. 2, was taken through the open window from the outside of the factory. The engine room is built into the shop; that is, it is partitioned off from it so that the machinery within is entirely inclosed by glass windows. By this construction the engine, etc., is in reality in a separate and distinct apartment. This room contains the 100 horse power Atlas engine which drives the main line shaft of the works and is also belted directly, as shown, to the welding generator. In addition to the engine and dynamo there is also in the room a complete switch-board for the welder. The switch-board is shown to the left in the illustration.

The generator which supplies current for the welding, is a 30,000 watt machine built to deliver current in the primary of the welder at a potential of about 300 volts. The maximum primary current which the machine may be called on to deliver is about 150 amperes. This dynamo is of the same general design as the machine usually employed by the Thomson Welding company in connection with its other welding equipments. It is a multipolar machine, and is over compounded to about 15 per cent. It is self-exciting.

The welder proper is of the type described by the Thomson Welding company as their "pipe machine." It has a capacity from the smallest sizes of pipe up to 2 inch pipe.

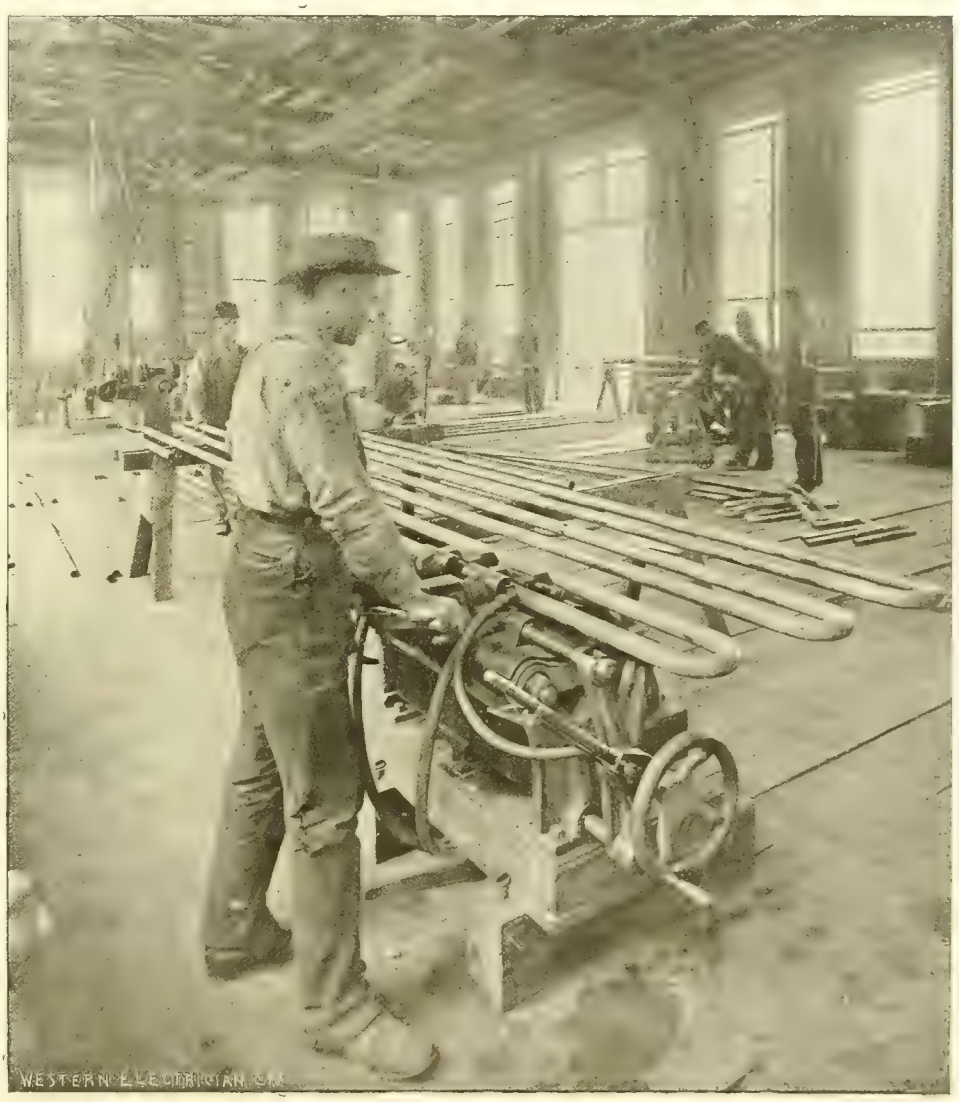


FIG. 1. FIRST ELECTRIC PIPE-WELDING PLANT IN CHICAGO.

As used in this company's works, the machine requires for its most successful operation, the services of three men. One man and a helper make the welds on the machine and another workman is employed with a file in preparing the ends of the pipe.

As this machine was only started a few weeks ago, the company, while feeling confident that a great saving is effected through its use, is as yet unable to give any accurate data relating to the machine's performance. From the point of good workmanship, however, the company is well satisfied with the electrical method. The welds can be made each in about 15 seconds, but the average number of welds in a day's work owing to the time taken up in handling the material, is about 225. It is estimated that an average of 55 horse power is required to weld the 2 inch extra heavy pipe upon which the company is now working.

It may be mentioned that all the coils are tested after having been welded, with an air pressure of 500 pounds to the square inch. The test is made with the pipe under water, the air being applied to the coils while they are submerged. By this means any leak may be detected by air bubbles rising to the surface of the water. When the machine was first started a special test was made in which an air pressure of 800 pounds was employed. Eight short pieces of pipe were welded together in the usual manner but the closest scrutiny failed to reveal that the pipe was otherwise than absolutely tight at all the joints.

Electrical Department, World's Fair.

Lumber is already on the ground at the site of the electricity building in Jackson Park, and it is probable that building operations will be begun immediately on this as well as the Mines building. Some delay has been caused by the dispute with the Illinois Central Railroad company as to the price to be paid per carload for hauling freight and material to the grounds, but the indications are that this difference will be speedily and satisfactorily adjusted, and that the contractor will soon have a large force of men at work.

The planning of the permanent electric lighting arrangements at the grounds and buildings at Jackson Park is still under advisement by the departments of electricity and construction, and will be, of course, for some time to come. The present idea is to defer actual work on the general scheme until representatives of the two departments—probably Chief Barrett and Mr. Sargent—shall have returned from a visit to the East for the purpose of conferring with the big electrical companies on the subject. It is proposed, if possible, to give every company in the country manufacturing electric lighting plants a chance to do a portion of the work in connection with its exhibit. It is thought that some arrangement of this sort can be made if the various exhibitors will enter into the spirit of the plan and co-operate in friendly rivalry. Prof. Barrett will make an earnest effort to bring about an understanding of this kind. He expects to start at once on his tour of investigation.

Bids for the work and material necessary for the temporary lighting installation at the World's Fair grounds will be opened July 13th.

The Field Engineering company of New York has applied for 625 feet of space in the electrical building.

Electrical Engineer Sargent of the Construction Department has a plan for an electrical fountain at the exposition, which, if carried out, can hardly fail to result in one of the greatest popular attractions of the fair. The fountain is to rise from the water of the lagoon, near the administration building, with a basin 100 feet in diameter. A beautiful design for the structure itself has already been proposed by an eminent eastern sculptor, and Mr. Sargent's plan has to do purely with the electro-scenic effects on the water. The fountain will be very much larger than the one at Lincoln Park and finer in every way. The principle employed will be different, depending upon the use of hollow nozzles, by which the light is thrown into the water from the middle of the jet itself. It is proposed to introduce the water into one-half of the basin through large entry pipes that will have the appearance of spouting forth great streams of different colored liquids. On the other side the water will flow back into the lagoon, over the edge of the basin, in one unbroken cascade. Back of this sheet of water incandescent lamps with globes of different colors will be placed, which will produce a very beautiful effect.

Water lilies, with little lamps taking the place of blossoms amid the dark green leaves, will float on the surface of the water and queer phosphorescent fish, electrically illumined, can be seen in the quiet depths. Other novel features are proposed, and Mr. Sargent is confident that the fountain could easily be made to surpass anything of the kind ever attempted.

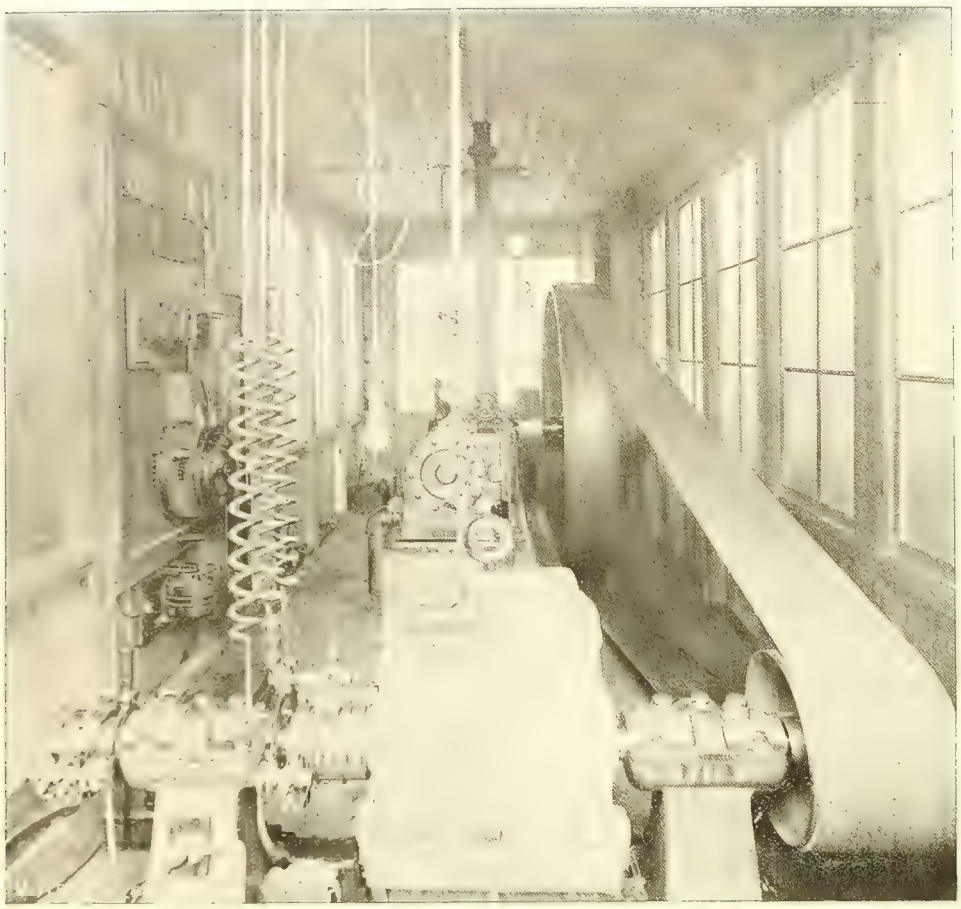


FIG. 2. FIRST ELECTRIC PIPE-WELDING PLANT IN CHICAGO.

Before long arrangements will be made for complete fire alarm and police patrol telegraphic service on the exposition grounds.

Controversy over a Franchise.

According to the Chicago daily papers several city officials have been worrying over the complaint made by a member of the city council at a committee meeting last week. A sub-committee was appointed to investigate the relations between the Chicago Arc Light & Power company and the Archer Electric Light company. The charge was made that the former company had violated the terms of its franchise in renting its conduits to the Archer company.

B. E. Sunny, when called upon by a representative of the WESTERN ELECTRICIAN, stated that the Chicago Arc Light & Power company had a perfect right to sub-let its conduits, and that its dealings were fair and above board. Mr. Wilmerding, the secretary of the Arc Light company, when called upon, stated that the company was bound by the franchise to permit any company [illegible], charging it a reasonable rate. If the contracting company regarded the rate as too high, they had the right to demand the appointment of a board of arbitration. The Archer company had made no com[illegible] such demand. "Had the council committee examined the franchise," said Mr. [illegible] company was [illegible] following out [illegible] with the Archer [illegible] and I [illegible] to create [illegible] company, which is [illegible]

Experiments on the Zipernowsky Electric Railway with a Vertical Track.

The following is a description by a correspondent in the London *Electrical Review* of the first experiments at the Buda Pesth Wagon Works on the Zipernowsky vertical track electric tramway.

This trial line was designed to represent all the conditions which occur on a tramway, and thus test the applicability of the system.

To this end there was laid down a curve of 90°, and of 20 meter radius, and further a counter-curve of 30 meters radius without a straight transition piece, as also a complete shunt consisting of two changes with a length of 42 meters between the points.

The trial line is level, but both in the straight parts and in the curve there are short portions of the track with an in[illegible]

As carried out in the present instance the surface which gives off the current is horizontal. The upper surface of the rails is also coated with a peculiar substance, which insulates and also prevents metallic particles which might be accidentally introduced through the slit of the rails into the interior of the channel, from occasioning a short circuit.

The rails weigh 23 kilos per meter, and the guide-rails 10 kilos.

The upper structure is in part completely walled in, but a portion is merely screwed to the sleepers which, are bedded in sand. This was done in order to observe the operation of the mechanism in the channel during the journey.

The most essential part of the car, namely, the plate extending through the slit between the rails into the interior of the channel, consists of wrought cast steel of the thickness of 25 to 27 mm.

This plate carries at its lower end two guide rollers fixed at a distance of 10 mm. from each other, which run on the guide rails of the car. A little above these rollers there are sliding contacts on each side of the plate, which constantly press upward against the surface of the current-rails.

The car consists of two turning supports set at a distance of 3 meters apart. The sliding contacts are eight in number, four on each current rail. By this arrangement the advantage is secured that if one pair should accidentally find no contact, the upper pair would take up the contact at a distance of 3 meters, before or behind.

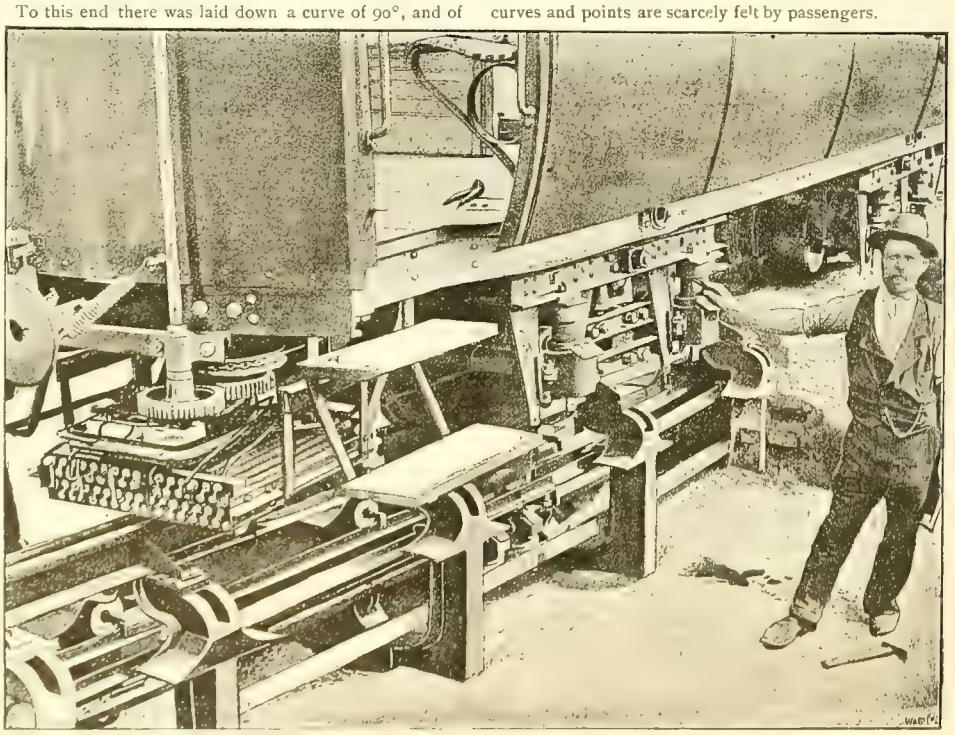
Each rotating support consists of two wheels, one only of which is driven by the motor. Hence the car has two running and two driving wheels. The wheels are set vertically. The action of the motors upon the axles is effected by means of a worm and gear. The worm is keyed upon the shaft of the motor, and the worm wheel is bolted upon the driving shaft.

The box of the car is 1,600 mm. in breadth and 5,000 mm. in length, containing three compartments with 24 seats. The middle compartment is partitioned off, and there are besides six seats at the front end of the car. Here there is also a platform of 1,000 mm. in length, from which both motors can be attended to and regulated by means of a hand brake.

The trial trips, it is claimed, proved that this system was especially suited for electric lines in narrow streets with an underground supply of current.

Both in the straight lines and in the curves and at the points a speed of 10 kilometers an hour was attained, and it could easily be doubled on a longer line.

The movements of the car are extremely smooth. No shocks are perceptible, and the operations of passing curves and points are scarcely felt by passengers.

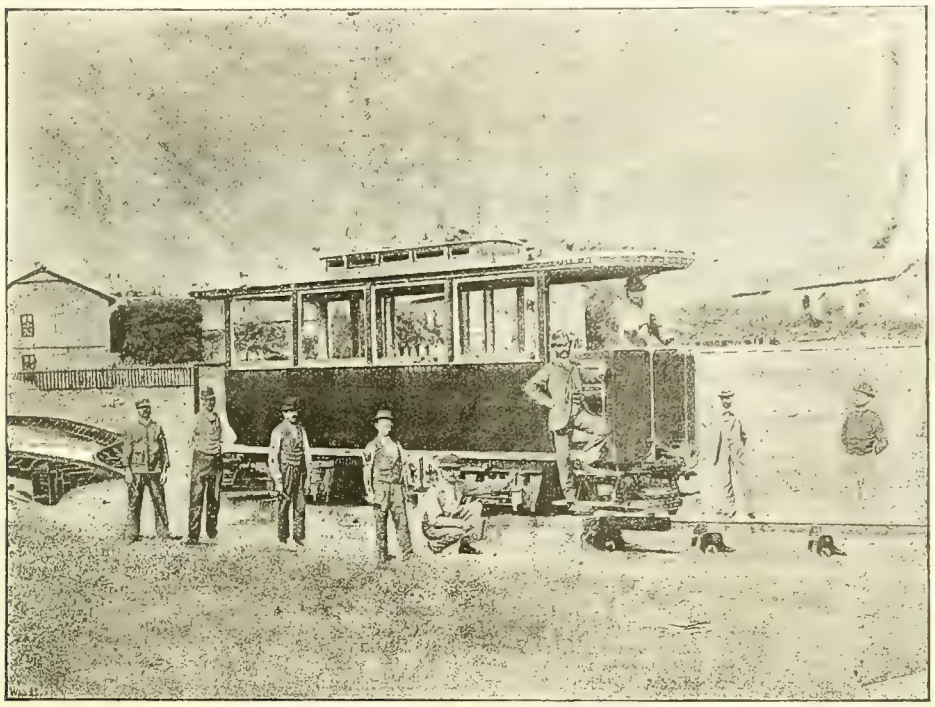


ZIPERNOWSKY'S ELECTRIC RAILWAY WITH VERTICAL TRACK.

Measurements undertaken to test the steadiness of the car showed that in the parts not walled in, and especially at the parts where the distance of the running rails and guide rails had not been quite accurately adjusted (which was done purposely) the highest point of the oscillations of the car did not amount quite to 50 mm in a horizontal direction. On other tramways, even those with a normal track, such oscillations are very frequent, and have not

been obviated. The oscillations are chiefly occasioned by the circumstance that the structure was not walled in but merely bedded in sand, and that therefore the elasticity of the sand and of the legs of the chairs came into full play. At parts where the line was walled in and paved, the oscillations did not exceed 30 mm.

Vertical oscillations were not observed, probably because



ZIPERNOWSKY ELECTRIC RAILWAY WITH VERTICAL TRACK.

the car was built without springs. Nevertheless, the movements of the car were gentle, and vibrations generally felt in cars without springs were evaded by placing india-rubber rings under the supports of the car.

Trial trips were made with the car loaded on one side, but no changes were observed either in the upper structure or the cars, and especially not in the guide plates, which were loaded with 20 kilos. per square mm.

The working of the points (in which a spiral spring now serves instead of a counterpoise to bring back the points to the normal position) is faultless. It is asserted that an automatic system of changing from one line to another can be used. The passage of current through both changes is almost continuous.

To render it practicable for a car to turn into the left hand track instead of into the right-hand, a setting arrangement, worked by hand, has been provided at the lower tongue of the point.

The cuts will doubtless aid the reader in obtaining an idea of the construction of the system.

Pole Chopping in New Orleans.

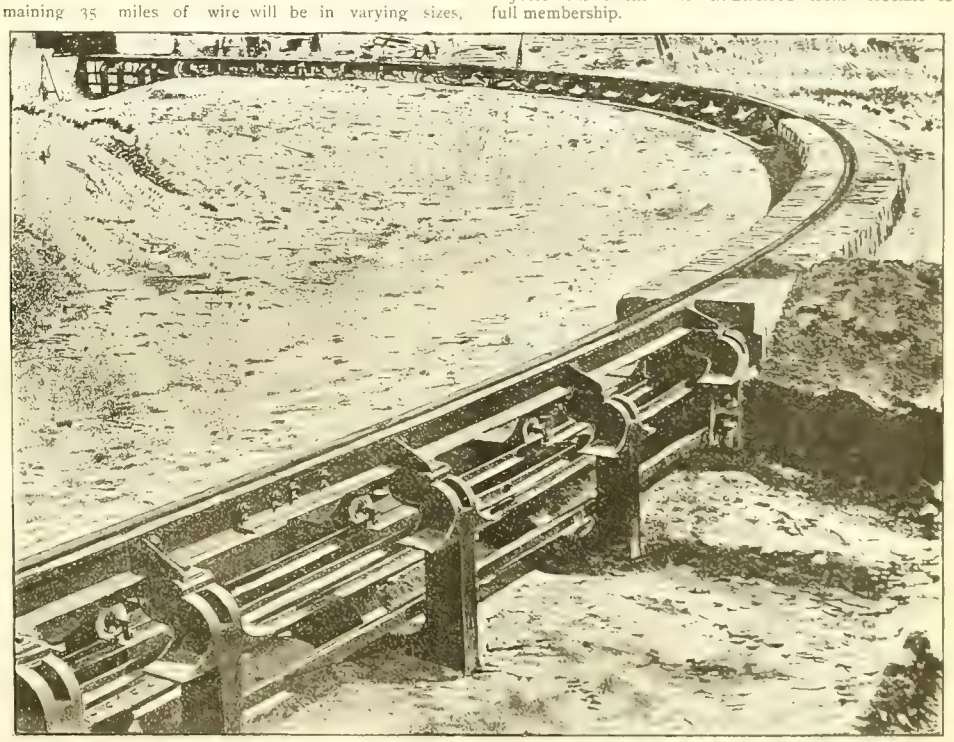
Belligerent councilmen have introduced the pole chopping craze in New Orleans. A press dispatch gives this account of the affair:

When the council recently granted the Postal Telegraph & Cable company the right to enter the city it was stipulated that it should either use the poles of other companies or construct an underground cable. The company did not, at the time, give its consent to this arrangement, and instead of utilizing the cable privilege in its grant again applied to the council for permission to erect poles. The council, without even hearing the Postal Telegraph people, refused the request. On Monday of last week the company put up a line of poles and strung two wires to its office. The council at once ordered an investigation, and, should the report prove true, instructed the mayor to tear down the poles. No report was expected until Friday night, and the telegraph company expected to take out an injunction. Chairman A. C. Landrey, of the streets and landings committee, who had charge of the investigation, filed his report on Thursday and with it a request that the mayor carry out the council's order. Half an hour afterward the mayor had the poles chopped down against the protest of the Postal Telegraph company and before it could appeal to the courts. It will make a strong appeal. Mayor Shakespeare says that he carried out an order to which he is opposed. The action of the council disgusted him and seemed to say that the right to erect poles belonged to only a few people of the council's choice. He wants the people to find out how the council is working against their interests and so carried out the order, believing that the result will be to place the council in such a position before the public that the latter will see clearly what is going on.

The workshops and yards of the Intercolonial railway at Moncton, N. B., are to be lighted by electricity. The Wood arc lighting system will be used.

Underground Wires at Minneapolis.

Much interest has been excited among the member of the electrical fraternity in the Northwest by the elaborate system of underground construction contemplated by the Minnesota Brush Electric Light company of Minneapolis. About 85 miles of cables will be needed, as the company's wires will be put underground in all the business section of the city, as well as in a considerable portion of the resident district. This will be the most extensive system of underground street construction for electric wires ever attempted, and the cost is estimated at $100 000. Of the conductors required some fifty miles will be No. 5 B. & S. wire for arc lights and series motors. The remaining 35 miles of wire will be in varying sizes,



ZIPERNOWSKY ELECTRIC RAILWAY WITH VERTICAL TRACK.

from 250,000 circular mils down, and will supply current for alternating incandescent lamps and constant potential motor service. The conduits, with the necessary manholes, are all laid at present, and the wiring contract will include drawing in, jointing, special junction boxes and about 100 terminal heads at street lamps, and at centers of distribution at block centers. Naturally all of the companies supplying underground cables are anxious to get this large contract. The following named companies have put in bids: Standard Underground Cable company, Electrical Supply company (Habirshaw), Knapp Electrical Works (Safety), Central Electric company (Okonite), John A. Roebling's Sons company, Western Electric Company, [illegible] where.

American Institute Electrical Engineers.

At the meeting of the council of the American Institute of Electrical Engineers, the following delegates were appointed to attend the Frankfort Electrical Conference in accordance with a resolution adopted at the general meeting, May 21st: Carl Hering, [illegible] Heinrich, Nikola Tesla, Dr. E. L. Nichols. Prof. Heinrich is already in Europe and Mr. Hering [illegible] Normannia.

The following named associate members were elected:

John H. Barnard, general manager Asheville Street Railway company and Asheville Light & Power company, Asheville, N. C.

Henry B. Cram, treasurer Bernstein Electric company, 175 Prospect street, Cambridgeport Mass.

Frank L Dame, superintendent Vancouver Electric Railway & Light company, Vancouver, B. C.

Charles Edward Emery, consulting engineer 22 Cortlandt street, N. Y.

Thomas J. Fay, Maine Electric Improvement company, 136 Liberty street, N. Y.

Walter C. Fisk, manager Bernstein Electric company, 620 Atlantic avenue, Boston, Mass

John L. Gans, superintendent and electrician, the Electric company, Connellsville, Pa.

Warren B. Hadley, superintendent wiring department Edison Electric Illuminating company, 431 Fifth avenue, New York.

Louis W. Healy, The Wightman Electric company, 1205 Marion street, Scranton, Pa.

James W. Kellogg, assistant to district engineer, Edison General Electric company, 149 E. 25th street, New York.

Thatcher T. P. Luquee, assistant in surveying and practical mining, and student in electrical engineering, Columbia College, N. Y. and Bedford, N. Y.

Thomas Reeve Roseburgh, lecturer in electrical engineering, School of Practical Science, Toronto, Ont.

Giles Taintor, assistant electrician, N. E. Telephone & Telegraph company, 7 Walnut street, Boston, Mass.

Herbert C. Wirt, electrician marine department, Thomson-Houston Electric company, 12 Millmont street, Roxbury, Mass.

Francke L. Woodward, student in electricity, 49 Grand street, Albany, N. Y.

Jesse M. Smith was transferred from associate to full membership.

No further meetings of the Institute will be held until September.

A search light for railway purposes was tested recently by the electrician of the Jersey Central railroad. One Huntington light of 3,200 candle power was mounted on the switch signal bridge, 20 feet above the track. It is said that when turned on a station building one-third of a mile away even the outlines of the bricks could be distinctly seen; when turned on the track, the ties could be seen in front of the same station. Colors were plainly distinguished at a half mile distance. At [illegible] feet it would enable an engineer to tell the position of switches. The reflector was parabolic like those of locomotive headlights and silver plated and highly burnished.

Experiments with Alternate Currents of Very High Frequency and Their Application to Methods of Artificial Illumination.[1]

By Nikola Tesla.

Of all the forms of nature's immeasurable, all-pervading energy, which ever and ever changing and moving, like a soul animates the inert universe, those of electricity and magnetism are perhaps the most fascinating. The effects of gravitation, of heat, and light, we observe daily, and soon we get accustomed to them, and soon they lose for us the character of the marvelous and wonderful; but electricity and magnetism, with their singular relationship, with their seemingly dual character unique among the forces in nature, with their phenomena of attractions, repulsions and rotations, strange manifestations of mysterious agents, stimulate and excite the

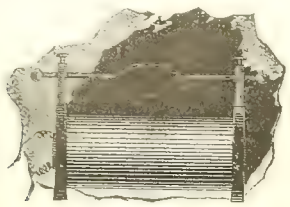


Fig. 4.—Sensitive Thread Discharge

mind to thought and research. What is electricity, and what is magnetism? These questions have been asked again and again. The most able intellects have cease lessly wrestled with the problem; still the question has not as yet been fully answered. But while we cannot even to day state what these singular forces are, yet we have made good headway toward the solution of the problem. We are now confident that electric and magnetic phenomena are attributable to ether, and we are perhaps justified in saying, that the effects of static electricity are effects of ether under strain and those of dynamic electricity and electro-magnetism effects of ether in motion. But this still leaves the question as to what electricity and magnetism are, unanswered.

It is not with the object of advancing an opinion, but with the desire of acquainting you better with some of the results, which I will describe, to show you the reasoning I have followed, the departures I have made—that I venture to express, in a few words, the views and convictions which have led me to these results.

I adhere to the idea that there is a thing which we have been in the habit of calling electricity. The question is, What is that thing; or, what of all things, the existence of which we know, have we the best reason to call electricity. We know that it acts like an incompressible fluid; that there must be a constant quantity of it in nature; that it can be neither produced nor destroyed; and, what is more important, the electro-magnetic theory of light and all facts observed teach us that electric and ether phenomena are identical. The idea at once suggests itself, therefore, that electricity might be called ether. In fact, this view has in a certain sense been advanced by Dr. Lodge. His interesting work has been read by every one and many have been convinced by his arguments. His great ability and the interesting nature of the subject, keep the reader spellbound; but when the impressions fade one realizes that he has to deal only with ingenuous explanations. I

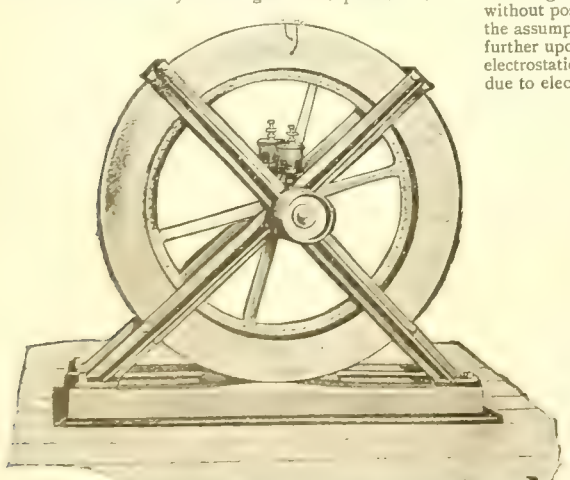


Fig. 2.—High Frequency Alternator with Revolving Disc Armature.

they range into hundreds of million millions per second. Nor can any one prove that there are transverse ether waves emitted from an alternate current machine, giving a small number of alternations per second; to such slow disturbances, the ether, if at rest, may behave as a true fluid. Electricity cannot be called ether in the broad sense of the term; but nothing would seem to stand in the way of calling electricity ether associated with matter, or bound ether; or, in other words, that the so called static charge of the molecule, is ether associated in some way with the molecule. Looking at it in that light, we would be justified in saying that electricity is concerned in all molecular actions.

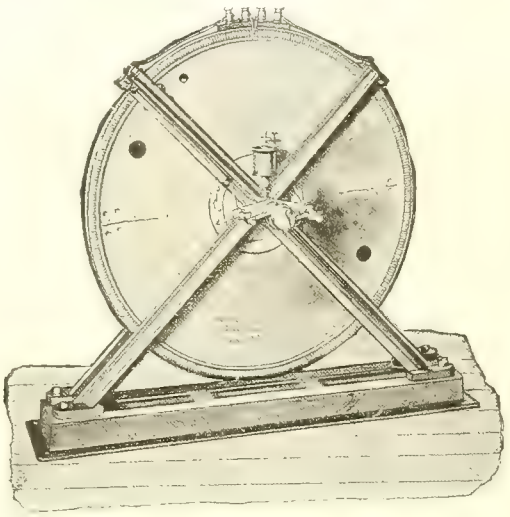


Fig. 1.—High Frequency Alternator with Drum Armature.

About fifteen years ago, Prof. Rowland demonstrated a most interesting and important fact, namely, that a static charge carried around produces the effects of an electric current. Leaving out of consideration the precise nature of the mechanism, which produces the attraction and repulsion of currents, and conceiving the electrostatically

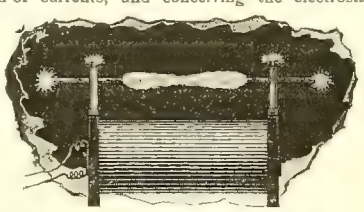


Fig. 6.—Streaming Discharge.

charged molecules in motion, this experimental fact gives us a fair idea of magnetism. We can conceive lines or tubes of force which physically exist, being formed of rows of directed moving molecules; we can see that these lines must be closed; that they must tend to shorten and expand, etc. It likewise explains in a reasonable way, the most puzzling phenomenon of all; permanent magnetism, and in general, has all the beauties of the ampere theory without possessing the vital defect of the same, namely, the assumption of molecular currents. Without enlarging further upon the subject, I would say, that I look upon all electrostatic, current and magnetic phenomena, as being due to electrostatic molecular forces.

Of all these phenomena the most important to study are the current phenomena, on account of the already extensive and ever growing use of currents for industrial purposes. It is now a century since thefirst practical source of current has been produced, and ever since, the phenomena which accompany the flow of currents, have been diligently studied, and through the untiring efforts of scientific men the simple laws which govern them have been discovered. But these laws were found to hold good only when the currents are of a steady character. When the currents are rapidly varying in strength quite different phenomena, often unexpected, present themselves and quite different laws hold good, which even now have not been determined as fully as desirable, though through the work principally of English scientists, enough knowledge has been gained on the subject to enable us to treat simple cases, which now present themselves in daily practice.

The phenomena which are peculiar to the changing character of the currents are greatly exalted when the rate of change is increased, hence the study of these currents is considerably facilitated by the employment of properly constructed apparatus. It was with this and other objects in view that I constructed alternate current machines capable of giving more than two million reversals of current per minute, and to this circumstance it is principally due that I am able to bring to your attention some of the results thus far reached, which I hope will prove to be a step in advance on account of their direct bearing upon one of the most important problems namely, the production of a practical and efficient source of light.

The study of such rapidly alternating currents is very interesting. Nearly every experiment discloses something new. Many results may, of course, be predicted, but many more are unforeseen. The experimenter makes many interesting observations. For instance, we take a piece of iron, and hold it against a magnet. Starting from low alternations and running up higher and higher we feel the impulses succeed each other faster and faster, get weaker and weaker, and finally disappear. We then observe a continuous pull; the pull, of course, is not continuous; it only appears so to us: our sense of touch is imperfect.

We may next establish an arc between the electrodes and observe as the alternations rise, that the note which accompanies alternating arcs gets shriller and shriller, gradually weakens and finally ceases. The air vibrations, of course continue, but they are too weak to be perceived; our sense of hearing fails us.

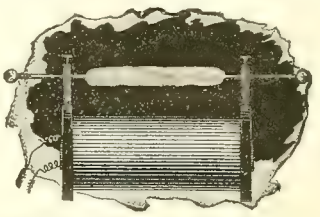


Fig. 5.—Flaming Discharge.

We observe the small physiological effects, the rapid heating of the iron cores and conductors, curious inductive effects, interesting condenser phenonema and still more interesting light phenomena, with a high tension induction coil. All these experiments and observations would be of the greatest interest to the student, but their description would lead me too far from the principal subject. Partly for this reason, and partly on account of the vastly greater importance, I will confine myself to the description of the light effects produced by these currents.

In the experiments to this end a high tension induction coil or equivalent apparatus for converting currents of comparatively low into currents of high tension, is used.

In general my experience tends to show that bodies which possess the highest specific inductive capacity, such as glass, afford a rather inferior insulation to others, which, while they are good insulators, have a much smaller specific inductive capacity, such as oils, for instance the dielectric losses being no doubt greater in the former. The difficulty of insulating, of course, only exists when the potentials are excessively high, for with potentials such as a few thousand volts there is no particular difficulty encountered in conveying currents from a machine giving, say 20,000 alternations per second to quite a distance. This number of alternations, however, is by far too small for many purposes, though quite sufficient for some practical applications. This difficulty of insulating is fortunately not a vital drawback; it affects mostly the size of the apparatus, for, when excessively high potentials would be used, the light-giving devices would be located not far from the apparatus, and often they would be quite close to it. As the air-bombardment of the insulated wire is dependent on condenser action, the loss may be reduced to a trifle by using excessively thin wires heavily insulated.

The investigator who desires to repeat the experiments which I will describe, with an alternate current machine, capable of supplying currents of the desired frequency and an induction coil, will do well to take the primary coil out and mount the secondary in such a manner as to be able to look through the tube upon which the secondary is

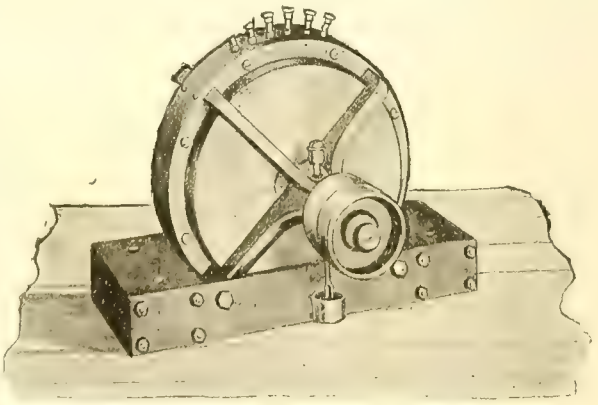


Fig. 3.—High Frequency Alternator with Stationary Disc Armature and Stationary Exciting Coil.

wound. He will then be able to observe the streams which pass from the primary to the insulating tube, and from their intensity he will know how far he can strain the coil. Without this precaution he is sure to injure the insulation. This arrangement permits, however, an easy exchange of the primaries, which is desirable in these experiments.

Fig. 1 represents the machine used in my experiments before the Institute. The field magnet consists of a ring of wrought iron with 384 pole projections. The armature comprises a steel disk to which is fastened a thin, carefully welded rim of wrought iron. Upon the rim are wound several layers of fine, well annealed iron wire, which, when wound, is passed through shellac. The armature wires

are wound around brass pins, wrapped with silk thread. The diameter of the armature wire in this type of machine should not be more than ⅛ of the thickness of the pole projections, else the local action will be considerable.

Fig. 2 represents a larger machine of a different type. The field magnet of this machine consists of two like parts which either inclose an exciting coil, or else are independently wound. Each part has 480 pole projections, the projections of one facing those of the other. The armature consists of a wheel of hard bronze, carrying the conductors which revolve between the projections of the field magnet. To wind the armature conductors, I have found it most convenient to proceed in the following manner: I construct a ring of hard bronze of the required size. This ring and the rim of the wheel are provided with the proper number of pins, and are both fastened upon a plate. The armature conductors being wound, the pins are cut off and the ends of the conductors are fastened by two rings which screw to the bronze ring and the rim of the wheel respectively. The whole may then be taken off and forms a solid structure. The conductors in such a type of machine should consist of sheet copper, the thickness of which of course, depends on the thickness of the whole projections; or else twisted thin wires should be employed.

Fig. 3 is a smaller machine, in many respects similar to the former, only here the armature conductors and the exciting coil are kept stationary, while only a block of wrought iron is revolved.

I deem it well to call the attention of the investigator to two things, the importance of which, though self-evident, he is nevertheless apt to underestimate; namely, to the local action in the conductors which must be carefully avoided, and to the clearance which must be small. I may add, that since it is desirable to use very high peripheral speeds, the armature should be of very large diameter in order to avoid impracticable belt speeds.

In operating an induction coil with very rapidly alternating currents, among the first luminous phenomena noticed are naturally those presented by the high tension discharge. As the number of alternations per second is increased, or as—the number being high—the current through the primary is varied, the discharge gradually changes in appearance. It would be difficult to describe the minor changes which occur and the conditions which bring them about, but one may note five distinct forms of the discharge.

First, one may observe a weak, sensitive discharge in the form of a thin, feeble-colored thread, Fig. 4. It always occurs when, the number of alternations per second being high, the current through the primary is very small.

When the current through the primary is increased the discharge gets broader and stronger, and the effect of the capacity of the coil becomes visible until, finally, under proper conditions, a white flaming arc, Fig. 5, often as thick as one's finger and striking across the whole coil, is produced. It develops remarkable heat, and may be further characterized by the absence of the high note which accompanies the less powerful discharges.

When the flaming discharge occurs the conditions are evidently such that the greatest current is made to flow through the circuit. This kind of discharge is the severest test for a coil; the break, when it occurs, is of the nature of that in an overcharged Leyden jar. To give a rough approximation I would state that, with an ordinary coil of, say 10,000 ohms' resistance, the most powerful arc would be produced with about 12,000 alternations per second.

When the frequency is increased beyond that rate the potential, of course, rises, but the striking distance, may nevertheless, diminish, paradoxical as it may seem. As the potential rises the coil attains more and more the properties of a static machine until finally, one may observe the beautiful phenomenon of the streaming discharge, Fig. 6, which may be produced across the whole length of the coil. At that stage streams begin to issue freely from all points and projections. These streams will also be seen to pass in abundance in the space between the primary and the insulating tube. When the potential is excessively high they will always appear, even if the frequency be low, and even if the primary be surrounded by as much as an inch of wax, hard rubber, glass or any other insulating substance.

Besides the potential, the intensity of the streams depends on the frequency; but if the coil be very large they show themselves, no matter how low the frequencies used. For instance, in a very large coil of resistance of 67,000 ohms, constructed by me some time ago, they appear with as low as 100 alternations per second and less, the insulation of the secondary being ¾ inch ebonite. When very intense they produce a noise similar to that produced by the charging of a Holtz machine, but much more powerful, and they emit a strong smell of ozone. The lower the frequency, the more apt they are to suddenly injure the coil. With excessively high frequencies they may pass freely without producing any other effect than to heat the insulation slowly and uniformly.

At the stage when the streaming discharge occurs, or with somewhat higher frequencies, one may, by approaching the terminals considerably and regulating properly the effect of capacity, produce a veritable spray of small silver-white sparks or a bunch of excessively thin silvery threads, Fig. 7, amidst a powerful brush—each spark or thread possibly corresponding to one alternation. This, when produced under proper conditions, is probably the most beautiful discharge, and when an air blast is directed against it, it presents a singular appearance.

If the frequency is still more increased, then the coil refuses to give any spark unless at comparatively small distances, and the fifth typical form of discharge may be observed, Fig. 8. The tendency to stream out and dissipate is then so great that when the brush is produced at one terminal no sparking occurs even if, as I have reepeatedly tried, the hand, or any conducting object, is held within the stream; and what is more singular, the luminous stream is not at all easily deflected by the approach of a conducting body.

At this stage the streams seemingly pass with the greatest freedom through considerable thicknesses of insulators, and it is particularly interesting to study their behavior. For this purpose it is convenient to connect to the terminals of the coil [illegible] spark instantly ceases and the discharge spreads into an intensely luminous circle several inches in diameter, provided the spheres are sufficiently large. The passage of the streams heats, and, after a while, softens the rubber so much that two plates may be made to stick together in this manner. If the spheres are so far apart that no spark occurs, even if they are far beyond the striking distance, by inserting a thick plate of glass the discharge is instantly induced to pass from the spheres to the glass in the form of luminous streams. It appears almost as though these streams pass *through* the dielectric. In reality this is not the case, as the streams are due to the molecules of the air which are violently agitated in the space between the oppositely charged surfaces of the spheres. When no dielectric other than air is present, the bombardment goes on, but is too weak to be visible; by inserting a dielectric the inductive effect is much increased, and besides the projected air molecules find an obstacle and the bombardment becomes so intense that the streams become luminous.

From the behavior of the dielectrics in these experiments we may conclude that the best insulator for these rapidly alternating currents would be the one possessing the smallest specific inductive capacity and at the same time one capable of withstanding the greatest differences of potential; and thus two diametrically opposite ways of securing the required insulation are indicated; namely, to use either a perfect vacuum or a gas under great pressure; but the former would be preferable. Unfortunately neither of these two ways is easily carried out in practice.

It is especially interesting to note the behavior of an excessively high vacuum in these experiments. If a test tube provided with external electrodes and exhausted to the highest possible degree be connected to the terminals of the coil, Fig. 10, the electrodes of the tube are instantly brought to a high temperature and the glass at each end of the tube is rendered intensely phosphorescent, but the middle appears comparatively dark, and for awhile remains cool.

When the frequency is so high that the discharge shown in Fig. 8 is observed, considerable dissipation no doubt occurs in the coil. Nevertheless, the coil may be worked for a long time, as the heating is gradual.

In spite of the fact that the difference of potential may be enormous, little is felt when the discharge is passed through the body, provided the hands are armed. This is to some extent due to the higher frequency, but principally to the fact that less energy is available externally, when the difference of potential reaches an enormous value, owing to the circumstance that with the rise of potential the energy absorbed in the coil increases as the square of the potential. Up to a certain point the energy available externally increases with the rise of potential, then it begins to fall off rapidly. Thus, with the ordinary high tension induction coil, the curious paradox exists, that, while with a given current through the primary the shock might be fatal, with many times that current it might be perfectly harmless, even if the frequency be the same. With high frequencies and excessively high potentials when the terminals are not connected to bodies of some size, practically all the energy supplied to the primary is taken up by the coil. There is no breaking through, no local injury, but all the material, insulating and conducting, is uniformly heated.

To avoid misunderstanding in regard to the physiological effect of alternating currents of very high frequency, I think it necessary to state that while it is an undeniable fact that they are incomparably less dangerous than currents of low frequencies, yet it should not be thought that they are altogether harmless. What has just been said is

(Continued on page 21.)

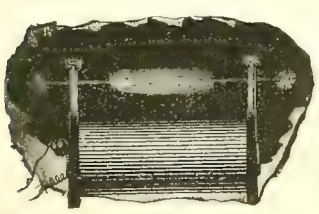


FIG. 7.—BRUSH AND SPRAY DISCHARGE.

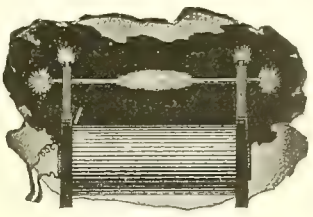


FIG. 8.—FIFTH TYPICAL FORM OF DISCHARGE.

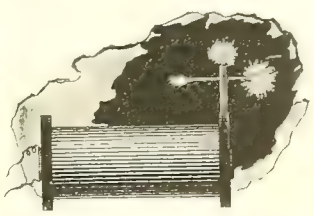


FIG. 14.—EFFECT OF BALL AND POINT.

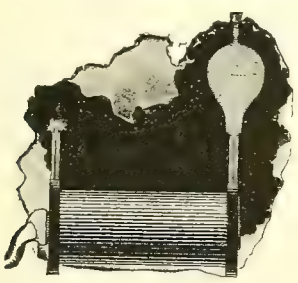


FIG. 16.—INCANDESCENT WIRE OR FILAMENT SPINNING IN AN UNEXHAUSTED GLOBE.

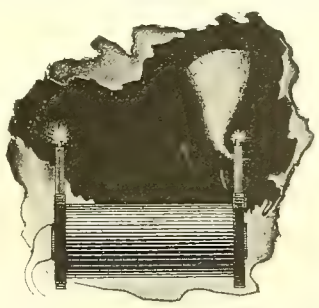


FIG. 13.—ASPECT PRESENTED BY A VERY THIN WIRE ATTACHED TO A TERMINAL OF THE COIL.

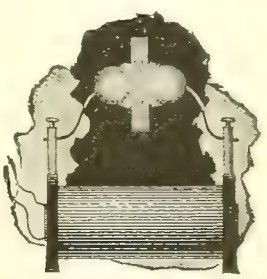


FIG. 9.—LUMINOUS DISCHARGE WITH INTERPOSED INSULATORS.

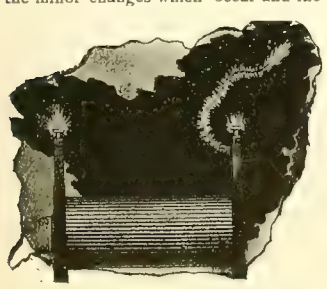


FIG. 12.—LUMINOUS STREAMS ESCAPING FROM A COTTON-COVERED WIRE.

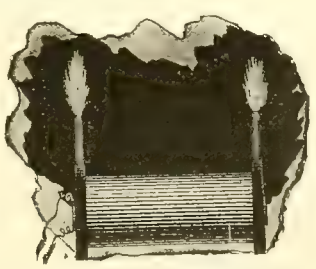


FIG. 15.—ASPECT OF COIL UNDER POWERFUL BRUSH DISCHARGE.

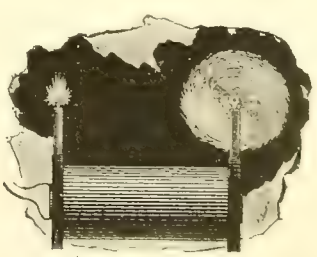


FIG. 11.—PINWHEEL DRIVEN BY A POWERFUL BRUSH.

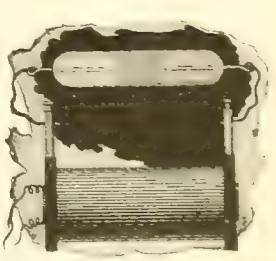


FIG. 10.—DISCHARGE THROUGH HIGHEST VACUUM.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - Editor and Publisher
J. B. O'HARA, - - - - - - -
F. L. PERRY, - - - - - - - - Associate Editors.
W. E. KEILY, - - - - - - -
J. L. BAKER, - - - - - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
The First Electric [illegible] Welding Plant in Chicago. Illustrated	15, 16
Electrical Department World's Fair	15, 16
[illegible] Française	16
Experiments with the Zipernowsky Electric Railway with Vertical Trucks. Illustrated	16, 17
[illegible] in New Orleans	17
Underground Wires in Minneapolis	17
American Institute Electrical Engineers	17
Experiments with Alternate Currents of High Frequency and their Application to Methods of Artificial Illumination, by Nikola Tesla. Illustrated. American Institute of Electrical Engineers	[illegible], 21, 22, 23, 24
Editorial	20
[illegible] Rochester Electric Railway. Illustrated	24
[illegible] Illustrated	24
[illegible] Interests	24
[illegible] Illustrated	24
[illegible]	24, 25

DEPARTMENTS.

Correspondence	25, 26
New [illegible]	27
Electric Lighting	27
E[illegible]	27
[illegible]	27
T[illegible]	27
T[illegible]	27
Miscellaneous	27
T[illegible]	28
[illegible]	28
E[illegible]	28

[illegible] of Greece during his recent visit to this country, examined the coast defenses at New York. The [illegible] explained to the visitor and some interesting tests showing the method of operation, were [illegible].

[illegible] communication between lightships and lighthouses, which is attracting so much attention just now, is deserving of the best thought that [illegible]

[illegible]

reasonable cost has made it unprofitable to develop these regions, but now by utilizing water power for generating current, the cost of operation can be reduced to a minimun. The advantages to be derived from utilizing electricity in mining have already been shown. It is safe to say that rapid advances may be looked for in this field.

DETROIT is edeavoring to secure rapid transit and the street railway companies have expressed a willingness to extend their lines and substitute electricity in place of animal power, provided a twenty years' franchise is guaranteed. This is certaintly a reasonable condition, and the citizens should gladly accept the proposition. To introduce a first class electric railway equipment, the Detroit companies will of course have to expend large sums of money, and their demand for a twenty years' franchise is only just.

THE completion of the electric railway lines in the Minneapolis-St. Paul system is hailed with delight by the people of both cities who desire to see a consolidation effected. Several years ago a proposition to unite these municipalities would be rejected, but now the scheme has many earnest advocates in both cities. The electric system has had much to do with bringing about this state of affairs. Owners of property between the cities desire to establish a better feeling, and as the electric railways connecting these cities afford excellent transportation facilities the property is valuable for residence purposes. Thus it is that one of the questions which have been the cause of much contention in the Northwest will probably be settled through the agency of the electric railroad.

THE electrical execution law has served to stir up the people of New York during the last week, and the daily papers throughout the country have been filled with accounts of the "last hours" of the condemned murderers in Sing Sing prison and the preparations for their execution. The idea of surrounding these executions with an air of mystery has had the effect of exciting the morbid curiosity and superstitious fears of the ignorant. The secrecy maintained has aroused the public mind to a sense of the danger attending the establishment of such a precedent. The fear that abuses might creep into the administration of justice under the cloak of secrecy and the fact that it would therefore be all the harder to correct these errors have done more toward creating opposition to the present law than the most sensational reports of bungled executions.

IT seems that the Order of Railway Telegraphers made a miscalculation in assuming that all it had to do was to knock at the doors of the Federation of Railway Employes to be admitted. A press dispatch from Terre Haute, Ind., states that the Supreme Council of the Federation rejected the application of the order—on what ground does not appear. The Brotherhood of Railway Station Men was likewise refused admission. It is further stated that representatives of the two unsuccessful organizations met at the Terre Haute hotel and formed an alliance, taking steps toward federation. A meeting will soon be held at which arrangements will probably be perfected for a second federation of railway employes. The Order of Railway Conductors is also at swords' points with the Federation, and, altogether, the latter aggregation appears to be in a bad way. We can only repeat our expression of regret that the railway telegraphers should have seen fit to mix in the melee.

A PERUSAL of Nikola Tesla's account of his recent experiments before the Institute leaves a different impression from that obtained through reading the incomplete reports of the lecture which have appeared heretofore. Most of the effects obtained, as was stated editorially last week, might have been deemed by some as only exaggerations of curious phenomena which are already familiar to many. The description, however, of the experiments prepared by the lecturer himself, carrying one as it does into the depths of a most interesting investigation of a fascinating subject, reveals that the experimenter has in reality opened up a line of work in which there are, apparently, unlimited possibilities. The boldness with which Mr. Tesla has struck out along a practically untrodden path cannot fail to excite admiration. As the reader follows him through these experiments there arises a feeling that the near future will witness astonishing developments in the direction of the application of currents of great frequency and high potential.

It is interesting to note that Mr. Tesla found during his [illegible] bodies which possess [illegible] such as glass, afford a rather inferior insulation to others, which, while they are good insulators, have a much smaller specific inductive capacity. Or, to quote Mr. Tesla's own words relative to the behavior of the dielectrics in the experiments, "The best insulator for these rapidly alternating currents would be the one possessing the smallest specific inductive capacity and at the same time one capable of withstanding the greatest differences of potential." In the latter class, which includes oils, he considers the dielectric losses to be less than in the former.

He thus indicates two opposite ways of securing the necessary insulation, i. e., to use either a perfect vacuum or a gas under great pressure. The difficulty of employing either method, however, is appreciated.

Mr. Tesla's remarks in regard to the heating of iron cores in apparatus for rapidly alternating currents may be found to be of value to the transformer builder.

His reference to the ideal method of lighting and his experiment relative to it, are suggestive. Whether the future will see a practical application of the electrostatic field in a lighting system such as suggested by Mr. Tesla's experiments is another of the interesting points in which the paper abounds.

MINNEAPOLIS is contemplating the introduction of an extensive underground system of electric light wires. One of the local lighting companies will undertake the work, and as the management of the company seems desirous of giving the underground system a fair trial the result of the experiment, for such it must still be considered, will be awaited with considerable interest. Electric lighting companies generally do not look with favor on underground construction, and it has been charged that where they have introduced conduits which did not prove entirely satisfactory they permitted the failure for the purpose of forcing the authorities to abandon the hope of securing first-class service from underground work. In this case such a charge could not be considered by the bitterest opponent of electric lighting companies.

There are many problems connected with the operation of underground wires which must be solved before lighting companies can be induced to bury all their wires. The example of the Minneapolis company will do much toward establishing confidence in the mind of the public.

IN a recent number of the London *Electrical Review* attention is called to two communications from A. L. Stevenson and Wm. H. Massey, in which it is claimed that the application of electricity to mining has not progressed as rapidly in this country as American engineers assert. To any one familiar with the facts the absurdity of the statement is evident at a glance. Thus, Mr. Massey says: "I was in the United States for several weeks last autumn, and I utterly failed to find, except in one solitary case in a coal mine near Pittsburgh, a single practical application of electricity to any of the numerous purposes you mentioned." Of course Mr. Massey's "several weeks" in this country enabled him to visit all the principal mines in the Union and inspect the improved machinery and methods employed! Mr. Massey should realize, if he knows anything about America and its mining interests, that only a very general idea of what is being done here could be obtained in that time. There are mining camps in this country which alone would require more time for intelligent examination than Mr. Massey devoted to all the mining interests in the country combined.

Mr. Massey should know that there are several coal mines in Illinois where he might witness the "practical application of electricity" to coal cutting. Then again the same power is used for illuminating the mines, the operation of hoists and tramways and in numerous other applications, but possibly this is not "practical" enough for Mr. Massey! The manner in which Mr. Massey obtained his information is explained by him in this paragraph: "There was plenty of talk of what might be done in the near future, and I was shown, in various works, a few more or less promising experimental machines; but after discussing the whole question fully with well informed Americans, I came to the conclusion that the applications of electricity to mining work in England and Wales were far more numerous than those on the whole of the American continent put together." Further comment on Mr. Massey and his conclusions is unnecessary.

And now a word with Mr. Stevenson. After airing his opinions he says: "But American engineers still come over here and find much in our mines to learn, and I have not met with any who can meet me and prove that upon a single engineering question he is right, and I am wrong, in respect of either safety or economy."

In view of this admission it would be useless to endeavor to penetrate the density of this self-confessed ignorance.

[Continued from page 19.]

fers only to currents from an ordinary high tension induction coil, which currents are necessarily very small; if received directly from a machine or from a secondary of low resistance they produce more or less powerful effects and may cause serious injury, especially when used in conjunction with condensers.

From the nature of the phenomenon we can conclude that the higher the frequency the smaller must, of course, be the wind produced by the streams, and with sufficiently high frequencies no wind at all would be produced at the ordinary atmospheric pressures. With frequencies obtainable by means of a machine the mechanical effect is sufficiently great to revolve, with considerable speed, large pin-wheels, which in the dark present a beautiful appearance owing to the abundance of the streams, Fig. 11.

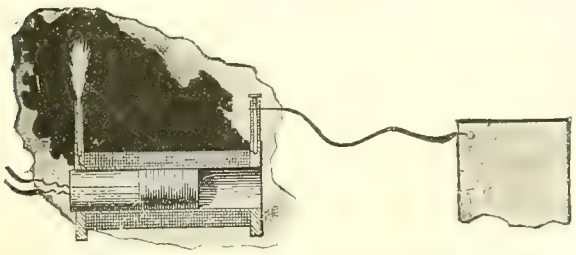


FIG 17A.—COIL ARRANGED FOR POWERFUL BRUSH EFFECTS.

In general, most of the experiments usually performed with a static machine can be performed with an induction coil when operated with very rapidly alternating currents. The effects produced, however, are much more striking, being of incomparably greater power. When a small length of ordinary cotton covered wire, Fig. 12, is attached to one terminal of the coil, the streams issuing from all points of the wire may be so intense as to produce a considerable light effect. When the potentials and frequencies are very high, a wire insulated with gutta percha or rubber and attached to one of the terminals appears to be covered with a luminous film. A very thin bare wire when attached to a terminal emits powerful streams and vibrates continually to and fro or spins in a circle, producing singular effect, Fig. 13.

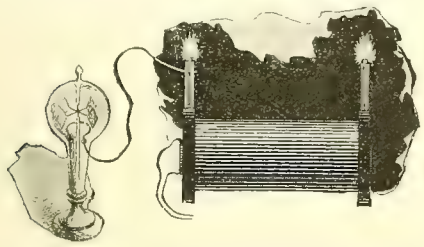


FIG. 19.—THE CROOKES EXPERIMENT ON OPEN CIRCUIT.

Another peculiarity of the rapidly alternating discharge of the induction coil is its radically different behavior with respect to points and rounded surfaces.

If a thick wire, provided with a ball at one end and with a point at the other, be attached to the positive terminal of a static machine, practically all the charge will be lost through the point, on account of the enormously greater tension dependent on the radius of curvature. But if such a wire is attached to one of the terminals of the induction coil it will be observed that with very high frequencies streams issue from the ball almost as copiously as from the point, Fig 14

FIG. 21.—LAMP WITH TWO FILAMENTS IN HIGHEST VACUUM WITH LEADING-IN WIRES.

There is still another and far more striking peculiarity of the brush discharge produced by very rapidly alternating currents. To observe this it is best to replace the usual terminals of the coil by two metal columns insulated with a good thickness of ebonite. It is also well to close all fissures and cracks with wax so that the brushes cannot form anywhere except at the tops of the columns. If the conditions are carefully adjusted—which, of course, must be left to the skill of the experimenter—so that the potential rises to an enormous value, one may produce two powerful brushes several inches long, nearly white at the roots which in the dark bear a striking resemblance to two flames of a gas escaping under pressure, Fig. 15. But they do not only [illegible], they are veritable flames for they are hot. Certainly they are not as hot as a gas burner but they would be so if the frequency and the potential would be sufficiently high. Produced with, say twenty thousand alternations per second, the heat is easily perceptible even if the potential is not excessively high. The heat developed is, of course, due to the impact of the air molecules, against the terminals and against each other. By preventing the change of the air molecules the local heating effect may be so exalted as to bring a body to incandescence. Thus, for instance, if a small button, or preferably a very thin wire or filament, be inclosed in an unexhausted globe and connected with the terminal of the coil, it may be rendered incandescent. The phenomenon is made much more interesting by the rapid spinning round in a circle of the top of a filament, thus presenting the appearance of a luminous funnel, Fig. 16, which widens when the potential is increased. When the potential is small the end of the filament may perform irregular motions, suddenly changing from one to the other, or it may describe an ellipse; but when the potential is very high it always spins in a circle, and so does generally a thin straight wire attached freely to the terminal of the coil.

One of the ways to prevent the streams between the primary and the tube, is to wind a short primary, Fig. 17 A, so that the difference of potential is not at that length great enough to cause the breaking forth of the streams through the insulating tubes. The length of the primary should be determined by experiment. Both the ends of the coil should be brought out on one end through a plug of insulating material fitting in the tube as illustrated. In such a disposition one terminal of the secondary is attached to a body the surface of which is determined with the greatest care so as to produce the greatest rise in the potential. At the other terminal a powerful brush appears which may be experimented upon

The above plan necessitates the employment of a primary of comparatively small size, and it is apt to heat when powerful effects are desirable for a certain length of time. In such a case it is better to employ a larger coil. Fig. 17 B, and introduce it from one side of the tube, until the streams begin to appear. In this case the nearest terminal of the secondary may be connected to the primary or to the ground, which is practically the same thing, if the primary is connected directly to the machine. In the case of ground connections it is well to determine experimentally the frequency which is best suited under the conditions of the test Another way of obviating the streams more or less, is to make the primary in sections and supply it from separate well insulated sources

FIG. 20.—LAMP WITH SINGLE BLOCK OF REFRACTORY MATERIAL.

In many of these experiments, when powerful effects are wanted for a short time it is advantageous to use iron cores with the primaries. In such case a very large primary coil may be wound and placed side by side with the secondary, and, the nearest terminal of the latter being connected to the primary, a laminated iron core is introduced through the primary into the secondary as far as the streams will permit.

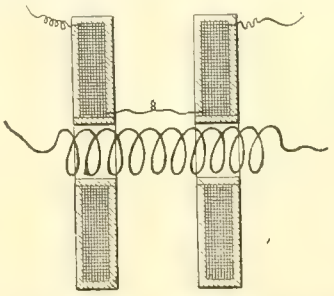


FIG. 18.—COIL FOR PRODUCING VERY HIGH DIFFERENCE OF POTENTIAL.

In these experiments if an iron core is used it should be carefully watched, as it is apt to get excessively hot in an incredibly short time. To give an idea of the rapidity of the heating, I will state, that by passing a powerful current through a coil with many turns, the inserting within the same of a thin iron wire for no more than one second's time is sufficient to heat the wire to something like 100° C.

But this rapid heating does not need to discourage us in the use of iron cores in connection with rapidly alternating currents. I have for a long time been convinced, that in the industrial distribution by means of transformers some such plan as the former might be practicable. We may use a comparatively small iron core, subdivided, or perhaps not even subdivided. We may surround this core with a

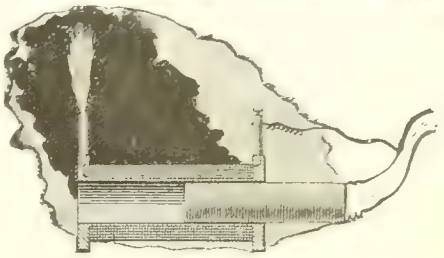


FIG. 17B.—COIL ARRANGED FOR POWERFUL BRUSH EFFECTS—ST ELMO'S HOT FIRE.

would be sufficiently thick only a limited amount of energy could be radiated in spite of the high temperature. Transformers have been constructed by me on that plan, but for lack of time, no thorough tests have as yet been made.

Another way of adapting the iron core to rapid alternations, or, generally speaking, reducing the frictional losses, is to produce by continuous magnetization a flow of something like seven thousand or eight thousand lines per square centimeter through the core and then work with weak magnetizing forces and preferably high frequencies around the point of greatest permeability.

FIG. 23.—LAMP WITH SINGLE STRAIGHT FILAMENT AND ONE LEADING-IN WIRE.

If it is desired to construct a coil for the express purpose of performing with it such experiments as I have described, or, generally, rendering it capable of withstanding the greatest possible difference of potential, then a construction as indicated in Fig. 18 will be found of advantage. The coil in this case is formed of two independent parts which are wound oppositely, the connection between both being made near the primary. The potential in the middle being zero, there is not much tendency to jump to the primary, and not much insulation is required. In some cases, the middle point may, however, be connected to the primary or to the ground. In such a coil the places of greatest difference of potential are far apart and the coil is capable of withstanding an enormous strain. The two parts may be movable so as to allow a slight adjustment of the capacity effect.

FIG. 22.—LAMP WITH TWO REFRACTORY BLOCKS IN HIGHEST VACUUM.

As to the manner of insulating the coil it will be found convenient to proceed in the following way: First the wire should be boiled in paraffine, until all the air is out; then the coil is wound by running the wire through melted

paraffine wetted for the purpose of fixing the wire. The coil is then taken off from the spool, immersed in a cylindrical vessel filled with pure melted wax and boiled for a long time until the bubbles cease to appear. The whole is then left to cool down thoroughly, and then the mass is taken out of the vessel and turned up in a lathe. A coil made in this manner and with care is capable of withstanding enormous potential differences.

It may be found convenient to immerse the coil in paraffine oil or some other kind of oil; it is a most effective way of insulating, principally on account of the perfect exclusion of air, but it may be found that after all a vessel

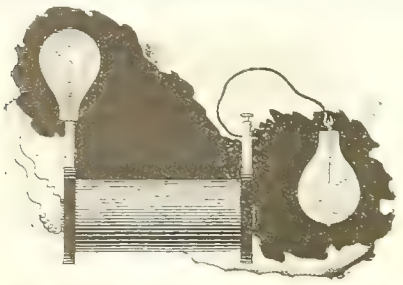


FIG. 24.—LAMPS WITH ONE LEADING-IN WIRE RENDERED INCANDESCENT.

filled with oil is not a very convenient thing to handle in a laboratory.

If an ordinary coil can be dismounted, the primary may be taken out of the tube and the latter plugged up on one end, filled with oil and the primary reinserted. This affords an excellent insulation, and prevents the formation of the streams.

I have stated that a body inclosed in an unexhausted bulb may be intensely heated by simply connecting it with a source of rapidly alternating potential. The heating in such a case, is in all probability, due mostly to the bombardment of the molecules of the gas contained in the bulb. When the bulb is exhausted the heating of the body is much more rapid and there is no difficulty whatever in bringing a wire or filament to any degree of incandescence by simply connecting it to one terminal of a coil of the proper dimensions. Thus, if the well-known apparatus of Prof. Crookes, consisting of a bent platinum wire with vanes mounted over it, Fig. 19, be connected to one terminal of the coil—either one or both ends of the platinum wire being connected—the wire is rendered almost instantly incandescent, and the mica vanes are rotated as though a current from a battery were used. A thin carbon filament, or, preferably, a button of some refractory material, Fig. 20, even if it be a comparatively poor conductor, inclosed in an exhausted globe, may be rendered highly incandescent; and in this manner a simple lamp capable of giving any desired candle power is provided.

The success of lamps of this kind would depend largely on the selection of the light-giving bodies contained within the bulb. Since, under the conditions described, refractory bodies—which are very poor conductors and capable of withstanding for a long time excessively high degrees of temperature—may be used, such illuminating devices may be rendered successful.

At the outset of this work the idea presented itself to

FIG. 26A.

FIG. 26B.

LAMP WITH ONE FILAMENT, ONE INSIDE AND ONE OUTSIDE CONDENSER COATING.

In an ordinary lamp this is impracticable on account of the destruction of the filament, and it has been determined by experience how far it is advisable to push the incandescence. It is impossible to tell how much higher efficiency could be obtained if the filament could withstand indefinitely, as the investigation to this end obviously cannot be carried beyond a certain stage; but there are reasons for believing that it would be very considerably higher. An improvement might be made in the ordinary lamp by employing a short and thick carbon; but then the leading-in wires would have to be thick, and besides, there are many other considerations which render such a modification highly impracticable. But in a lamp as above described, the leading-in wires may be very small, the incandescent refractory material may be in the shape of blocks offering a very small radiating surface, so that less energy would be required to keep them at the desired incandescence; and in addition to this the refractory material need not be carbon, but may be manufactured from mixtures of oxides, for instance, with carbon or other material, or may be selected from bodies which are practically non-conductors and capable of withstanding enormous degrees of temperature.

Various forms of lamps on the above described principle with the refractory bodies in the form of filaments, Fig. 21, or blocks, Fig. 22, have been constructed and operated by me, and investigations are being carried on in this line.

With these rapidly alternating potentials there is, however, no necessity of inclosing two blocks in a globe, but a single block, as in Fig. 20, or filament, Fig. 23, may be used. The potential in this case must of course be higher, but it is easily obtainable and besides it is not necessarily dangerous.

The facility with which the button or filament in such a lamp is brought to incandescence, other things being equal, depends on the size of the globe. If a perfect vacuum could be obtained, the size of the globe would not be of importance, for then the heating would be wholly due to the surging of the charges and all the energy would be given off to the surroundings by radiation. But this can never occur in practice. There is always some gas left in the globe and although the exhaustion may be carried to

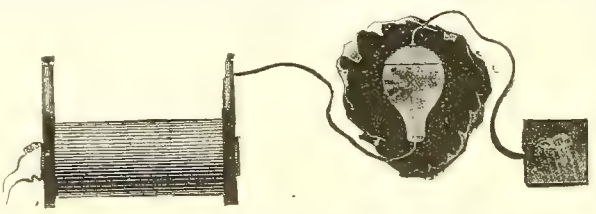


FIG. 29.—INCREASING THE BRILLIANCY OF LAMP ON ONE WIRE.

the highest degree, still the space inside of the bulb must be considered as conducting when such high potentials are used, and I assume, that in estimating the energy that may be given off from the filament to the surroundings we may consider the inside surface of the bulb as one coating of a condenser, the air and other objects surrounding the bulb forming the other coating. When the alternations are very low there is no doubt that a considerable portion of the energy is given off by the electrification of the surrounding air.

In order to study this subject better I carried on some experiments with excessively high potentials and low frequencies. I then observed that when the hand is approached to the bulb—the filament being connected with one terminal of the coil—a powerful vibration is felt being due to the attraction and repulsion of the molecules of the air which are electrified by induction through the glass. In some cases when the action is very intense I have been able to hear a sound, which must be due to the same cause.

When the alternations are low one is apt to get an excessively powerful shock from the bulb. In general, when one attaches bulbs or objects of some size to the terminals of the coil, one should look out for the rise of potential, for it may happen that by merely connecting a bulb or plate to the terminal, the potential may rise to many times its original value. When lamps are attached to the terminals, as illustrated in Fig. 24, then the capacity of the bulbs should be such as to give the maximum rise of potential under the existing conditions. In this manner one may obtain the required potential with fewer turns of wire.

The use of alternating currents of very high frequency makes it possible to transfer by electrostatic or electro-magnetic induction through the glass of a lamp, sufficient energy to keep a filament at incandescence, and so do away with the leading-in wires.

In the accompanying cuts some of the types of lamps of this kind are shown. Fig. 25 is such a lamp with a broken filament, and Fig. 26 A and 26 B one with a single outside and inside coating, and a single filament. I have also made lamps with two outside and inside coatings and a continuous loop connecting the latter.

The disruptive discharge of a condenser is especially suited for operating such lamps—with no outward electrical connections—by means of electromagnetic induction; the electromagnetic inductive effects being excessively high, and I have been able to produce the required incandescence with only a few short turns of wire. Incandescence may also be produced in this manner in a simple closed filament.

Leaving now out of consideration the practicability of such lamps, I would only say that they possess a beautiful and desirable feature, namely that they can be rendered, at will, more or less brilliant simply by altering the relative position of the outside and inside condenser coatings or inducing and induced circuits.

When a lamp is lighted by connecting it to one terminal only of the source this may be facilitated by providing the globe with an outside condenser coating, which serves at the same time as a reflector and connecting this to an insulated body of some size. Lamps of this kind are illustrated in Fig. 27 and Fig. 28. Fig. 29 shows the plan of connections. The brilliancy of the lamp may, in this case,

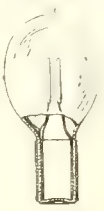


FIG. 25.—LAMP WITH TWO BLOCKS OR FILAMENTS AND A PAIR OF INDEPENDENT INSIDE AND OUTSIDE CONDENSER COATINGS.

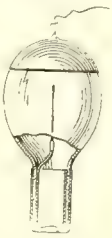


FIG. 28.—LAMP WITH ONE FILAMENT, ONE INSIDE AND ONE OUTSIDE CONDENSER COATING, AND AUXILIARY COATING.

be regulated within wide limits by varying the size of the insulated metal plate to which the coating is connected.

It is likewise practicable to light with one leading wire, lamps such as illustrated in Fig. 21 and Fig. 22, by connecting one terminal of the lamp to one terminal of the source and the other to an insulated body of the required size. In all cases the insulated body serves to give off the energy into the surrounding space, and is equivalent to a return wire. Obviously in the two last named cases, instead of connecting the wires to an insulated body, connections may be made to the ground.

During my investigations in this line, I endeavored to excite tubes, devoid of any electrodes, by electromagnetic induction, making the tube the secondary of the induction device, and passing through the primary the discharges of a Leyden jar. These tubes were made of many shapes, and I was able to obtain luminous effects which I then thought were due wholly to electromagnetic induction. But on carefully investigating the phenomena I found that the effects produced were more of an electrostatic nature. It may be attributed to this circumstance that this mode of exciting tubes is very wasteful, namely, the primary circuit being closed, the potential, and consequently the electrostatic inductive effect is much diminished.

When an induction coil, operated as above described, is used, there is no doubt that the tubes are excited by electrostatic induction and that electromagnetic induction has little, if anything, to do with the phenomena.

By placing a tube at some distance from the coil, and nearer to one terminal—preferably at a point on the axis of the coil—one may light it by touching the remote terminal with an insulated body of some size or with the hand, thereby raising the potential at that terminal nearer the tube. If the tube is shifted nearer to the coil so that it is lighted by the action of the nearer terminal, it may be made to go out by holding, on an insulated support, the end of a wire connected to the remote terminal, in the vicinity of the nearer terminal, by this means counteracting the action of the latter upon the tube. These effects are evidently electrostatic. Likewise, when a tube is placed

FIG. 27.—LAMP WITH ONE FILAMENT AND LEADING-IN WIRE AND EXTERNAL CONDENSER COATING.

at considerable distance from the coil, the observer may, standing upon an insulated support between coil and tube, light the latter by approaching the hand to it; or he may even render it luminous by simply stepping between it and the coil. This would be impossible with electromagnetic induction, for the body of the observer would act as a screen.

When the coil is energized by excessively weak currents, the experimenter may, by touching one terminal of the coil with the tube, extinguish the latter, and may again light it by bringing it out of contact with the terminal and allowing a small arc to form. This is clearly due to the respective lowering and raising of the potential at that terminal. In the above experiment when the tube is lighted through a small arc it may go out when the arc is broken, because the electrostatic inductive effect alone is too weak, though the potential may be much higher; but when

the arc is established the electrification of the end of the tube is much greater and it consequently lights.

If a tube is lighted by holding it near to the coil, and in the hand, which is remote, by grasping the tube anywhere with the other hand, the part between the hands is rendered dark and the singular effect of wiping out the light of the tube may be produced by passing the hand quickly along the tube and at the same time withdrawing

FIG. 33.—LAMP KEPT AT INCANDESCENCE ACROSS A THICK COPPER BAR—SHOWING NODES.

it slightly from the coil, judging properly the distance so that the tube remains dark afterward.

If the primary coil is placed sidewise as in Fig. 17 B, for instance, and an exhausted tube be introduced from the other side in the hollow space, the tube is lighted most intensely because of the increased condenser action, and in this position the striæ are most sharply defined. In all these experiments described and in many others the action s clearly electrostatic.

The effects of screening also indicate the electrostatic nature of the phenomena and show something of the nature of electrification through the air. For instance, if a tube be placed in the direction of the axis of the coil and an insulated metal plate be interposed, the tube will generally increase in brilliancy, or if it be too far from the coil to light, it may even be rendered luminous by interposing an insulated metal plate. The magnitude of the effects depends to some extent on the size of the plate. But if the metal plate be connected by a wire to the ground its interposition will always make the tube go out even if it be very near the coil. In general, the interposition of a body between the coil and tube increases or diminishes the brilliancy of the tube or its facility to light up, according to whether it increases or diminishes the electrification. When experimenting with an insulated plate the plate should not be taken too large else it will generally produce a weakening effect by reason of its great facility for giving off energy to the surroundings.

If a tube be lighted at some distance from the coil and a plate of hard rubber or other insulating substance be interposed, the tube may be made to go out. The interposition of the dielectric in this case only slightly increases the inductive effect, but diminishes considerably the electrification through the air.

In all the last described experiments tubes devoid of any electrodes may be used, and there is no difficulty in producing by their means sufficient light to read by. The light effect is, however, considerably increased by the use of phosphorescent bodies such as yttria, uranium glass, etc.

Instead of depending on induction at a distance to light the tube, the same may be provided with an external—and, if desired, also with an internal—condenser coating, and may then be suspended anywhere in the room from a conductor connected to one terminal of the coil, and in this manner a soft illumination may be provided.

The ideal way of lighting a hall or room would, however, be to produce such a condition in it that an illumina-

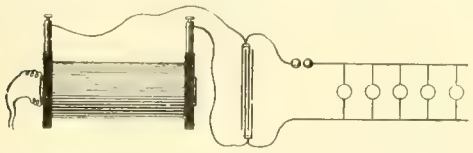


FIG. 31.—DIAGRAM OF CONNECTIONS FOR CONVERTING FROM HIGH TO LOW TENSION BY MEANS OF THE DISRUPTIVE DISCHARGE.

ting device could be moved and put anywhere, and that it is lighted, no matter where it is put and without being electrically connected to anything. I have been able to produce such a condition by creating in the room a powerful, rapidly alternating electrostatic field. For this purpose I suspend a sheet of metal a distance from the ceiling on insulating cords and connect it to one terminal of the induction coil, the other terminal being preferably connected to the ground. Or else I suspend two sheets as illustrated in Fig. 30, each sheet being connected with one of the terminals of the coil, and their size being carefully determined. An exhausted tube may then be carried in the hand anywhere between the sheets or placed anywhere, even a certain distance beyond them; it remains always luminous.

In such an electrostatic field interesting phenomena may be observed, especially if the alternations are kept low and the potentials excessively high. In addition to the luminous phenomena mentioned, one may observe that any insulated conductor gives sparks when the hand or another object is approached to it, and the sparks may often be powerful. When a large conducting object is fastened on an insulating support and the hand approached to it a vibration due to the rythmical motion of the air molecules is felt and luminous streams may be perceived when the hand is held near a pointed projection. When a telephone receiver is made to touch with one or both of its terminals an insulated conductor of some size, the telephone emits a loud sound; it also emits a sound when a length of wire is attached to one or both terminals, and with very powerful fields a sound may be perceived, even without any wire.

How far this principle is capable of practical application the future will tell. It might be thought that electrostatic effects are unsuited for such action at a distance. Electromagnetic inductive effects, if available for the production of light, might be thought better suited. It is true the electrostatic effects diminish nearly with the cube of the distance from the coil, whereas the electromagnetic inductive effects diminish simply with the distance. But when we establish an electrostatic field of force the condition is very different, for then instead of the differential effect of both the terminals we get their conjoint effect. Besides, I would call attention to the fact that in an alternating electrostatic field a conductor, such as an exhausted tube, for instance, tends to take up most of the energy, whereas in an electromagnetic alternating field the conductor tends to take up the least energy, the waves being reflected with but little loss. This is one reason why it is difficult to excite an exhausted tube at distance by electromagnetic induction. I have wound coils of very large diameter and of many turns of wire, and connected a Geissler tube to the ends of the coil with the object of exciting the tube at distance; but even with the powerful inductive effects producible by Leyden jar discharges the tube could not be excited unless at very small distance, although some judgment was used as to the dimensions of the coil. I have also found that even the most powerful Leyden jar

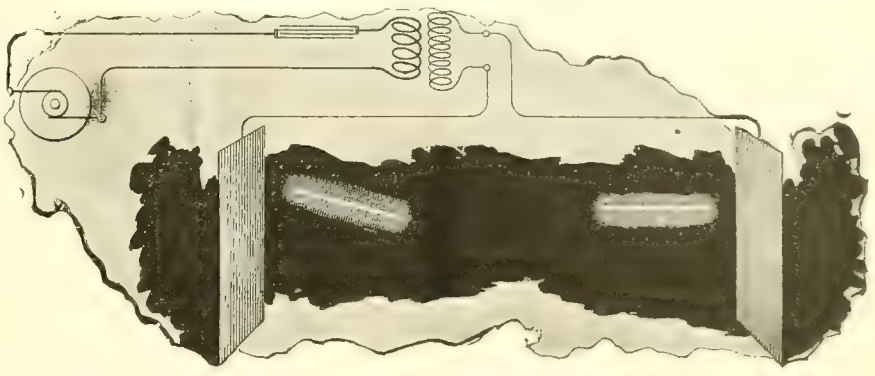


FIG. 30.—IDEAL METHOD OF LIGHTING A ROOM.—TUBES DEVOID OF ANY ELECTRODES RENDERED BRILLIANT IN AN ALTERNATING ELECTROSTATIC FIELD.

discharges are capable of exciting only feeble luminous effects in a closed exhausted tube, and even these effects upon thorough examination I have been forced to consider of an electrostatic nature.

When the terminals of a high tension induction coil, Fig. 31, are connected to a Leyden jar, and the latter is discharging disruptively into a circuit, we may look upon the arc playing between the knobs as being a source of alternating, or, generally speaking, undulating currents, and then we have to deal with the familiar system of a generator of such currents, a circuit connected to it, and a condenser bridging the circuit. The condenser in such case is a veritable transformer, and since the frequency is excessive, most any ratio in the strength of the currents in both the branches may be obtained. In reality the analogy is not quite complete for in the disruptive discharge we have most generally a fundamental instantaneous variation of comparatively low frequency and a superimposed harmonic vibration, and the laws governing the flow of currents are not the same for both.

In converting in this manner the ratio of conversion should not be too great, for the loss in the arc between the knobs increases with the square of the current, and if the jar be discharged through very thick and short conductors, with the view of obtaining a very rapid oscillation, a very considerable portion of the energy stored is lost. On the other hand, too small ratios are not practicable for many obvious reasons.

As the converted currents flow in a practically closed circuit the electrostatic effects are necessarily small, and I therefore convert them into currents or effects of the required character. I have effected such conversions in several ways. The preferred plan of connections is illustrated in Fig. 32. The manner of operating renders it easy to obtain by means of a small and inexpensive apparatus enormous differences of potential, which have been usually obtained by means of large and expensive coils. For this it is only necessary to take an ordinary small coil, adjust to it a condenser and discharging circuit forming the primary of an auxiliary small coil, and convert upward. As the inductive effect of the primary currents is excessively great the second coil need have comparatively but very few turns.

In Fig. 31 a plan of connections is shown for convert-

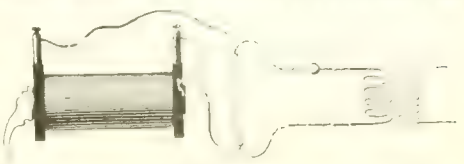


FIG. 32.—MANNER OF OPERATING AN INDUCTION COIL

erate ordinary lamps and even motors in this manner. The line being connected to the ground, all the wires could be handled with perfect impunity, no matter how high the potential at the terminals of the condenser. In these experiments a high tension induction coil, operated from a battery or from an alternate current machine, was employed to charge the condenser; but the induction coil might be replaced by an apparatus of a different kind, capable of giving electricity of such high tension. In this manner direct or alternating currents may be converted, and in both cases the current impulses may be of any desired frequency. When the currents charging the condenser are of the same direction, and it is desired that the converted currents should also be of one direction, the resistance of the discharging circuit should, of course, be so chosen that there are no oscillations.

In operating devices on the above plan I have observed curious phenomena of impedance which are of interest. For instance, if a thick copper bar be bent as indicated in Fig. 33 and shunted by ordinary incandescent lamps, then, by passing the discharge between the knobs, the lamps may be brought to incandescence although they are short-circuited. When a large induction coil is employed it is easy to obtain nodes on the bar, which are rendered evident by the different degrees of brilliancy of the lamps, as shown roughly in Fig 33. The nodes are never clearly pronounced, but there are simply maxima and minima of potential along the bar. This is probably due to the irregularity of the arc between the knobs. In general, when the above described plan of conversion from high to low tension is used, the behavior of the disruptive discharge may be closely studied. The nodes may also be investigated by means of an ordinary Cardew voltmeter, which should be well insulated. Geissler tubes may also be lighted across the points of the bent bar; in this case, of course, it is better to employ smaller capacities. I have found it practicable to light up in this manner a lamp and even a Geissler tube shunted by a short heavy block of metal, and this result seems at first very curious. In fact, the thicker the copper bar in Fig. 33, the better it is for the success of the experiments, as they appear more striking. When lamps with long slender filaments are used it will

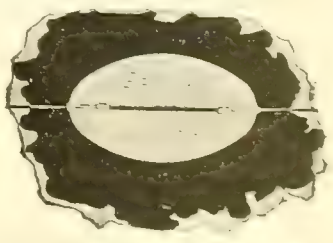


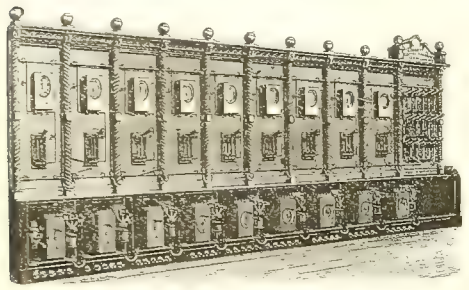
FIG. 34.—PHENOMENON OF IMPEDANCE IN AN INCANDESCENT LAMP.

be often noted that the filaments are from time to time violently vibrated, the vibration being smallest on the nodal points. This vibration seems to be due to an electrostatic action between the filament and the glass of the bulb.

In some of the above experiments it is preferable to use special lamps having a straight filament, as shown in Fig. 34. When such a lamp is used a still more curious phenomenon than those described may be observed. The lamp may be placed across the copper bar and lighted up by using somewhat larger capacities, or, in other words, smaller frequencies or smaller impulsive impedances, the

filament may be brought to any desired degree of incandescence. But when the impedance is increased, a point is reached when comparatively little current passes through the carbon and most of it through the rarefied gas, or perhaps it may be more correct to state that the current divides nearly evenly through both, in spite of the enormous difference in the resistance, and this would be true unless the gas and the filament behave differently. It is then noted that the whole bulb is brilliantly illuminated, and the ends of the leading in wires become incandescent and often throw off sparks in consequence of the violent bombardment; but the carbon filament remains dark. This is illustrated in Fig. 34. Instead of the filament a single wire extending through the whole bulb may be used, and in this case the phenomenon would seem to be still more interesting.

From the above experiment it will be evident, that when ordinary lamps are operated by the converted currents, those should be preferably taken in which the platinum wires are far apart, and the frequencies used should not be too great, else the discharge will occur at the ends of the filament or in the base of the lamp between the leading in wires, and the lamp might then be damaged.



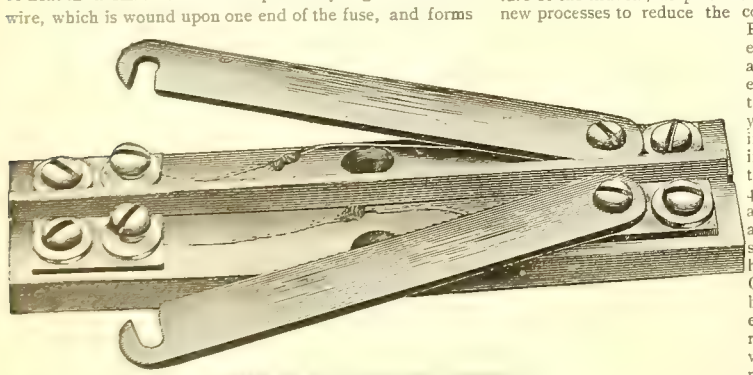
SWITCH-BOARD FOR THE ROCHESTER ELECTRIC RAILWAY.

Switch-board for the Rochester Electric Railway.

In the accompanying cut is shown a switch-board for the electric railway at Rochester, N. Y. The upper portion is built of mahogany, delicate workmanship being shown in the pillars and cornices. The rheostats and protecting devices and heavy switches are arranged in a row on the lower portion of the board, which is made of slate highly polished and given an ebony finish. The upper portion of the board is occupied by regulating devices and switches. The board, which was made by the Short Electric Railway company of Cleveland, is pronounced the most complete in the country. The cut is reproduced from the *Street Railway Journal*.

The W. B. G. Circuit Protector.

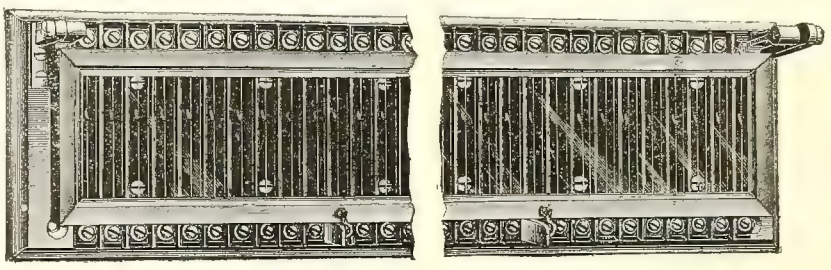
It is well known that a piece of fine wire laid out straight and exposed to the air can easily carry enough current to destroy a pair of magnet coils composed of much larger wire than the straight piece, and it is upon this fact that the construction of the device illustrated in the cuts is based. The main features of the "W. B. G." protector is the manner in which the fuse is melted by the generation of heat in a small coil of comparatively high resistance wire, which is wound upon one end of the fuse, and forms



2-WIRE W. B. G. CIRCUIT PROTECTOR.

Proposed Consolidation of Supply Interests.

The project of consolidating the electrical supply houses of the country has been revived by the recent failure of the Empire City Electric company. The sharp competition and tight money market had made it impossible to continue the business, and the promoters of the enterprise endeavored to effect a combination, but failed. Several attempts were made, it is asserted, to form a trust of the leading supply companies of the country, but without success. F. S. Terry of the Electrical Supply company, Chicago, speaking of the failure, says: "It is not surprising that the promoters of the company should desire to discontinue a business which has grown unprofitable. The supply companies are in the midst of a dull season, and the profits are very much narrowed by the bitter competition between the numerous companies. There have been frequent attempts toward the formation of a trust here but none has succeeded as yet, nor are they likely to succeed in the future." He added: "However there are plans on foot at present for an arrangement between the companies to regulate prices, and the prospects for their success are encouraging. Until this is done the dealer in electrical supplies must be satisfied with a narrow margin of profits."



50-WIRE W. B. G. CIRCUIT PROTECTOR BOARD.

La Boiteaux Fan Outfit.

In the accompanying illustration is shown a new style of fan motor brought out by the La Boiteaux Electric Motor & Fan company of Cincinnati. The distinguishing feature is the revolution of the whole outfit—motor, fan and all—on the iron pedestal which serves as the base. While the fan itself is whirling around at the rate of 2 000 revolutions per minute the whole apparatus slowly revolves on the upright pedestal at the rate of ten revolutions per minute. It is claimed that this double motion results in greater effectiveness in stirring the air, while the unpleasant effects of a continuous draught in one direction are not felt. The fans are furnished with or without lamp attachments.

Production of Aluminum.

The statistics gathered by the census department of the government relating to the production of aluminum will be received with special interest by the electrical fraternity. A bulletin relating to this metal has been prepared by R. L. Packard of the Division of Mines and Mining of the Census Office. This interesting metal has at last reached the stage of actual production, and the United States is now one of the leading producers. The all-important feature of the industry at present, however, is the effort by new processes to reduce the cost of making the metal Prominence is therefore given to a concise and very exact resume of the methods of extraction of aluminum and their results for a number of years, with other valuable information relating to this industry. The product for the census year 1889 was 47,468 pounds, including aluminum in alloys, valued at $97,335. The principal sources of aluminum have heretofore been cryolite from Greenland and imported bauxite, but recent discoveries of bauxite have been made in Arkansas, which will, no doubt, lead to the more extensive use of the domestic article.

Mr. Packard believes that aluminum has been attracting an amount of attention during the last two or three years which is out of proportion to its actual importance as a metal and the position in the arts which it has hitherto occupied. This is accounted for, he says, by the comparatively recent appearance of the metal in commerce, the difficulty of extracting it, and the unfamiliar and elaborate metallurgical processes which have been invented in consequence. Some of these processes are reproductions on a large scale of experiments which are not ordinarily used, even in chemical laboratories. A brief resume of the history of these methods of extraction and their results will give a correct idea of the scope and merit of the industry.

In 1807 and 1808 Sir Humphrey Davy succeeded in obtaining the metals from the alkaline earths, baryta, strontia, lime, and magnesia, by electricity. His method was to place a piece of the respective earths, on a strip of platinum connected with the positive pole of a powerful battery, put mercury in a small cavity in the paste, and connect it with the negative wire of the battery. Under the influence of the current the metallic oxide (the earth) was decomposed, an amalgam of the metal which it contained was formed, and the pure metal was obtained from this by distilling off the mercury. On applying this method to a paste made of alumina, Sir Humphrey Davy could not obtain the expected amalgam; he therefore varied the experiment in a way which is notable in view of certain recent methods, and which he described as follows:

"The first experiment by which I obtained evidence of its composition was made in 1808 by fusing iron negatively electrified in contact with it. The earth was moist in this process, and a very high voltaic power was applied. The globule of metal obtained was whiter than pure iron, effervesced slowly in water, becoming covered with a white powder, and the solution in muriatic acid decomposed by an alkali afforded alumina and oxide of iron."

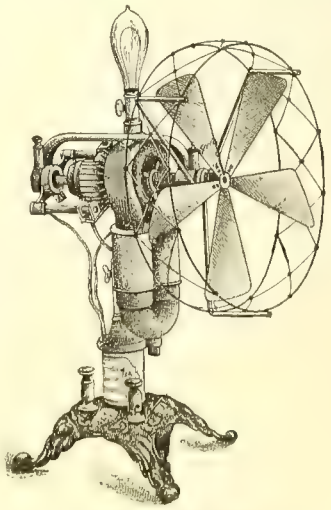
He continues:

"By passing potassium in vapor through alumina heated to whiteness the greatest part of the potassium became converted into potassa, which formed a coherent mass with that part of the alumina not decompounded, and in this mass there were numerous gray particles, having the metallic luster and which became white when heated in the air, and which slowly effervesced in water."—1840, *vol.* 4, *p.* 262,

Inconclusive as these experiments are as far as the separation of aluminum is concerned, they are interesting as the pioneers of the two lines of experiments, the electrical and chemical, each of which afterward led to the establishment of a commercial process.

The next step in advance was in the line of chemical experiment. Sir Humphrey Davy had failed to obtain aluminum from alumina, the oxide of the metal, by potassium vapor. Some twenty years later Woehler, by substituting the chloride of aluminum for the oxide in this operation, succeeded in obtaining the metal, and was able to determine its physical properties.

In the account of his own works, published in 1827,[1] Woehler describes Oersted's experiments, made three years previously, and attributes to him the discovery of volatile aluminum chloride, which he prepared by the method, now well known in practice, of passing chlorine gas over a mixture of alumina and carbon heated to redness. By acting on the chloride so obtained with potassium amalgam Oersted stated that he had obtained an amalgam of aluminum from which he had recovered the metal by distilling off the mercury. Woehler repeated this experiment, but was unable to obtain aluminum, the metal remaining, after distilling off the mercury, being only potassium left over from the amalgam which had been used in the experiment. He did, however, succeed in reducing aluminum chloride by potassium itself, operating in porcelain crucibles. The aluminum was obtained in the form of a gray powder, and was not pure.



LA BOITEAUX FAN OUTFIT.

In 1845 Woehler renewed his experiments,[2] but in order to avoid the lively chemical reaction he varied the arrangement in such a way as to keep the aluminum chloride and potassium separate while the potassium was melted in the vapor of the chloride. This was accomplished in two ways: First, he introduced the chloride into a platinum tube, and then placed a platinum boat containing potassium in the tube near it. The tube was gradually heated to redness, when the chloride was volatilized and passed in vapor over the melted potassium, which decomposed the chloride and liberated the aluminum. He also placed the

1. Poggendorff's Annalen, xi, p. 117.
2. Poggendorff's Annalen, lxiv, 1845, pp. 147-451

potassium in a small porcelain crucible, which was set in a larger one, and the space between was filled with chloride. The whole was well covered and heated, when the reaction occurred. As before, the aluminum so obtained seemed to be in the form of a gray powder, but on closer inspection this powder was seen to be composed of tin-white metallic globules. Woehler determined the specific gravity and other properties of these globules.

These laboratory experiments were resumed by H. Sainte-Claire Deville in France in 1854, who substituted sodium for potassium and operated on a larger scale than his predecessors He placed aluminum chloride in considerable quantity in a glass tube, into which porcelain boats containing sodium were introduced, and the tube was then heated. The aluminum chloride was volatilized, and, coming in contact with the melted sodium, was decomposed thereby with a lively incandescence, forming chlorides of aluminum and sodium and setting free the aluminum, which was retained in the double chloride in a finely divided state. This mixture was then placed in boats made of retort carbon, which were highly heated in a porcelain tube, through which a current of dry hydrogen was passed. The double chloride was distilled off by this means, leaving the aluminum, which was afterward re melted and run into ingots. This was the method which Deville carried out on a large scale in 1855 in a furnace consisting of a retort for distilling the aluminum chloride, a chamber connected therewith containing iron nails to hold any ferric chloride which might distill over, and a third chamber beyond this containing trays of sodium. The inventor found much to improve in the details of the process, and by 1859 it had become modified so that the reduction was effected in a reverberatory furnace and fluorspar or cryolite was used as a flux. The double chloride aluminum and sodium which was used in this operation was made by heating a mixture of alumina, carbon, and common salt in a retort and passing dry chlorine gas through it, on the principle introduced by Oersted, whereby the double chloride was distilled over and caught in a receiver. Since that date many improvements have been made in the way of lessening the cost of the materials used in the process, especially in the manufacture of sodium by the Castner process in England, but the metallurgy remains substantially as it was when Deville established it.[1]

This was the only process in practical operation in Europe down to three or four years ago. No serious attempt was ever made to introduce it into this country, because the limited uses and the high price of aluminum and its difficult metallurgy, which would be still more costly in this country than in Europe, where the refinements of chemical technology are more familiar than here, all conspired to repel investment in any large way.

The first step in advance in the electro-metallurgy of aluminum dates from the electrical decomposition of the fused double chloride of aluminum and sodium in 1854. The electrical decomposition of fused magnesium chloride by Prof. Bunsen led to operating in a similar way on the fused double chloride of aluminum and sodium. Bunsen, in Germany, and Deville, in France, obtained metallic aluminum in this way, but no attempt was made to repeat the operation on an industrial scale until a much later date, when the introduction of modern dynamo electric machines made it feasible.

The Siemens electric furnace, patented in England in 1879 which was the forerunner of certain recent furnaces, may be regarded as a further advance toward the electric-metallurgy of aluminum. It consisted of a large crucible, placed in a vessel filled with charcoal as a non-conductor. The cathode passed through the bottom of the crucible, and was in contact with the metal to be melted by the heat of the arc. The anode passed through a hole in the cover of the crucible, and the distance between the poles was ingeniously regulated by a solenoid. [2] Iron. steel, and platinum were melted in this crucible.

The intense heat which the electric current is capable of producing for metallurgical purposes was now known. It was also known that aluminum could be obtained by electrolysis, and the time was ripe for the industrial application of these facts as soon as dynamo electricity would be made available. Accordingly, in the last decade electro-metallurgical processes for obtaining aluminum have become favorite subjects for patents with inventors. It is sufficient to describe briefly the two which have been commercially successful in this country, and they will serve as types of all. The earlier of these, the Cowles process, was established in 1885, and is at present confined to the production of aluminum alloys, viz., aluminum bronze (and brass) and ferro aluminum. This process, which is now well known to persons interested in metallurgy, consists in passing the current from a powerful dynamo through a mixture of alumina (in the form of corundum, bauxite, etc.), carbon, and pieces of copper contained in a suitable vessel lined with carbon, through the ends of which vessel the large terminals of the dynamo are inserted. The mixture is arranged so as to prevent short circuiting. On passing the current the alumina is reduced in the presence of carbon and unites with the melted copper to form an alloy rich in aluminum This alloy is afterward remelted, and enough copper added to it to reduce the aluminum contents to the proportions desired for aluminum alloys of the required grades.

The production of aluminum bronze has been increased since 1885 from 4,000 to 5,000 pounds valued at $1,600 to $2,000 to 144,764 pounds valued at $57,000 in 1887. It is now much greater.

Besides aluminum bronze the Cowles company makes ferro aluminum by the same process by which the bronze is made, substituting iron for copper. The alloy, containing from 5 to 10 per cent. of aluminum, is used as a vehicle for introducing aluminum into molten iron to increase its tensile strength and solidity. An idea of the growing demand for ferro aluminum for this metallurgical use is obtained from the statement of the Cowles company that they made in 1886 from 2,000 to 3,000 pounds, valued at from $780 to $1,170, and in 1887, 42,617 pounds, valued at $16,621. The total aluminum alloys produced in 1887 was 171,759 pounds.

Many proposals have been made and many patents obtained for making alloys of aluminum with iron and sometimes with copper by reducing alumina with carbon in the presence of fluxes and the metals. Clay, kaolin, and other compounds of alumina, it is asserted, may be used for this purpose. Sometimes the iron or copper is added to the melted mixture used as a "bath," sometimes the mixture is added as a flux to iron in a cupola or similar furnace, and sometimes it is used as a paste on iron, which is then heated. The object in most cases is to make an iron aluminum alloy for "beneficiating" iron. The announcement of the good effect produced on iron by adding minute quantities of aluminum to it while melted and Mr. Keep's experiments on this subject have probably led inventors to patent processes of the above kind. It is to be regretted that these processes do not yet offer clear and certain evidence that they are distinct and decided improvements like the electrical processes, or, indeed, that they are operative in the manner described.

The extraction of aluminum itself is also effected by dynamo electricity, and is a new industry carried on under the patents of C. M. Hall. The process consists in forming a fused bath of the fluorides of aluminum, calcium, and sodium, to which calcium chloride is subsequently added, by melting a mixture of cryolite, aluminum fluoride, and fluorspar in a suitable vessel lined with carbon, adding alumina thereto, and then separating the aluminum by the current from a dynamo, the carbon electrodes of which dip into the bath. The process is continuous, because the alumina is renewed as it becomes exhausted. One merit of the process is that the fused bath is of less specific gravity than the aluminum set free, which therefore sinks to the bottom of the vessel. If alloys are desired, the negative electrode is formed of the metal which it is desired to alloy with aluminum. Variations in the composition of the bath are described in the different patent specifications, but that above given is believed to be the one used in practice. The total production of aluminum in the United States during 1889, including that contained in alloys, was 47,468 pounds, with a total value of $97,335.

Until the recent metallurgical use of aluminum in treating molten iron was introduced the metal was worked in this country in a small way, principally for parts of optical, engineering, and astronomical instruments, balance beams, light weights, and the like, where lightness and strength are desired. An idea of the extent of its use may be had from the fact that the amount imported into this country in one year was valued at $14,086

France was the only country which produced aluminum commercially until a few years ago. It had never been seen in any quantity until the Paris Exposition of 1855, where it was shown in ingots and in the form of manufactured articles of various kinds. Among ornamental articles it was noticed that a small body of the imperial guard wore breastplates of aluminum. The price of the metal was then 2,000 francs a kilo.

Aluminum was still somewhat of a curiosity in 1878, and was exhibited at the Paris Exposition in blocks, wire, sheets, and foil, and according to the report of the United States commissioners in the form of "objects, from a thimble and penholder to dinner sets of aluminum bronze and metal." Telescopes, opera glasses, and other optical instruments, mounted wholly or in part in aluminum, and chemical balances made of the same metal, were shown, which were very light and strong.

There was an English manufacture of aluminum from about 1860 to 1874, but no statistics of its production are obtainable. It could not have been very considerable, as the price of the metal was then very high. The Castner process was inaugurated in England in 1888. Supposing 5,000 pounds per annum to represent the English production from 1883, when the Webster process was put in operation, to 1888, we have 30,000 pounds, which, with the 12,000 pounds for 1889, equaling 42,000 pounds, or 21 tons, may be regarded as the English production up to the beginning of 1890. The French and English production together would therefore amount to about 82 tons. The Aluminum and Magnesium Fabrik, at Hemelingen, near Bremen, has been in operation since the latter part of 1887, and has supplied all the aluminum produced in Germany.

The tenacity of commercial aluminum is given by W. J. Keep as 18,866 pounds per square inch for a specimen, the probable composition of which was aluminum, 96.96 per cent.; silicon, 0.59 per cent., and iron, 1.79 per cent. This was an average of four tests which were made by Theodore Stevens. The specific gravity of the metal was 2.66. Another series of tests of commercial aluminum containing 95.50 per cent. aluminum, 1 62 per cent. silicon, and 2.88 per cent. iron gave 17,425 pounds per square inch tensile strength, the specific gravity being 2.72.[1] On the other hand, tests made by W. H. Barlow give 26,800 pounds per square inch as the tensile strength, and tests of aluminum made by the Deville-Castner process give from 25,000 to 30,000 pounds.[2]

The principal sources of aluminum have hitherto been cryolite from Greenland and imported bauxite. The Greenland mine is at Evigtok near Arksut. Before 1860 only small quantities of this cryolite were exported, but soon after that date the deposit was systematically worked, and cryolite was exported in considerable quantities. In recent years an American company, the Pennsylvania Salt Manufacturing company, has imported several thousand tons annually. A writer in the New York *Sun* described the appearance of the mine or quarry as "a hole in the ground, elliptical in shape, and, say, 450 feet long by 150 wide." The pit is 100 feet deep, and drills have penetrated [illegible] This prospecting promises well for the future. The mine [illegible] and load directly from the "stock pile" of the mine.

The increased demand for alumina bearing materials has [illegible] in 1887, at which time the deposit had not been opened to any extent, was published by Edward Nichols in the Transactions of the American Institute of Mining Engineers, volume 16 (1888), page 905.

The most recent discoveries of bauxite are in Saline and Pulaski counties, Arkansas. Dr. J. C. Branner, the State geologist, has made a report on the subject to the governor of that state, from which the following information is condensed.

The mineral or ore occurs in Arkansas only in tertiary areas and in the neighborhood of granites. It appears in irregular deposits, whose thickness and extent are determinable only by direct methods of examination. The Arkansas bauxite beds are known to cover a total area of about 640 acres in Saline and Pulaski counties.

"Alum beds" have been found in Purgatory valley, about twelve miles east of Trinidad, Colo., and some assessment work has been done there in locating claims and opening up the deposits. Two deposits of a similar material have also been found on the Gila river, in New Mexico, one of which is some twenty miles from Silver City. It is said to be extensive, and many claims have been taken up and some prospecting work done. The other deposit is on the southern Gila, and fluorspar has been found in the neighborhood.

1. Deville, de l'Aluminum, Paris, 1859.

2. English patent 2110 of 1879. Description of operation by dynamos, Ann. de chemie, ser. 5, tome 30, p. 495.

1. American Institute of Mining Engineers, Washington meeting, February, 1890.

2. Richards' Aluminum, 1890, pages [illegible]

CORRESPONDENCE.

New York Notes.

NEW YORK, July 4.—The question of lightning protectors has lately been under discussion in various metropolitan journals. The present discussion arose partly from the paper recently read before the Institute of Electrical Engineers by Mr. Hodges, when he drew attention to his "patent lightning dispeller," and partly from the efforts of one of the leading daily papers to draw forth opinions from electrical men on the action of lightning and lightning rods generally. The consensus of opinion is against Mr. Hodges' theory and his practice and his "dispeller." Mr. Hodges claims to have found no case where metal has been "dissipated," and damage has been done in the immediate neighborhood of the metal. Others, however, cite just such cases as Mr. Hodges failed to discover in his search of the "records." To all arguments against the probable efficacy of his scheme of protection Mr. Hodges replies immovably, that he has stated a physical law; and laws are serious things to trifle with, especially physical laws. The other day during a heavy thunderstorm in New Jersey two horses drawing a private carriage were killed by lightning. One would think there ought to be enough dissipatable metal on harness to protect a horse, but the records do not say in this case whether any of it was dissipated; regarding the destruction of the horses there was no doubt. Curiously enough, Mr. Hodges does not bring forward a single case where his "dispeller" has dissipated and dispelled, but he goes on advertising his "system" with the utmost confidence. Some people may think that five dollars is a pretty good price to pay for 75 feet of copper tape, especially as the tape must all be dissipated in a single flash if it does its work properly. In some parts of the country protection from lightning would come pretty dear at five dollars a flash.

The Rapid Transit Commissioners are engaged in considering plans for an east side road, and they find considerable difficulty in selecting a route above the Harlem River. A public hearing was given the other day to representatives of associations in the annexed district and there was considerable difference of opinion as to the route which should be chosen; the district to be served is a large and scattered one and each section wants the road to run through or near it. There is considerable dissatisfaction expressed at the dilatoriness of the Commission in arriving at a decision, and its action in the case of the west side road has really received far more praise than it deserved. The route chosen was obviously the only one to choose and an underground road worked by electric motors was a foregone conclusion long before the decision was announced. The report of the Commission was studiously vague and indefinite in every other respect, and every promoter of a system claimed that his was the system recommended in the report. The Commission ignominiously shirked the responsibility of reporting on the various plans submitted for the construction and equipment of the road, leaving the engineers to make their choice. The real work only begins when the commission has made its weak kneed report, and one cannot but think how much better it would have been to appoint a commission of engineers at first leaving the respectable business men to look after their business. It is pretty obvious that the Commission is by no means able to handle the really gigantic task allotted to it, and it is

distinctly disappointing to experience such long delays with so little result.

Carping spirits continue to carp at the idea of an electric underground road, although the *Sun*, chief among carpers, has maintained a discreet silence since the publication of Mr. Sprague's challenge. A carper with a decidedly original turn of mind wrote to an evening paper to suggest that the reason why the traffic on the City and South London line is so small is to be found in the disinclination of the public [illegible]. (The italics are the carper's). He suggests that the New York public will feel the same way and says that capital will hesitate to come forward if there is any reason to suppose that [illegible]. As a matter of fact, the City and South London road carries all the passengers it can possibly accommodate, and the profits on the first six months' working amounted to about $100,000. The road is a short one and serves a comparatively unimportant district of London, which previously was dependent entirely on omnibuses, so that naturally the number of passengers carried is not large, compared, say, with the number carried by one of the New York elevated roads. The elevators are considered a distinct boon and are very freely used, as of course they always would be wherever they save time and trouble. The objection is too grotesque for serious discussion, but it serves to show what trivialities carping spirits will indulge in.

Attention is being drawn here to the movement now on foot in England to establish telegraphic communication between lightships and lighthouses both on the mainland and on adjacent islands, and the general telegraph system. It is urged that steps should be taken to place the lighthouses and lightships on the Atlantic coast in communication with the mainland, and it is thought that the shipping interests will be willing to help in paying the expense of a work so obviously to their advantage. The harbor master of Bridgeport, Conn., points out that the system of signaling on Long Island Sound is good in fair weather only. In thick, heavy weather, when lighthouse communication is most needed, it is absolutely worthless. Various lights are important observation points in storms, but no communication can be had with them without a telegraph wire. Instances are cited in which telegraphic communication with the lights would have been invaluable assistance in times of danger. It is to be hoped that this important question will be thoroughly ventilated, and that active steps will be taken to carry some scheme of lighthouse communication into effect.

New Yorkers do not see much of electric railroading, and the electric motor for traction work so far has not made much of a record for itself in this vicinity. The storage battery cars which for a long time were familiar objects on Fourth avenue now decorate a vacant lot. The trolley system has no chance in New York, and even in the suburbs it meets with bitter opposition. For the annexed district it has been rejected so far, although the promoters of the road do not yet despair of convincing the cantankerous residents that the trolley system is what they want. In Brooklyn, after an exciting struggle, it has been firmly sat upon, and altogether there is not much chance for electric traction here until storage batteries or underground conduits come to the rescue. An electric road has recently begun operations between Long Island City and the principal cemeteries in Queen's county. It is worked by the trolley system, and the cars are lighted electrically. The [illegible] and may do something toward overcoming the prejudice which exists against the trolley system in this part of the country. In New Jersey an electric road is to be built connecting Newark with the Oranges. Very little work has yet been done, and the company was recently granted an extension of three months' time by the East Orange Township committee. [illegible]

[illegible] a few days in New York [illegible] Willet's Point and was shown the submarine harbor defenses of [illegible]

week, appears to have resulted from a misunderstanding rather than from an oversight on the part of the Bureau of Equipment. In view of the continued improvements and innovations which are almost daily being introduced in electric lighting appliances of all descriptions, it was recommended by the bureau some time ago that separate contracts be made for the electric light equipment of new vessels in order that the specifications might be amended from time to time so as to secure the latest type of machinery and accessories, taking advantage of any new designs or inventions. This very sensible proposition was supposed to have been acted on favorably, and to have received the assent of the secretary of the navy, but the secretary does not recollect having given his assent. No doubt he will now give it and set matters straight, as it is of course out of the question to leave a modern war vessel unprovided with the very best appliances for electric lighting that can be got.

Three of the condemned murderers now in Sing Sing are to be electrocuted next week. These are Slocum, Smiler and Jugiro. Their lawyers have given up the attempt to cheat the dynamo any longer. The negro, Wood, is also under sentence, but his lawyer has not yet relinquished hope of securing a respite. Mr. Sherman, the lawyer who has had Jugiro's case in charge, believes that his client, being a robust sailor, will not succumb to the current in less than ten minutes, and that he will be roasted to death. Of course Mr. Sherman does not base his belief on scientific knowledge, but the uncertain action of the electric current on individuals affords grounds for this kind of prophecy, and it is pretty certain that if the scenes at the execution of Kemmler are repeated this week at Sing Sing there will be a very general demand for the repeal of the electrocution law. Warden Brown believes that the sentence of death on all four men will be carried out. He has completed all his arrangements and the machinery is all ready to do its deadly work. All the invitations to the persons who will witness the executions have been sent out.

Electrical affairs in New York are very slack just now. There is very little new work going on and almost all the large companies complain of hard times, while the general depression has forced one or two concerns to the wall altogether. The Crosby Electric company, which made such a splurge a short time ago, has been placed in the hands of a receiver. The company was incorporated less than two years ago with a capital stock of $100,000, the promoter and first president being the late William L. Muller, an intimate friend of Governor Hill. Mr. Muller furnished the greater part of the working capital of the company. He died in January last, and the company has found it impossible to meet its obligations. The liabilities, it is said, are only about $10,000 and the actual assets are estimated at about $5,000. It is confidently expected that trade will pick up again in the fall, and that the electrical business will be in a flourishing condition in a few months.

Postmaster Van Cott has an idea that a pneumatic tube service between New York and Brooklyn would be a success. If such a service were established, perhaps the mail between New York and Brooklyn would be a little quicker than it is now; at present it is atrociously slow. The postmaster thinks a couple of tubes six or eight inches in diameter would be necessary for the work, the tubes to be laid on the East River bridge. The service could be used not only to Brooklyn, but to all parts of the city and it would effect a great saving by doing away, in a measure, with the use of wagons, messenger service and the telegraph. Such is Mr. Van Cott's opinion, although he doubts if Congress can appropriate the money for doing the work. He thinks it might be done by private enterprise and says if he were out of office he would like to take it up himself. The idea is a good one, but it is questionable whether pneumatic tubes could be maintained in working condition on the bridge. The structure is in constant vibration and the movement at the expansion joints when trains pass is something considerable; the change in the bridge when there is a rise or fall of temperature of thirty or forty degrees in a few hours—not at all an unusual thing in New York—would surprise those who are unaccustomed to its little ways. This sort of thing can be withstood by solid cables, but a tube is a different thing altogether, and the enterprise suggested by Mr. Van Cott would be rather a risky one.

W. L. H.

[illegible], July 7.—James J. Slocum, Joseph Wood, Harris A. [illegible] and [illegible] Jugiro were killed this morning by electricity, in conformity with the legal decree, in the [illegible] chamber at the state prison at Sing Sing. Only the prison officials, scientific experts and the witnesses [illegible] the execution. The four men were executed between four and five this morning.

Minneapolis, Minn.

MINNEAPOLIS, July 6.—The glorious Fourth witnessed the completion of every main electric street car line in the city of Minneapolis. There are still a few spurs in process of building, which will require a week or two to complete, but the work is in such an advanced condition that Minneapolitans can congratulate themselves on having the finest electric transportation system in the country. It is interesting to note the changed condition of public sentiment in both Minneapolis and St. Paul with reference to the consolidation of the two cities, since Mr. Lowry's company has intertwined them with his multitudinous electric lines, and it is easy to trace this change in sentiment to the work which Mr. Lowry has so successfully carried out within a year and a half. While six months ago both cities were in the heat of a conflict which seemed likely never to end, to-day nine-tenths of the people are favorable to actual municipal consolidation, and already schemes are on foot to accomplish this result and to commence the work of building up the interurban district which has been delayed so many years on account of local jealousies. The St. Paul chamber of commerce has recently made advances looking toward municipal consolidation, and while some coy opposition is still manifest in this city it is evident that the various public organizations will soon take the matter in hand in conjunction with the St. Paul chamber of commerce and arrange a basis for this highly desirable consummation.

Surburban transportation is now in a highly satisfactory condition. The company has an almost unlimited supply of cars, and the principal lines in both cities are now running trailers, thus offering the public all the accommodations in the way of seats that are needed. The announcement is made that the Hennepin boulevard line, over which there was some intermittent litigation last fall, is completed, and that within a few days it will be carrying passengers to Lakes Harriet and Calhoun, thus affording much needed relief to the First avenue line, which has been overtaxed all summer in carrying this traffic. The company has decided to put 25 horse power Thomson-Houston motors on the Hennepin boulevard line.

The Minneapolis company issued 100,000 transfer checks for the Fourth of July business.

The old motor cars that have been doing service on the Fourth avenue line for something over a year are to be remodeled into trailers, and the Thomson-Houston motors with which they were equipped are to be put into large new cars. It is a mystery to most people what the street railway company has done with all of the cars and the army of horses employed on the old lines, as they have all completely disappeared.

F.

Pittsburg, Pa.

PITTSBURG, Pa., July 3.—Troubles are heaped thick on the heads of the electric street railway men. The residents of the Twentieth ward, for instance, are very strongly objecting to the smoke emanating from the stacks of the power house of the Duquesne Traction company, and they have recently given vent to their disapproval by suing the company for creating a smoke nuisance. The Central Traction company is another rapid transit company which has a legal fight on hand, and in its case the city is the plaintiff. The cause of this suit has arisen from the fact that some time ago, when the Traction company began to lay tracks along Center avenue, the city entered a formal protest on the ground that the company had forfeited the right to lay its tracks. It is claimed that the ordinance granting the company the right to operate a line on Center avenue particularly stipulated that the track should be laid within a certain time. This time, the city avers, has long since expired, and the company has therefore lost its claim to the street altogether. The outcome of this controversy is anxiously watched by the persons interested.

The adjourned annual meeting of the Westinghouse Electric & Manufacturing company will be held at 64 Westinghouse building, this city, on Wednesday, July 15th, at 10 o'clock A. M., for the purpose of electing directors to conclude the plans for the reorganization of the company.

The Second avenue passenger railway company of this city is now making preparations to build a bridge across the Monongahela river at Glenwood in order to extend its line from this city to Homestead. This company shows the advantages of an electric railway as an investment. The road when operated with horses was perhaps the worst in this city. It never could be made to pay, and the company was compelled to use the cheapest horses obtainable. A little over a year ago, however, the company began to operate its line by electricity, and to-day it has not only paid one dividend but it is also expending more money for new improvements, and this has all been done in spite of the fact that the road runs its entire length parallel to a steam railroad, which has local stations every three-quarters of a mile along the line.

R. L. W.

PERSONAL.

E. M. Winters, general manager of the Winters Electric company, Chicago, has gone East on a two weeks' business trip.

A. D. Lundy, of the firm of Sargeant & Lundy, Chicago, was unexpectedly called to Atlanta, Ga., last week, but returned to Chicago last Monday.

B. M. Downs, manager of the Bushwick Glass Works, 83 Fulton street, New York, returned home a few days since after a successful business trip in the West.

C. K. Mead, manager of the Des Moines Water Power company, of Des Moines, Iowa, was in Chicago on July 1st on his return from a business trip to Fort Wayne, Ind.

W. D. Allison, whose withdrawal from the Chicago Telephone company was noted last week, has accepted a position in the railway department of the Thomson-Houston Electric company.

Gustave Monrath has resigned his position as superintendent-electrician with the Monitor Electric company, Chicago. His intention is to open an office in Chicago as consulting and contracting electrical engineer. Mr. Monrath has been a resident of Chicago for several years, and has had quite an extensive experience in electrical work. His early training in electrical science was acquired in the principal cities of Europe, and later with the Edison company in America. Mr. Monrath has the best wishes of a number of friends for success in his new venture.

NEW INCORPORATIONS.

City Traction company, Pittsburgh, Pa.; capital stock, $25,000; operating a street railway by electricity.

Southern Electric company, Lynchburgh, Va.; capital stock, $25,000; electrical and mechanical apparatus and supplies.

Delhi Electric company, Delhi, Delaware county, N. Y.; capital stock, $30,000; to manufacture and use electricity for light, heat and power.

Millville Electric company, Millville, N. J.; capital stock, $50,000; manufacturing, supplying and transmitting heat, light, power and sound.

Shenandoah Electric Light & Power company, Shenandoah, Iowa; capital stock, $15,000; to erect an electric light and power plant at the town of Shenandoah.

Monticello Electric company, Monticello, Iowa; capital stock, $8,000; purchasing, erecting, maintaining and operating an electric light power plant at Monticello.

Lieb Insulating company, Hoboken, N. J.; capital stock, $50,000; to manufacture, buy, sell and deal in electrical machinery and appliances of all kinds and metal goods of all kinds.

Cumberland Illuminating company, Portland, Maine; capital stock, $25,000; supplying light, heat and power by gas and electricity in towns of Westbrook, Deering and Cape Elizabeth, Maine.

Beaver Valley Traction company, Beaver Falls, Pa.; capital stock, $300,000; construction and operation of motors and cables or other machinery for supplying motive power to passenger railways, etc.

Columbus Electric Railway company, Columbus, O.; capital stock, $100,000; constructing, and operating, street railroad in Columbus, to be operated by electric, steam, gas, horse, mule, or other power.

Montana Loan & Realty company, Helena and Butte, Mont.; capital stock, $300,000; general land improvements, including the establishment of electric road and light plants; mines, mining and mine products.

Columbian Medical & Magnetic Battery company, Chicago, Ill.; capital stock, $10,000; to manufacture and sell magnetic, electro-magnetic and electrical batteries and appliances, and medical and surgical supplies.

Westfield Investment & Improvement company, Westfield, Union county, N. J.; capital stock, $50,000; building houses, improvement and sale of lands, maintaining and operating works for the supply of electricity for electric light, heat and power.

Livingston Water Power company, Livingston, Mont.; capital stock, $250,000; buying, selling and dealing in real estate, building and constructing canals and water ditches, manufacture and operate water power, building, constructing and maintaining street and suburban railways and electric light and gas plants, laying water mains, build, maintain, operate, buy or sell factories of all kinds or description, and to do and perform any other acts pertaining to the water or other power.

ELECTRIC LIGHTING.

There are four search lights and 471 incandescent lamps on the United States cruiser Philadelphia.

The Water Front & Amusement company of Elkton, Va., has been organized, and will, it is said, erect an electric light plant.

The city of Rutherfordton, N. C., will hold an election to determine the question of issuing bonds to erect an electric light plant.

It is reported that the electric light plant of the Florence, Ala., Gas, Electric Light & Power company has been sold to W. P. Campbell for $8,000.

The Reno Electric Light and Power company has advertised for bids for the furnishing of timber for the construction of a proposed flume, necessary head-gates and wasteways. It proposes to use water power to drive its plant.

The electric light station at Havana, Cuba, is to be increased so as to have a capacity of 6,000 incandescent lights. The Westinghouse system is used.

W. N. Fishburne, R. G. Wright, W. B. Gerhart and others have incorporated the Waynesboro, Va., Street Railway, Light & Water company to erect an electric light plant and construct a system of water works. The capital stock is to be not less than $100,000.

H. Reaves has leased and will operate the Greenville, Tenn., Electric Light company's plant and increase the capital stock to $10,000. Machinery for a complete alternating electric light system has been ordered from the Thomson-Houston Electric company of Boston.

The Thomson-Houston Electric company of Boston, Mass., is said to have purchased $60 000 worth of stock and $50,000 in bonds of the Capital Electric Lighting company of Nashville, Tenn., and is now reported to be negotiating for the purchase of the entire property.

Work on the "Fair" building is progressing rapidly, men being kept busy at night as well as during the day, the necessary illumination being furnished by the Chicago Arc Light & Power company. As soon as the work has progressed far enough the Sperry company will begin the installment of a permanent plant, which will be complete throughout.

The building of the Washington, D. C., Electric Lighting company at Thirteen-and-one half and B streets now only occupies a portion of the 200 feet frontage which the company owns. The entire property is to be covered with a building which will be just twice the size of the one now in use. The new structure will have a floor space of some 25,000 feet, and will be built in a substantial manner of brick, stone and iron. While the building will be doubled in size the machinery will be tripled in capacity. The company has underground wires laid along Connecticut avenue, Massachusetts avenue, K street and other streets.

According to a press dispatch from St. Louis the lighting situation in that city is becoming serious, and if the town is not confronted with the actual possibility of being left in total darkness there is at least a strong possibility that it will have to enter into new negotiations with the corporation now doing the illuminating, the Municipal Electric Light & Power company. The company has a ten-year franchise to furnish arc lights at $75 a lamp, and, as the company is losing about $25 a lamp a year, affairs are rapidly approaching a crisis. The company's bond is but $50,000, and it is stated that this will be forfeited and the city left to flounder in the darkness or resort to gas, or make a more liberal contract. Suit has been brought against the company by the trustees of Roban Bros., who supplied the boilers, for a balance of $115,000, protected by a mechanic's lien. It is probable that the city will agree to pay a higher price for the 2,000 lights now in use, and thus avoid a disagreeable result.

ELECTRIC RAILWAYS.

The Rochester, N. Y., Railway company has extended its lines half a mile on West avenue.

The electric railway system in East Portland, Ore., is to be extended on G street from Fifth street eastward.

A cable car crushed into an electric car at Pittsburg last week, injuring the motor man and damaging both cars considerably.

The capital stock of the North Avenue Electrical Railway company of Baltimore, Md., has been increased from $50,000 to $100,000.

At Memphis, Tenn., the Citizens' Street Railway company is building a power house that will cost between $40,000 and $50,000.

The Second avenue electric railway of Brooklyn is now in operation. The trip from Fifty second street to Gravesend bay takes 45 minutes.

It is stated that surveys are being made for the construction of an electric railroad between the Warm, Healing and Hot Springs in Virginia.

The Salt Lake City and Rapid Transit street railway companies of Salt Lake City, Utah, are involved in a lawsuit regarding rights of way. Both lines are operated by electricity.

W. R. Hall of Chattanooga, Tenn., and Eugene T. Lynch of New York city have applied for right of way for the building of an electric railway from Memphis, Tenn., to Raleigh Springs at an estimated cost of $125,000.

The contract for the power house of the Queen City Street Railway company of Marion, Ind., has been let. Work must be commenced at once and pushed to completion as fast as possible. The building will be located at the corner of Twenty-third street and Buffalo avenue.

The Santa Cruz, Cal., Electric Railway company has let the contracts for furnishing motor trucks and 110 horse power generator and appliances to the Thomson-Houston Electric company. The electrical construction work was awarded to the California Electrical Works at San Francisco. Everything will be completed and in operation in ninety days. The amount of the two contracts is about $25,000.

The Love Conduit company of Chicago, whose system was described at length in the WESTERN ELECTRICIAN of March 7th, is now constructing a mile and a half of track on what is known as the Fullerton avenue loop of the North Chicago street railway system. This is to demonstrate the practicability of the new system to Mr. Yerkes, who

ELECTRIC MINING.

The [illegible] commenced the operation of its pumps by electricity generated [illegible]

The Edison General Electric company is installing electric drills at the Ute and Ulay mines at Lake City and at the San Bernardino mines [illegible]

The Brown Bear Mining company [illegible] putting in an electric light plant, and will light its mill, mine and buildings with incandescent lights. The engine that runs the mill machinery will furnish the power for the dynamo.

TELEGRAPH.

The telegraph office at Monongah [illegible] from Clarksburg, W. Va., was struck by lightning during a heavy storm a short time ago. James Boyles, the operator, was seriously injured and rendered completely deaf.

The Western Union Telegraph company has won a victory at Milwaukee by a report of the judiciary committee of the common council in favor of an amended ordinance granting the company the right to run its wires overhead in a cable instead of burying them.

Jay Gould says that on June 20th there were 4,645 stockholders in the Western Union Telegraph company, and that 673,262 shares of stock were held by investors and 188 738 shares were in the hands of brokers. Less than a year ago 234,030 shares were in the hands of brokers.

Robert G. Ingersoll is reported as having said that he recently had a secret conference with President Harrison in regard to the proposed establishment of a cable between the United States and Brazil, for the promotion of which Colonel Ingersoll is acting as attorney. The matter is still in its early stages and Colonel Ingersoll was disinclined to give any details.

TELEPHONE.

It is said that Berlin has 16,000 telephone subscribers.

The provincial authorities of Viscay, Spain, have decided to establish a complete system of telephones throughout the province, and to have a telephone station at each of the 122 municipalities which are situated in that energetic and prosperous district of the country.

The telephone line owned by the city of Rochester, N. Y., and running to Hemlock Lake, the source of that city's water supply, thirty miles away, is to be rebuilt at a cost of $6,803.60. The work is to be done within thirty days, and Butler & Riley have the contract.

An English electrical paper states that the Stockholm General Telephone company has established an annual rental rate of $2.75 for instruments in private houses, with an additional toll of about three cents for each conversation. The same paper asserts that in no other European country has the telephone found such an extensive application as in Sweden.

A press dispatch from Columbus, Ind., says: "The telephone service of this city has been practically destroyed by the city's electric light plant, recently put in, on account of the induction. A meeting of telephone patrons and the telephone managers was held last night with the city officials, to see if any remedy could be devised, but no definite conclusions were arrived at. It is impossible to get satisfactory service out of the telephone when the electric lights are burning, and the telephone company will bring damage suits unless relief is given it."

MISCELLANEOUS.

The Corpus Christi, Tex., Electric company has filed an amendment to its charter increasing the capital stock by $10,000.

The Edison General Electric company has declared the seventh quarterly dividend of 2 per cent., payable August 1, 1891.

The first electric boat built on the Continent was recently launched on the Lake of Zurich. It was built by Esscher & Wyss and the Oerlikon Maschinenfabrik. It attains a speed of six miles per hour, and can run five or six hours with one charge of the fifty-six secondary cells carried.

Among the American exhibitors at the Frankfort exposition are the Thomson-Houston company, Boston; Edison United Phonograph company, New York; Westinghouse company, Pittsburg; McIntosh, Seymour & Co., Auburn, N. Y.; Weston Electrical Instrument company, New York; Otis Elevator company, New York.

TRADE NEWS.

Since the latter part of March it is reported that the Sunbeam lamp has been placed on 50 electric street railroads, and has given satisfactory service. The business has greatly increased during that period.

Geo. Cutter is bringing out a simple but very useful device for lowering street lamps. By means of this invention the lamp is drawn to the pole and lowered, taking it

out of the way of trailing and other wires, thus saving much time and annoyance.

Chas. A. Schievren & Co. have secured the order for perforated electric belting for the Columbus Consolidated Street Railway company, Columbus, O.; also for the Worcester, Leicester & Spencer Street Railway company. In the former there are six 13½ inch double belts and in the latter one 40 inch and five 12 inch belts. There is quite a fair demand for the perforated belts for street railway purposes.

At a recent test of steam separators made at Sibley College, Cornell University, under direction of R. C. Carpenter, professor of mechanical engineering, six of the leading separators of the country were put in competition. The issue proved that the Hine eliminator stood far at the head in its efficiency percentage. The Hine Eliminator company, New York, has issued Professor Carpenter's report in neat pamphlet form and will send it on application.

The Creaghead Engineering company has recently been organized in Cincinnati. The work mapped out for the new organization is in the line of consulting and contracting engineers, a specialty being made of electric street railway construction and equipment. The company has secured an agency for the Star Electrix Specialties and other leading supply houses. Mr. Creaghead, the promoter, was formerly with Fraser & Chalmers of Chicago, holding the position of electrical engineer.

The Edison General Electric company has just issued a descriptive circular on small slow speed Edison motors, which it is now pushing. The list of machinery that is at present operated by small electric motors includes small pumps, drill presses and other tools, small fans and blowers, sewing machinery, small lathes, buffing wheels, cloth and paper cutting machinery, organ bellows and printing presses. The Edison company claims that the small motor it is now introducing was specially designed for this class of work.

Owing to the continued increase of business the Thomson-Houston Electric company has again found it necessary to make several changes in the arrangement of departments at the Chicago office. Two years ago the company occupied only one floor of the four-story building on Michigan avenue which at present is required for this extensive establishment. During the past week the engineering and mining departments have been changed to quarters on the first floor, taking the place of the accounting department, which has been removed to more commodious quarters on the second floor. The basement is to be fitted up as an exhibition room, where lighting apparatus, dynamos, motors and mining appliances will be shown.

On June 8th the Baxter Electric Motor company of Baltimore shipped three trucks, with motors attached, to Beatrice, Neb., and on the 12th sent a generator of 80 horse power. At the same time an expert electrician was despatched from the works to put the road in operation, including the erection of the power house. On June 27th the second car was started at 11:30 P. M. The next day, Sunday, 2 500 passengers were handled without a hitch of any kind. This is thought to be unusually quick work. The company has a larger number of orders for cars and motors throughout the South and West. Its electric motor cars are now running in Richmond, Va., Dayton and Cleveland, O., Chicago, Ill., Washington, D. C., and many other places.

The Electrical Supply company is now occupying its elegant new quarters at 102 and 104 Michigan avenue, corner Randolph street, Chicago. Its old address at 171 Randolph street has become so well known among the electrical fraternity that the change will be something of a surprise, but it will only be a question of a short time before the new quarters will be as well known as the old. A large force of men is constantly at work putting in fixtures and placing stock and it will not be very long before the company will be in thorough working order in the new building. A new and improved elevator is now being put in, so that customers may visit all the floors of the store without the inconvenience of climbing stairs. With all the confusion incidental to moving, the large volume of business has not suffered in the least. This company reports very large sales for this season of the year in Sunbeam lamps and other specialties. The Electrical Supply company invites all visiting electricians to call at the new quarters and [illegible] over again.

BUSINESS.

[illegible] of the Monitor Electric company [illegible] illustrated catalogue [illegible].

[illegible] Michigan street, Chicago, have [illegible] Lang's slate [illegible]. The slate bases [illegible] com-pleted, the switch-board will be the finest ever built in this city.

[illegible] work.

[illegible]

Wm. Crompton, general manager of the Economic Lamp company of Boston, visited Chicago last week. He expressed himself as highly pleased with the management of his Chicago agency, the sales having reached a point entirely beyond his expectation. While competition has been strong Mr. Kirkham of the Northwestern Electric Specialty company has sold the Economic lamp since May 1st, in over one hundred western cities and towns.

H. S. Walker has recently sold to the Elkhart Electric Street Railway company a Beck engine of 125 horse power capacity and one of 50 horse power to the Goodrich Transportation company, to run a Mather plant in the new steamer Virginia, which is nearly completed at Cleveland, and which is to be put in service between Chicago and Milwaukee in a week or so. Mr. Walker reports a very fine midsummer business in the different lines of machinery which he represents.

S. Taussig, 45 River street, Chicago, has gladly complied with a large number of requests coming from within 500 miles of this city for free thermometers advertising his Synovial Dynamo oil, a notice of which recently appeared in this paper; but when Anderson, S. C., and Tacoma, Washington, were heard from he was tempted to think it was time to draw the line. Mr. Taussig has taken the western agency for a little device for cutting water tube glasses that apparently has considerable merit. He still has a supply of thermometers on hand, which will be sent free to any one applying. He would particularly like the address of stationary engineers who need a thermometer and to whom he could send circulars advertising his new glass tube cutter.

J. D. Claghorn, manager of the Chicago Electric Manufacturing company, 73 West Jackson street, has recently added several pieces of new machinery to his factory, and now it would seem that everything necessary in any line of electrical work has been secured. During the past month a room has been set apart for the repair of fine electrical apparatus, fitted up with a specially wound No. 2 Edison dynamo, having a capacity of 30 amperes at 125 volts, to be used for testing, recalibrating, etc., with 10 cells of Anglo-American storage battery connected in parallel so that 200 amperes can be secured. This room is provided with a fine Wheatstone bridge, galvanometers and other apparatus necessary for the repair of low current ammeters and voltmeters of high and low tension, both alternating and direct current. E. W. Hammer, late general superintendent of the Ottumwa, Iowa, electric street railway system, has been engaged and will have immediate charge of this portion of the factory. Mr. Claghorn is now building to order a 500 ampere meter, and hereafter will devote more of his time to the detail work of the factory.

ELECTRICAL PATENTS.

Issued June 30, 1891.

454,867. Electrical Transmission of Telegraphic and Time Indications. Henry J. Haight, New York, N. Y.

454,873. Carbon for Electric Arc Lamps. Washington H. Lawrence, Cleveland, O.

454,881. Overhead Electric Conductor System. Gordon J. Scott, Minneapolis, Minn.

454,882. Electro Dynamic Machine. Gordon J. Scott, Minneapolis, Minn.

454,883. Motor Generator or Transformer. Gordon J. Scott, Minneapolis, Minn.

454,884. Printing Telegraph Instrument. Frederick Sedgwick, Chicago, Ill.

Claim seventeen follows:

"17. The combination, with a main line and electro generator, of a series of synchronous motors, a series of printing instruments having rotating type wheels, screw shafts and coating mechanism, as described, in said respective instruments for shifting said type wheels laterally, a normally shunted magnet, armature, rock shaft, and gears, as specified, for transferring the motor power from the type wheel shaft to said screw shaft, and means, as set forth, for breaking said shunt circuit at a predetermiued time."

454,888. Electric Car Motor Jacket. John Stephenson, New York, N. Y.

454,890. Apparatus for Removing Inductive Effects from Electric Lines. Elihu Thomson, Lynn, Mass.

Claim three is:

"3. The combination of two or more inducing electric lines and two or more telephone circuits inductively affected thereby and each provided with a counter inducing coil or induction generator placed in a composite air field produced by the two inducing line, each counter-inducing coil or generator for a telephone line being located in position to be out of inductive relation to the coil or generator for other telephone line."

454,897. Time Lock. George W. Adams, Malden, Mass

454,903. Means for Connecting Trolley and Feed Wires. John R. Fletcher, Chicago, Ill.

454,904. Aerial Cut-Out. John R. Fletcher, Dayton, O.

[illegible] Hotel Indicator. Frank B. Wood, New York, [illegible].

454,926. Protector for Use in Electric Circuits. William H. Clausen, Melrose, Mass.

[illegible] Method of Laying Electric Conduits. Alexander C. Chenoweth, New York, N. Y.

[illegible] Means for Constructing Electric Conduits. Alexander C. Chenoweth, New York, N. Y.

454,949. Electric Meter. Herbert M. Pilkington and Roger S. White, Brooklyn, N. Y.

[illegible] Electric Current Regulator or Rheostat. [illegible], U. S. Navy, and Thomas [illegible] and Frank [illegible] Anderson, Easton, Md.

454,973. Electric Signaling Apparatus. Morris Martin, Malden, Mass.

454,974. Circuit for Electric Signaling. Morris Martin, Malden, Mass.

454,979. Electric Heater. Charles W. Drew and Edward R Francis, Minneapolis, Minn.

In this invention the current is made to pass through resistance coils of a rheostat arranged near the heating surface, in this manner utilizing any heat generated in the coils of the rheostat.

454,985. Electric Temperature Controller. Emer H. Parker, Evanston, Ill.

454,995. Electric Switch. James Des Brisay, New York, N. Y.

455,005. Circuit Closer for Burglar Alarms. Don A. Palmer, Chicago, Ill.

This invention consists in a slotted sash pulley frame provided with suitable insulated contact points and a circuit closer adapted to make or break the current by the movement of the sash end over said pulley.

455,010. Electric Soldering Iron. Arthur E. Appleyard, Boston, Mass.

The soldering iron is heated by means of a conducting loop of platinum wire connected with a suitable source of electrical supply.

455,016. Electrical Annunciator William F. Harte and Clifford A. Gerold, Omaha, Neb.

455,019. Circuit Connection for Electric Car Motors. Arnold A. Ingraham, New York, N. Y.

455,037. Apparatus for Boring Wells Fulton Gardner, Chicago, Ill

Claim two reads:

"2. The combination with a revolving boring tool of an electric motor having a revolving armature connected to the boring tool, a locking or holding device consisting of radially moving jars adapted to engage the walls of the well for holding the field magnet of the motor from revolving, an extensible or telescoping connection located between said holding device and said boring tool to permit the feed of the latter, and jars for operating said holding device."

455,041. Electric Clock for Use in Electric Lighting and Other Systems. Friedrich von Hefner-Alteneck, Berlin, Germany.

455,055. Electric Time Denoting Device. William Ramsay, Washington, D C.

455,067. Electric Magnetic Motor. Nikola Tesla, New York, N. Y.

455,068. Electrical Meter. Nikola Tesla, New York, N. Y.

455,069. Electric Incandescent Lamp. Nikola Tesla, New York, N. Y.

Claim three reads:

"In an incandescent electric lamp the combination with a globe or receiver exhausted to the non-striking point of metallic wires sealed therein, a refractory body mounted on or electrically connected to each wire, the said wires within the globe and such parts of the refractory body as are not to be rendered incandescent being coated or covered with insulation."

455,071. Clutch for Arc Lamps. Frank H. Thompson, Philadelphia, Pa.

455,075. Printing Telegraph. Henry Van Hoevenbergh, New York, N. Y.

455,086. Push Button. Granville W. Wright, New Haven, Conn.

455,087. Electric Arc Lamp. Craig R. Arnold, Chester, Pa.

455,092. Automatic Electric Switch. Carl O. C. Billberg and Paul A. N. Winand, Philadelphia, Pa.

455,107. Insulator. James F. Munsie, Brooklyn, N. Y. Filed March 28, 1890.

455,109. Electric Motor. F. L. McGahan, Indianapolis, Ind.

455,110. Electric Motor. Frederick L. McGahan, Indianapolis, Ind.

455,126. Electric Postoffice Box. Will A. M. Smith and Robert T. F. Smith, Morrison, Ill.

455,138. Electric Signal for Steam Vessels. Dyson D. Wass, San Francisco, Cal.

455,164. Apparatus for Extracting Gold and Silver From Their Ores by Electrical Amalgamation. George Button and William E. Wyeth, Kimberley, Griqualand West, South Africa.

455,176. Apparatus for Automatically Regulating the Firing of Ordnance on Ships. Manuel J. Cuadros, Liege, Belgium.

455,187. Filament for Incandescent Electric Lamps. George Erlwein, Berlin, Germany.

455,223. Lightning Arrester. Frank Mansfield and Chas. W. Wason, Cleveland, O.

455,233. Electric Railway. James F. Munsie, Brooklyn, N. Y.

455,234. Electric Railway. James F. Munsie, Brooklyn, N. Y.

455,266. Electric Railway Signal. Winslow Stevens and Henry J Hovey, New Haven, Conn.

455,267. Automatic Regulator for Electric Motors or Dynamo Electric Machines. Schuyler S. Wheeler, New York, N. Y.

455,268. Telethermometer. Frederick W. Wiesebrock, New York, N. Y.

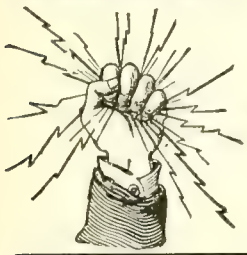
455,2[illegible]7. Socket for Incandescent Electric Lamps. Benjamin B. Keyes, Chelsea, Mass.

455,294. Printing Telegraph. David H. Bates and Henry Van Hoevenbergh, New York, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and is **guaranteed to be waterproof, and will not deteriorate, oxidize or crack**, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS FANS

FOR ELECTRIC MOTORS.

MANUFACTURED BY

THE TURNER BRASS WORKS,

4 LaSalle Ave., Chicago.

Write us for prices.

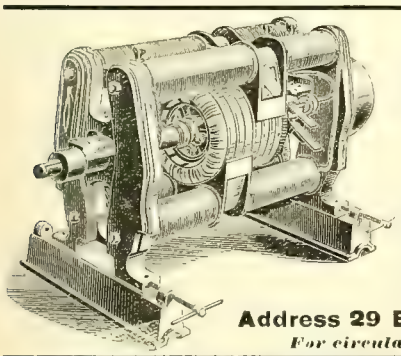
J. W. MASON,

DEALER IN

GENERAL ELECTRICAL SUPPLIES,

SAFETY INSULATED WIRES AND CABLES, WEATHERPROOF OFFICE AND ANNUNCIATOR WIRES, TAPES AND TUBING.

PROMPT SHIPMENTS. **527 Delaware Street, KANSAS CITY, MO.**



THE

Easton Electric Co.,

45 Broadway, NEW YORK CITY.

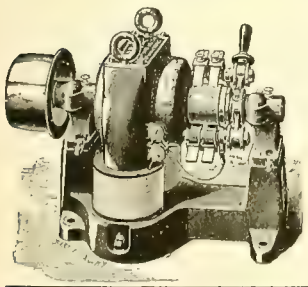
MANUFACTURERS OF

Arc and Incandescent Dynamos, Motors, Generators and Separators, And Arc Lamps adapted for use on Arc or Incandescent circuits.

Address 29 Broadway, New York City,

For circulars, prices and information.

THE CROCKER-WHEELER PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS

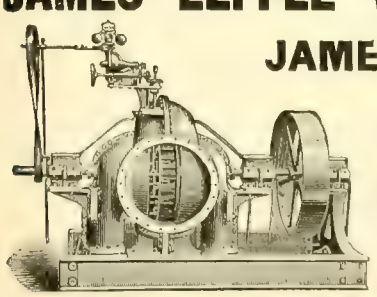
BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.



Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE **JAMES LEFFEL & CO.**

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

MICA.

I SELL NO OTHER.

Send for Samples and Prices.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

WANTED.

A Specialty to Manufacture ... preferred or sold ... Machine Plant on ... Address

C. C. PAIGE,

Eagle Iron Works **Oshkosh, Wis.**

CHICAGO. *The Electrical Construction Co.* 43 and 45 S. Fifth St.

C. A. HARTER, Manager. Telephone, 1718.

FOR SALE.

Small Electric Plant. Complete outfit. Excellent Dynamo. Six H. P. Boiler. Steam Pump and Steam Damper Regulator and Four 4 H P. Engines. Capacity, 24 16 C P. 110 Volt Lamps. Address

Box 902,

New Haven, Ct.

UNION ELECTRICAL WORKS.

Electric Specialties manufactured on royalty or **purchased of inventors.** Repair work of all kinds given careful attention.

Room 506, Springer Building, Chicago.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N.Y.**

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES

A SPECIALTY.

L. BLATZ, 103-107 West Monroe St., CHICAGO.

TRIPOD BOILER

Three Points of Superiority Guaranteed: **Safety, Economy, Low First Cost**

Repeated tests prove that it is absolutely Non-Explosive and the most Durable ever made.

Strong testimonials from hundreds of users, in all parts of the country.

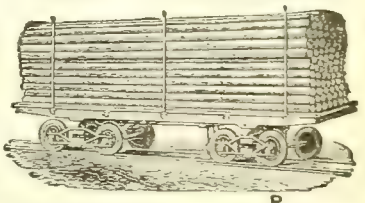
Sizes 10 to 1,000 H. P.

For full information address,

HAZELTON TRIPOD BOILER CO.

809 Monon Block., CHICAGO, ILL.

ELECTRICAL WOOD.



Telegraph / Telephone / Electric Light \ CROSS ARMS / POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

STANDARD ELECTRICAL MEASURING INSTRUMENTS

FOR EXPERIMENTAL AND PRACTICAL WORK.

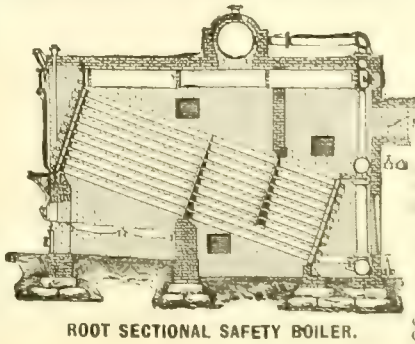
We make a great variety of Testing Instruments such as Ammeters, Voltmeters, Galvanometers, Resistance Boxes, Photometers, in fact everything that an electrician requires in making measurements of current, E. M. F., resistance, insulation, efficiency, etc.

Correspond with us before placing your orders, and send for our illustrated catalogue No. 1-66.

QUEEN & CO., PHILADELPHIA.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE.



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the Electric Light Companies of Boston, St. Louis, Chicago, Detroit, Lowell, Lawrence, Lynn, Salem, Fitchburg, Worcester, Springfield, Providence, Hartford, New Haven, Bridgeport, Lowell, Lynn, Salem, Fitchburg, Worcester, Springfield, Providence, Hartford, New Haven, Bridgeport, Mass.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St, New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

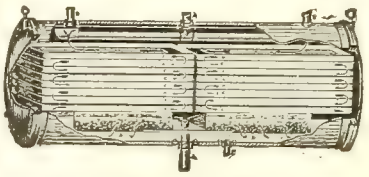
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents SCALE in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EMPIRE CHINA WORKS,

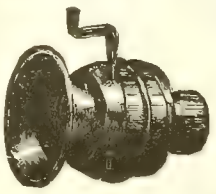
144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

— INCLUDING —

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

The body of our goods is made non conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

OLBURN ELECTRIC MFG. Co.

No 180 MAIN ST.

FITCHBURG, MASS, U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

ELECTRICAL BOOKS

OF ALL KINDS.

Send for Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building CHICAGO, ILL.

SLATE.

Six samples showing all finishes for $1.50.

T. J. MURPHY,

96 Columbus Ave., NEW YORK

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

BEST AND CHEAPEST.

REQUIRES LESS BATTERY.

MADE BY

HAY-HORN MFG. CO.,

63 S. Canal Street,

CHICAGO.

PLAYING CARDS.

You can obtain a pack of best quality playing cards by sending fifteen cents in postage to P. S. EUSTIS, Gen'l Pass. Agent C., B. & Q. R. R., Chicago, Ill.

73-75 W. Jackson St.

RELIABLE

WE ARE FITTED WITH

RELIABLE Machinery and Tools,

And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.

SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By re-filtering can be used continually. Adopted by the largest Electric Plants of the West.

Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO.

Bare and Insulated Wires.

(COPPER, IRON AND STEEL).

Supplies of Every Description

FOR ELECTRIC LIGHT, POWER, RAILWAY, TELEGRAPH AND TELEPHONE USE.

Quotations Cheerfully Furnished and Correspondence Solicited.

The Empire City Electric Company,

15 & 17 Dey Street, NEW YORK.

Manufacturers of

OCTAGONAL AND CEDAR

TELEPHONE & ELECTRICAL

RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

Fine Office Furniture and Folding Beds.

Brass and Wire Work. 215 Wabash Av.

A. H. Andrews & Co., Chicago.

BALL AUTOMATIC CUT OFF ENGINE

MADE ONLY BY

THE BALL ENGINE CO

ERIE PA.

DICTIONARY

—OF—

ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes over upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an Encyclopædia than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a short, concise definition, giving the sense in which they are correctly employed.

2d. A general statement then follows of the Principles of Electrical Science on which the definition is founded.

3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an Illustration or Diagram of the apparatus is given.

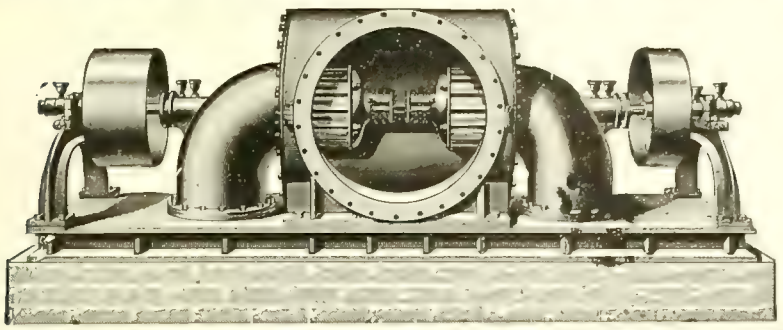
4th. To facilitate study, an elaborate system of Cross References has been adopted so that it is as easy to find the definitions as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure CLEARNESS, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES [illegible] CELEBRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** [illegible] diameter, being **double** the **Power** [illegible] number of the leading electric companies [illegible] ical use of water it is without an equal, producing [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no [illegible] required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of [illegible] **VICTOR TURBINES** arranged on a horizontal shaft with [illegible] Tubes, End Bearings for Shaft, and Driving Pulley [illegible] a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either singly or in pairs on horizontal shafts, [illegible] admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ALUMINUM

IN ALLOYS 75c. PER POUND.

Aluminum in alloys equal in purity to any on the market 75c. per pound for the contained Aluminum.

Cowles Pure Aluminum in ingots is offered as low as that of any American concern, quality guarantee d. The statement made by The Pittsburgh Reduction Company that customers buying Aluminum of us at less than $1.50 per pound are liable therefor is as silly as it is malicious. Aluminum is not a patented article, and therefore can be freely dealt in by all.

THE COWLES
Electric Smelting & Aluminum Co.,
LOCKPORT, N. Y.

HARRISON CONVEYOR

FOR HANDLING
Grain, Coal, Tan Bark, Seeds, Etc.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for illus. Catalog. **BORDEN & SELLECK CO.,** [illegible] Ill.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO.

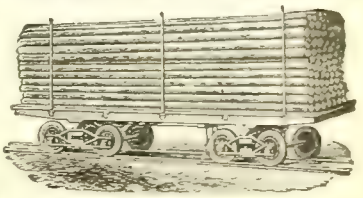
Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,
Consulting and Constructing
ELECTRICAL AND MECHANICAL ENGINEERS.
Complete Equipment of Electric Railways. Steam and Electric Plants.
47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

CEDAR POLES.



If in want of Poles, save money by getting my prices.

W. C. STERLING,
Monroe, Mich.

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

SUNBEAM INC. LAMP CO.
SUNBEAM
INCANDESCENT LAMP
CHICAGO ILLINOIS U.S.A.

OTHER PEOPLE
May Imitate Our Methods of Advertising
But They CANNOT Duplicate
THE
SUNBEAM LAMP,
STICK A PIN RIGHT HERE!

THE SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

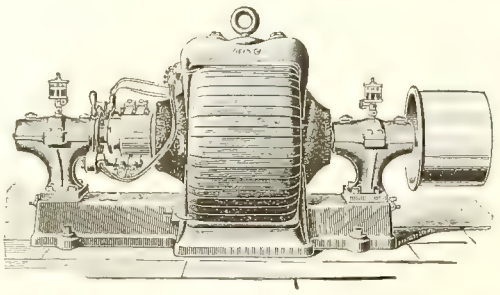
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS.

WIRES.

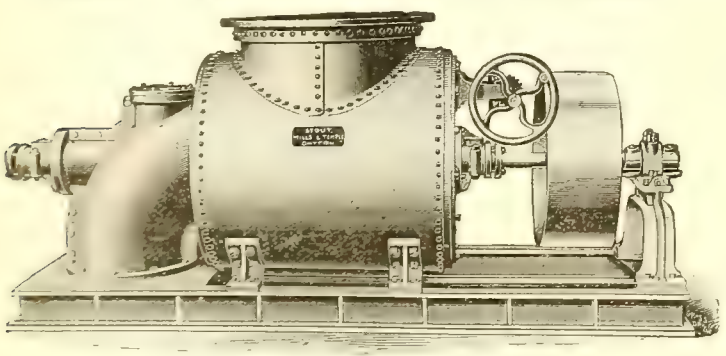
You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK.

G. H. MEEKER, Western Manager.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.

JOHN STEPHENSON CO.,

LIMITED,

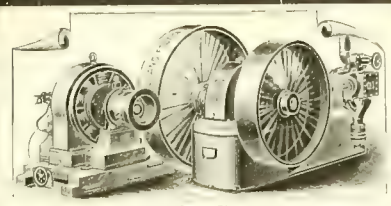
NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.



For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St, BOSTON, MASS.

Evans' Cones. For Varying Speed.

JUNE, JULY AND AUGUST.

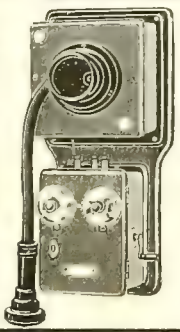
The most charming Summer Resorts, of which there are over three hundred choice locations, are to be found in Wisconsin, Iowa, Minnesota, South Dakota and the Peninsula of Michigan, along the lines of the Chicago, Milwaukee & St. Paul Ry. Nearly all are located near lakes which have not been fished out.

These resorts are easily reached by railway, and range in variety from "full dress for dinner" to the flannel shirt costume for every meal

SEPTEMBER AND OCTOBER.

The finest shooting grounds in the Northwest are on and tributary to the lines of the Chicago, Milwaukee & St. Paul Ry. The crop of Prairie Chickens will be exceptionally good this year; also Ducks and Geese. In Northern Wisconsin and the Peninsula of Michigan splendid Deer shooting is to be had.

Full information furnished free. Address GEO. H. HEAFFORD, Gen. Pass. Agt., Chicago, Ill.



THE STANDARD

TELEPHONE!

Non-Electric, and only one Adjustable to Atmospheric Changes.

SOLD OUTRIGHT with "PEERLESS INSULATORS."

For Private Short Lines, For Connecting Factory and Office, Residence and Store, Stable, etc., etc.

Plainest Speaking! Superior to Others! Highly Recommended!

Intending purchasers will do well to investigate it before buying elsewhere

THE BOSTWICK & BURGESS MFG. CO.,
NORWALK, OHIO, U.S.A.

ACTIVE MEN AND BUSINESS HOUSES can secure valuable territory in which to take orders and put up lines.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

BEST MAST ARM IN USE.

More Lamps Trimmed.
No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRONTOWER CO., FORT WAYNE, IND.

SEND FOR **New American Electrical Directory, just published, very complete lists. Invaluable for its information of Lighting and Railway Plants.**

COOLIDGE FUEL & SUPPLY CO.,

CEDAR AND OCTAGONAL PINE POLES.

Railroad Cross Ties and Piling.

Cross Arms, Pins and Brackets, Manufactured by J. R. CLARK CO.,
MINNEAPOLIS, MINN.

"MERIT LEADS TO SUCCESS."

HEISLER

LONG DISTANCE SERIES INCANDESCENT LIGHTING

HAS NO EQUAL.

ONLY successful method of distribution covering a large area WITHOUT swamping the plant with INTEREST on Copper Wire or cost of FUEL.
Transformers or Converters are a CONSTANT source of TROUBLE and EXPENSE, will cost MORE for repairs in a year than to renew the Lamps by our system.
Our PLANTS can be operated with success ELECTRICALLY and FINANCIALLY where no others can.
Plan of wiring SIMPLE, CHEAP and EFFICIENT.
LAMPS from 16 C. P. up, noted for BRILLIANCY and BEAUTY of the light.
ALSO SERIES LAMPS of any C. P. for Arc Light Circuits.
Gold Medal, Paris Exposition, 1889.
Estimates furnished on application, for erection of plants in any section. Correspondence solicited.

HEISLER ELECTRIC LIGHT CO., Drexel Building, PHILADELPHIA, PA.

Send for Circular.

OKONITE TRADE MARK

SOUTHERN ELECTRICAL SUPPLY CO.,

823 Locust St., ST. LOUIS, MO.,

Okonite Wires AND **Cables.**

AGENTS FOR THE CELEBRATED PACKARD LAMP.

Made to Fit any Socket.

We also have a full stock of Sockets made to fit any Lamp.

SEND US A TRIAL ORDER.

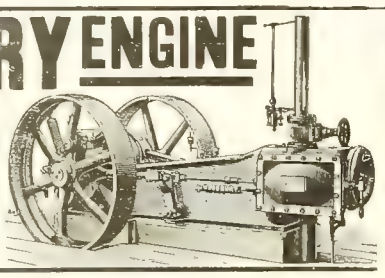
THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC HIGH SPEED STEAM ENGINE for Electric Lighting and Street Railway Service,

WITH BOILER PLANT COMPLETE.

Catalogues sent on application.

STEARNS MANFG. CO. ERIE, PA.

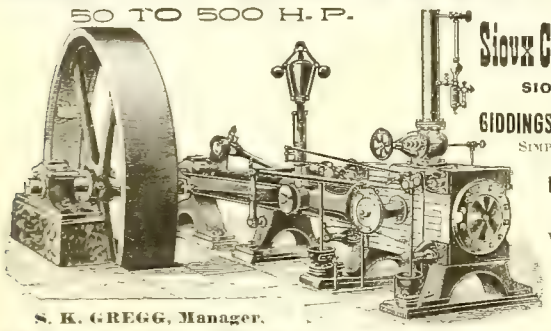


FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO.

HALF TONE PLATE SPECIALTY.

SIOUX CITY CORLISS ENGINE.

50 TO 500 H. P.



BUILT BY THE

Sioux City Engine Works,

SIOUX CITY, IOWA.

GIDDINGS' AUTOMATIC ENGINE,

SIMPLE AND COMPOUND.

BOILERS and Complete Power Plants built and erected.

Write for estimates and circulars.

Largest Engine Works WEST OF THE MISSISSIPPI.

S. K. GREGG, Manager.

48 S. Canal St., Chicago.

C. S. LEWIS, Agent, 703 Market St., St. Louis, Mo.

WESTINGHOUSE ENGINES

USED BY THE FOLLOWING GOVERNMENTS.

UNITED STATES.

U. S. Torpedo Station, Newport, R. I., 43 H. P.
U. S. Army Department, San Antonio, Tex., 50 H. P.
U. S. Engineer Corps, St. Louis, Mo., 8 H. P.
U. S. Military Post, Fort Canby, Wash., 4 H. P.
U. S. Government Quartermaster Department, Vancouver, Wash., 62 H.P.
U. S. Government Quartermaster Department, New Orleans, La., 15 H. P.
U. S. Senate, Washington, D. C., 150 H. P.
U. S. House of Representatives, Washington, D. C., 75 H. P.
U. S. Government Ice Factory, San Antonio, Tex., 4 H. P.
U. S. Navy Yard, Norfolk, Va., 125 H. P.
U. S. Navy Yard, Brooklyn, N. Y., 125 H. P.
U. S. Government, Ellis Island, N. Y., 120 H. P.
U. S. Steamer Boat "Lucerne," Norfolk, Va., 50 H. P.
Washington Monument, Washington, D. C., 35 H. P.
MEXICAN: State of Guerrero, 15 H. P.
JAPANESE: Its Government Coal Mines, 150 H. P.
HOLLANDS: Government Physical Laboratory of Leyden, 15 H. P.
RUSSIAN: Moscow Imperial Technical School, 10 H. P.
NEW SOUTH WALES: Government of New South Wales, 160 H. P.
TASMANIAN: Alexander's Battery, Hobart, 75 H. P.
ENGLISH: Number unknown. Details not reported. Over 30 engines.

Many others sold by agents, but not reported.

THE WESTINGHOUSE MACHINE COMPANY.

PITTSBURGH, PENNA. U.S. OF A.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,

ST. LOUIS. CHICAGO. KANSAS CITY.
OMAHA. DALLAS. SEATTLE.

W. N. HOBART, Pres't. L. O. MADDUX, Vice-Pres't and Treas. J. H. EICKERSHOFF, Sup't.
J. C. HOBART, Sec'y.

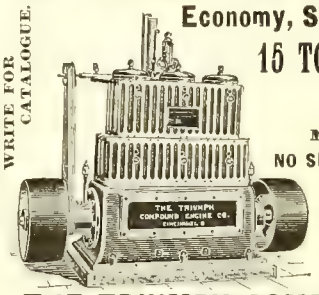
THE TRIUMPH

Economy, Simplicity, Durability, Silence.

15 TO 300 HORSE-POWER.

COMPOUND AND VALVELESS.

WRITE FOR CATALOGUE.



Most perfect regulation ever obtained.

NO SMALL PARTS REQUIRING REPAIRS.
NO ECCENTRICS. NO STUFFING BOXES.
NO PISTON RODS.
INTERNAL FRICTION A MINIMUM.
ALL PARTS INTERCHANGEABLE.

The engine is perfectly balanced and self contained; all wearing surfaces are exceptionally large, making it the most perfect high speed engine built.

THE TRIUMPH COMPOUND ENGINE CO., SOLE BUILDERS,

211, 213, 215 and 217 W. 2nd St., CINCINNATI, O.

FRASER & CHALMERS, Agents, Salt Lake City, Utah; Helena, Mont.

FAN MOTOR,

MANUFACTURED BY

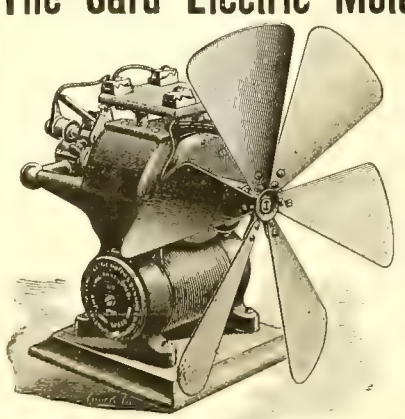
The Card Electric Motor and Dynamo Co.,

Cincinnati, Ohio,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits, from 1-6 to 50 H. P.

Correspondence Solicited.



AGENTS:

BOSTON—The Eastern Electrical Supply & Construction Co., 65 Oliver St.
CHICAGO—The Thos. L. Johnson Co., 312 Dearborn St.
MILWAUKEE—Henry Ramien, 641 Third St.
WASHINGTON, D. C.—J. Geo. Gardner, 1005 H St.
ST. LOUIS—Stagl Electrical Engineering Co., 1106 Pine St.
MONTGOMERY, ALA.—W. F. Murphy.
DETROIT, MICH.—The Michigan Electric Co., 212 and 214 Griswold St.
MINNEAPOLIS, MINN.—J. M. Lennon, No. 22 Loan and Trust Building.

COPYRIGHTED 1886 BY J. A. J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT

IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP

FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt

ALL LEATHER AND IRON ROD OR HINGE OLD STYLE LEATHER LINK AND IRON ROD BELT, AND ROPE TRANSMISSION SUPERSEDED.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION.

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY. BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

RAWHIDE LACE LEATHER AND PICKER LEATHER.

BRANCHES: 164 Summer St., Boston, Mass.; 225 Pearl St., New York City. 139 N. Third St., Philadelphia, Pa.; 60 W. Monroe St. Chicago. | **St. Louis, Mo.**

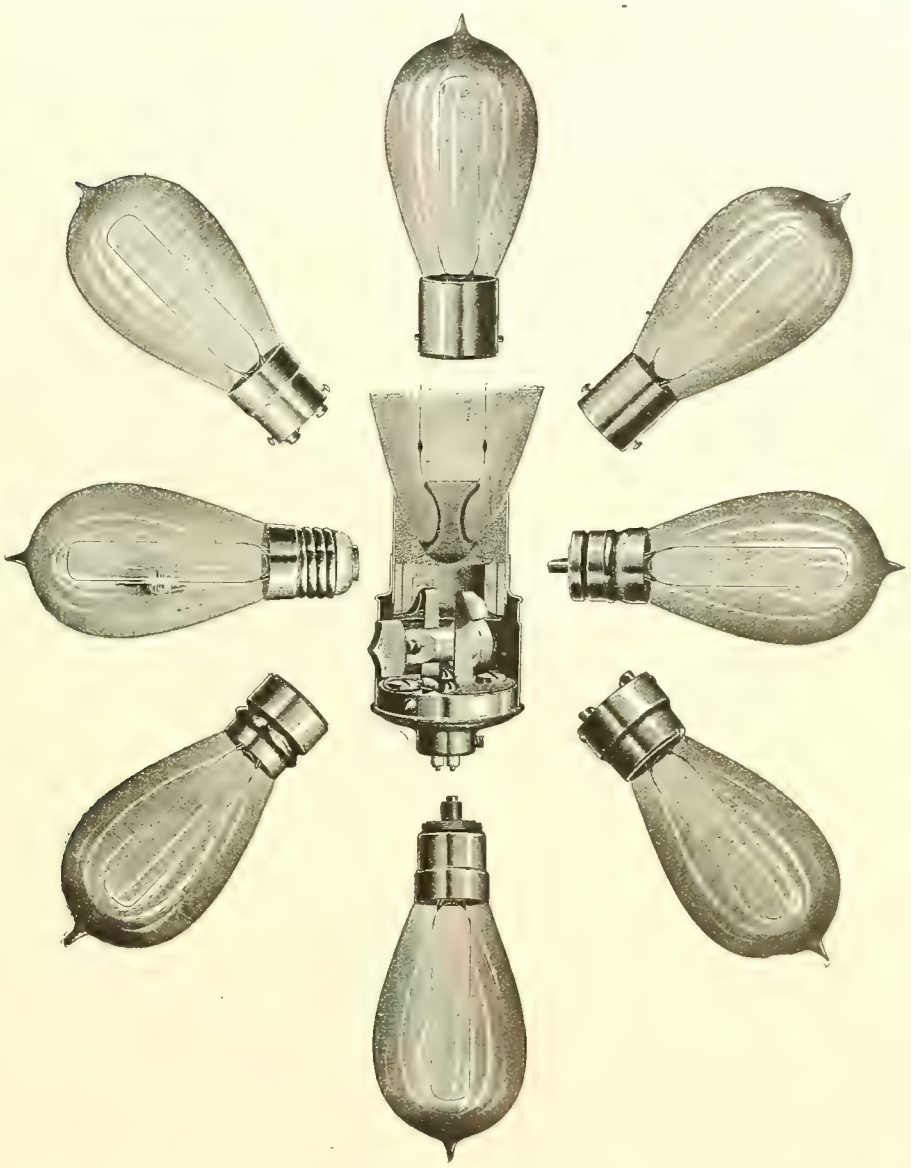
THE KNAPP ELECTRICAL WORKS,

General Western Agents for

THE PERKINS ELECTRIC LAMP CO.

HIGH EFFICIENCY.

ANY VOLTAGE.



ANY CANDLE POWER.

LONGEST LIFE.

S-A-F-E-T-Y

WIRES, CABLES AND CORDS FOR INSIDE, UNDERGROUND AND SUBMARINE USE.

MANUFACTURERS OF

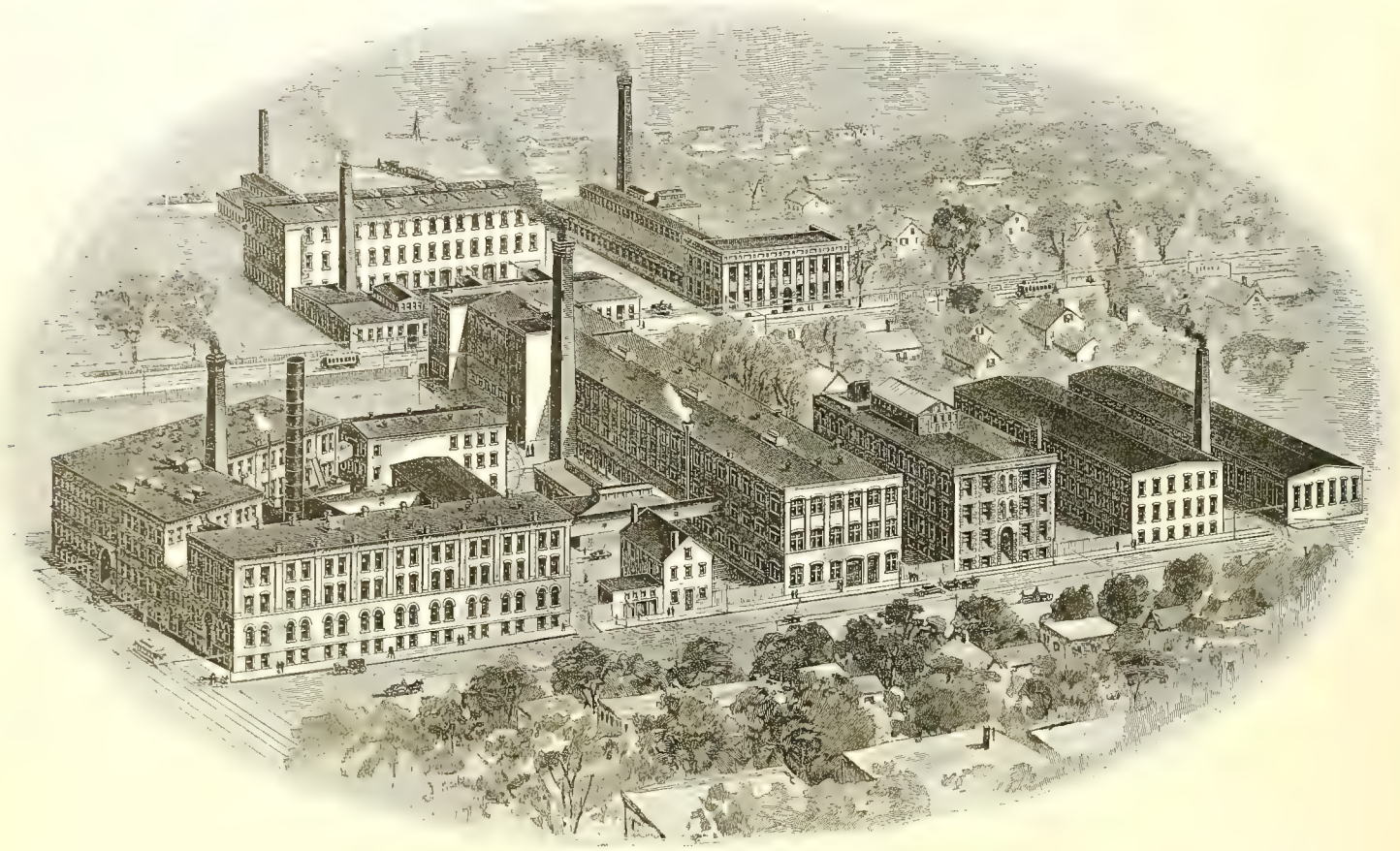
Street Railway, Electric Light, Telephone, Telegraph and Electrical House Goods.

PROMPT SHIPMENTS. LOWEST PRICES.

54 AND 56 FRANKLIN STREET, CHICAGO.

SEND FOR CATALOGUE.

THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.

1,000 HORSE POWER

—OF—

SHORT GEARLESS MOTORS

—AND—

7,000 HORSE POWER

—OF—

SHORT STANDARD MOTORS

HAVE BEEN PURCHASED

—BY—

Muskegon Railway Co., Muskegon, Mich.
South Covington & Cincinnati St. Ry. Co., Covington, Ky.
Pittsburgh Traction Co., Pittsburgh, Pa.
St. Louis Railway Co., St. Louis, Mo.
Brooklyn Street Railway Co., Cleveland, O.
Johnstown Passenger Railway Co., Johnstown, Pa.
Rochester Electric Railway Co., Rochester, N. Y.
Rochester Railway Co., Rochester N. Y.
Citizens' Street R. R. Co., Indianapolis, Ind.
Watervliet Turnpike & R. R. Co., Albany, N. Y.
Schuylkill Electric Railway Co., Pottsville, Pa.
Broadway & Newburgh Street Railway Co., Cleveland, O.
Jamestown Street Railway Co., Jamestown, N. Y.
Central Passenger Railway Co., Louisville, Ky.
Pittsburgh & Birmingham Traction Co., Pittsburgh, Pa.
West End Street Railway Co., Rockford, Ill.
Lincoln Street Railway Co., Lincoln, Neb.
Buffalo Street Railway Co., Buffalo, N. Y.
Georgetown & Tennalytown Ry. Co., Washington, D. C.
Battle Creek Street Ry. Co., Battle Creek, Mich.

SHORT ELECTRIC RAILWAY CO.,

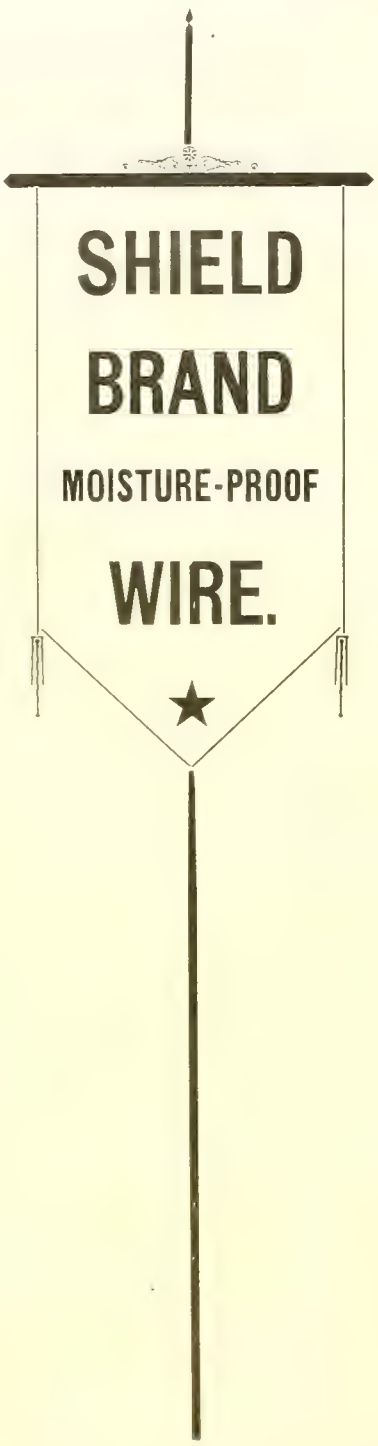
CLEVELAND, OHIO.

FACTORIES: ANSONIA, CONN.

THE ELECTRICAL SUPPLY CO.,

104 MICHIGAN AVENUE,

CHICAGO.



We don't Believe

That we can convince you, with mere blatant phraseology, that Shield Brand Wire is any better than its rivals.

You do Believe

Facts, and we offer a few for your consideration, appropriately framed. A test was made, taking about fifty feet of our standard insulation.

Here is the picture:

	NO GROUNDS. NO ACCIDENTS.	
NO UNSATISFACTORY SERVICE.	50 ft. of Shield Brand Moisture Proof At immersion, 200 Million Ohms. After 24 hours, 5,000,000 Ohms. After 72 hours, 5,000,000 Ohms. After 120 hours, 4,850,000 Ohms. One week, 4,200,000 Ohms.	NO UNDERGROUND AGITATION.
	NO UNNECESSARY CONSUMPTION OF FUEL.	

We made THAT test—now if you please, allow us to suggest that YOU make one. Take about three or four feet of "Shield Brand," and attempt to abrade or destroy the covering. Scrub it across a tree or a sharp corner and learn how long it takes to ruin the insulation. Again, take a short piece and wobble it until the wire is broken INSIDE and note the result.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having *won four distinct infringement suits* in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

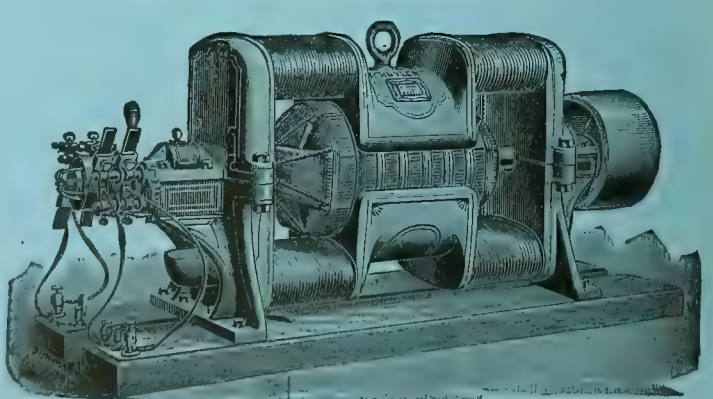
FACTORIES AND GENERAL OFFICES, BALTIMORE, MD.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, JULY 18, 1891. No. 3

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

THE HOLTZER-CABOT ELECTRIC CO.,
MANUFACTURERS OF AND DEALERS IN
EVERYTHING ELECTRICAL.
SEND FOR 256-PAGE CATALOGUE.
111 Arch Street, BOSTON, MASS.
SPECIAL AGENCIES: CLOWER & HARRIS, Dallas, Texas. PAUL SEHLERS ELECTRICAL WORKS, San Francisco, Cal.
A full line of our manufacture can be found at our Agencies.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes Telephonic transmission through Our Cable an easy
CAME.

An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices. Standard Underground Cable Co., New York, Pittsburgh, Chicago.

Nuttall Trolley. Patents Pending.

THE BEST!
$30.00
WRITE US.
Electric Railway Specialty COMPANY,
29 Broadway, NEW YORK.

KELLOGG
COMBINATION STEEL CENTER AND SIDE
POLES.
ENGINEERING EQUIPMENT CO.,
SOLE AGENTS,
NEW YORK, 143 Liberty St.
BOSTON, 126 Pearl St.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.
OKONITE TRADE MARK
INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.
BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP
AGENTS
J. W. PEALE, 1 BROADWAY, NEW YORK.
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.
DAY'S KERITE
The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.
Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.
GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.
THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 Dey Street, NEW YORK,
MANUFACTURERS AND IMPORTERS OF AND DEALERS IN
ELECTRICAL SUPPLIES
OF ALL DESCRIPTION.
Telegraph, Telephone, Electric Light, Power and Railway Appliances, Construction Tools, and Line Material.
Standard Electrical Measurement Apparatus.
TEST INSTRUMENTS A SPECIALTY.

ELECTRIC RAILWAY SUPPLIES
For All Systems.
EXCLUSIVELY.
SEND FOR CATALOGUE.
ELECTRIC MERCHANDISE CO.,
11 ADAMS STREET, CHICAGO.
W. R. MASON, General Manager.

IS THE THOMSON-HOUSTON ELECTRIC CO.'S SYSTEM OF LIGHTING A SUCCESS?

Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, **1,653 Lamps.**	**None.**	**None.**

Cut of Factory, 1888.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, **21,840 Lamps.**	29 Companies, **11,275 Lamps.**	**None.**

Read the Answer on Page xx.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....xxiv
Abendroth & Root Mfg. Co.....—
Alexander, Barney & Chapin . I, vii
American Electrical Works.....xiii
Automatic Switch Co..... x
Andrews & Co., A. H..... ...xiii
Baggot, E.....xiv
Bain Electric Mfg. Co..... xvii
Ball Engine Co.....xviii
Baxter Electric Motor Co.....xxiv
Bernstein Electric Co.....—
Blatz, L.....—
Borden & Selleck Co.....xv
Bostwick & Burgess Mfg. Co...xiv
Braun Illustrating Co.....xvii
Brownlee & Co..... xii
Brookfield, Wm..... xii
Brush Electric Co.....xxiii
Buckeye Electric Co.....—
Butler Hard Rubber Co.....viii
C. B. & Q. R. R..... xvii
C. & C. Electric Motor Co. ... xvi
Card Electric Motor & Dynamo Co.....—
Central Electric Co..... ... v
Chicago Electric Mfg. Co..... xiv
Chicago Insulated Wire Co.... xvii
Cleverly Electrical Works... ...iv
Colburn & Co., I. W..... xiv
Coolidge, Fuel & Supply Co... —
Cowles Electric Smelting and Aluminum Co.....xv
Crocker-Wheeler Electric Motor Co..... .xiii
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co..xvi
Eastern Electric Cable Co.....xiii
Easton Electric Co.....xiii
Edison General Electric Co.,— Motor Dept..... .vi
Edison General Electric Co, Wire Department..... vii
Electric Merchandise Co.....i
Electric Railway Specialty Co.....i
Electric Construction & Sup. Co. viii
Electrician Pub. Co...vii, xiv, xvii
Electrical Construction Co., The.xiii
Electrical Engineering Co.....xiii
Electrical Supply Co., The....xxii
Elektron Mfg. Co..... x
Empire China Works..... .xiv
Engineering Equipment Co.....i
Evans Friction Cone Co..... xvii
For Sale.....xiii, xiv
Fort Wayne Electric Co..... xxiv
Freeman, Coleman & Co..... x'i
Globe Carbon Co.... xv
Greeley & Co., The E. S.....i
Hawkeye Electric Mfg. Co..... —
Hay-Horn Mfg. Co .....—
Hazelton Tripod Boiler Co..... xvii
Heisler Electric Light Co.....—
Hill Clutch Works..... xix
Hine Eliminator Co.....—
Holmes, C. H.....xiii
Holmes, Booth & Haydens.....iv
Holtzer-Cabot Electric Co.....i
Hood, Wm..... x
Hunt Machine Co.,Rodney..... xvii
India Rubber & Gutta Percha Insulating Co.....iv
Interior Conduit & Insulation Co.. xii
International Okonite Co.....i
Kartavert Mfg. Co..... ,....xviii
Knapp Electrical Works..... xxi
Leffel & Co., Jas.....xiii
Loud, H. M. & Sons Lumber Co.....xiv
McLaughlin, James xiv
Mason, James H.....xiii
Mason, J. W..... xii
Milliken Bros.....iv
Minneapolis Street Railway Co.—
Monitor Electric Co x
Munsell & Co., Eugene.....xiii
Murphy, T. J.....xiv
National Carbon Co.....iv
National Electric Mfg. Co.....ix
N. Y. Belting & Packing Co....—
New York Insulated Wire Co.. xvi
New York & Ohio Co..... i
Northwestern Electrical Specialty Co.....—
Ostrander & Co., W. R.....xviii
Paiste, H. T..... xii
Page Belting Co.....xiv
Partrick & Carter Co..... x
Payne & Co., Geo. W.....—
Pearson & Co., W. B.....xviii
Phoenix Glass Co.....xix
Pond Engineering Co.....xviii
Powell Co., Wm..... .....—
Queen & Co..... xiii
Rockford Electric Mfg. Co.....xii
Roeblings' Sons Co., Jno. A....—
Rose Polytechnic Institute.....xiii
Sargent & Lundy.....xiii
Sawyer-Man Electric Co.....xi
Schieren & Co. Chas. A.....xii
Schoonmaker, A. O.....xiii
Schuyler Electric Co.....xix
Short Electric Railway Co..... xii
Shultz Belting Co.....
Sioux City Engine Works..... xviii
Southern Electrical Supply Co.xviii
Standard Underground Cable Co....i
Stanley & Hall.....—
Standard Paint Co.....xii
Stanley Electric Mfg. Co..... ..xix
Star Iron Tower Co.....—
Stearns Mfg. Co.....xviii
Stephenson Co., Jno.....xvi
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co xv
Taussig, S.....xiv
Temple, J. C..... xv
Thomson-Houston Electric Co. Lighting Department ..... ii, xx
Turner Brass Works..... ...xiii
Union Electric Works.....xiii
Union Hardware Co.....xii
United States Electric Lighting Co.....xi
Van Nuis C. S..... i
Vulcanized Fibre Co..... xv
Wanted .....xiii, xiv
Wenstrom Consolidated Dynamo & Motor Co., The x
Western Electric Co viii
Westinghouse Electric and Mfg. Co.....—
Westinghouse Machine Co.... xviii
Weston Electrical Instrument Co.....xii
Woodbridge & Turner Engineering Co xv
Worthington, Henry R.....xii

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Stanley & Hall.
Western Electric Co.

Anti-Friction Metal
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Hawkeye Electric Mfg. Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co.,The.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
Stanley & Hall.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Partrick & Carter Co.
Queen & Co.
Stanley & Hall.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Stanley & Hall.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Stanley & Hall.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co.,The E. S.
Holtzer Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Roebling's Sons Co., John A.
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
McLaughlin, Jas.
Temple, J. C.
Union Electrical Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Engineering Equipment Co.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Roebling's Sons Co., Jno. A.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Monitor Electric Co.
Southern Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Southern Electrical Supply Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Colburn & Co., I. W.
Easton Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Hawkeye Electric Manufacturing Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.
Union Electrical Works.

Electric Railways.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrollers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Sioux City Engine Works.
Stearns Mfg. Co.
Westinghouse Machine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Easton Electric Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Southern Electrical Supply Co.
Stanley & Hall.
Thomson-Houston Electric Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Butler Hard Rubber Co.
Central Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Buckeye Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Monitor Electric Co.
New York and Ohio Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Wenstrom Consolidated Dynamo & Motor Co.

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica
[illegible]

Mining Apparatus Electric
[illegible]

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Easton Electric Co.
Electrical Engineering Co.
Elektron Manufacturing Co.
Hawkeye Electric Mfg. Co.
[illegible]
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups and Brass Goods.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Standard Electrical Works.
Southern Electrical Supply Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Telephones, Non-Electric.
Bostwick & Burgess Mfg. Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Stanley Electric Mfg. Co.

Trucks, Electric Car
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.
Roebling's Sons Co., Jno. A.

THE NATIONAL CARBON CO.

Cleveland, Ohio.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

Cleverly
1018 CHESTNUT ST.
PHILA.

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY **MILLIKEN BROS.**

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

REMEMBER That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

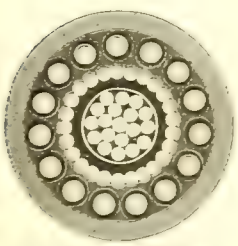
THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

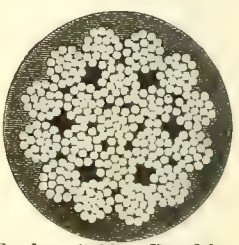
THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.

THE RUBBER USED IN

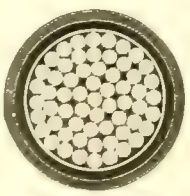
HABIRSHAW INSULATION

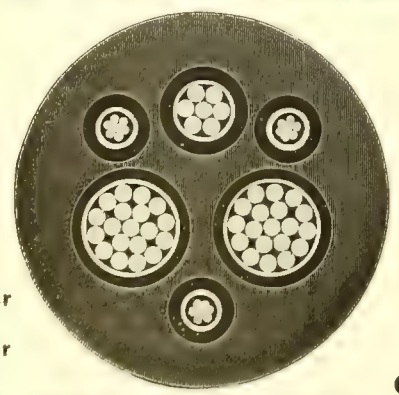
IS PURE PARA.

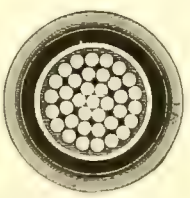

Underground Core.

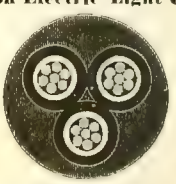

Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.


Naval Core, United States S. S. "Chicago."


Portable Cable, Broadway Theater.

Marine Core, used on Government Cruisers.

Naval Marine India Rubber Covered Wires.

Naval Land India Rubber Covered Wires.

PROMINENT INSTALLATIONS.

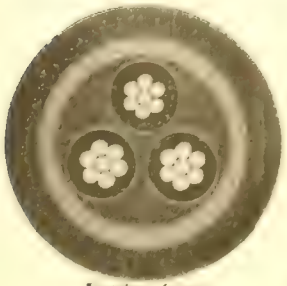
STANDARD INDIA RUBBER COVERED WIRES.

Feeder Conductor, "Dryplaces," Grand Central Depot.

Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

SOLID AND STRANDED CONDUCTORS, TAPED, BRAIDED, FLAME-PROOF.

The Habirshaw Insulation fulfills all requirements in places demanding the "Best," and in that field finds no successful competitors.


Feeder Core

FACTORY: GLENWOOD, YONKERS, N. Y.

WM. M. HABIRSHAW, F.C.S.,
GENERAL MANAGER.

OFFICE: 315 Madison Ave., Cor. Forty-Second St., NEW YORK CITY.

THE ELECTRICAL SUPPLY CO., Western Agents, 171 Randolph St., Chicago, Ill.

Feeder Cable, Brooklyn Edison Electric Light Co.

Our St. Louis Branch:
Southern Electrical Supply Co.,

OKONITE
TRADE MARK.

823 Locust St.,
ST. LOUIS, MO.

SOCKETS.

BEST IN THE WORLD.

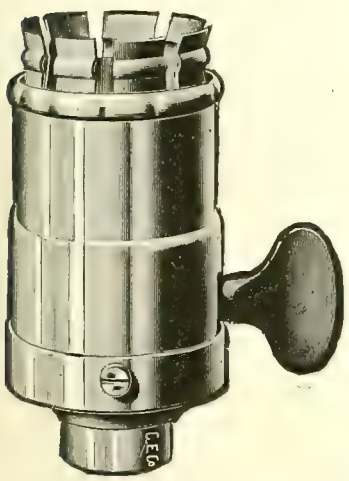
BRYANT'S INCOMBUSTIBLE SOCKETS.

The insulating parts of these Sockets are made of porcelain, and they contain nothing that will burn. They are handsomely finished, and are unquestionably the best Sockets now on the market. Made especially for Thomson-Houston, Sawyer-Man and Edison Lamps.

Our Kansas City Branch:
Gate City Electric Company,

OKONITE
TRADE MARK.

522 Delaware St.,
KANSAS CITY, MO.



General Western Agents for

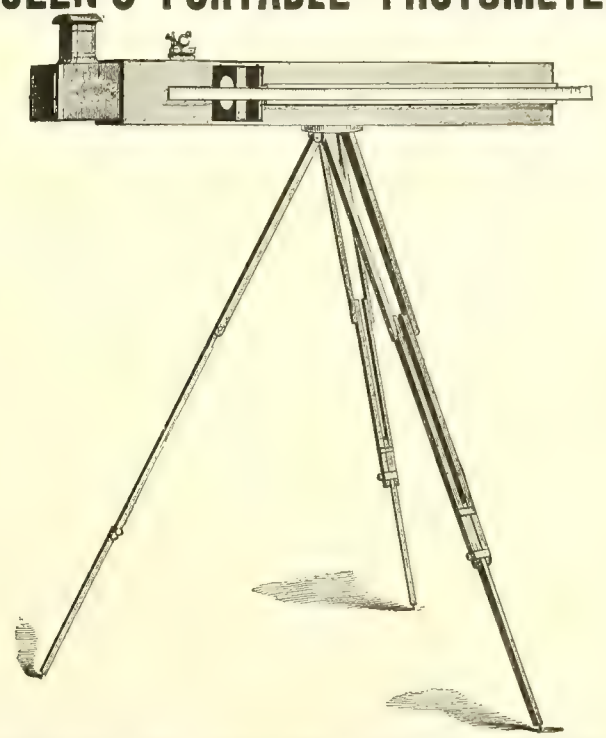
OKONITE

—AND—

IMPROVED

CANDEE WIRES.

QUEEN'S PORTABLE PHOTOMETER.

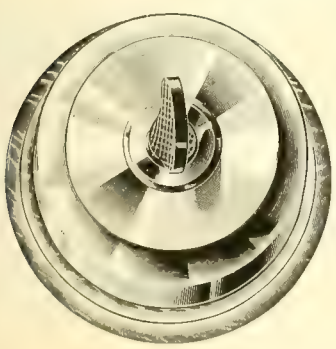


Dimensions: 37½ inches long, 5½ inches wide, 5½ inches deep; weight, 13 pounds. Complete of finely polished Cherry, with Lantern, Measuring Bar and Tripod. Just the thing to determine whether your lamps are burning up to candle power or not, and indispensable in determining the voltage of lamps.

HEADQUARTERS

FOR ALL

ELECTRICAL SUPPLIES.



PAISTE SWITCHES.

We can quote low on a large stock of Paiste Switches. Get our prices before ordering elsewhere.

Our Omaha Branch:
Western Electrical Supply Co.,

OKONITE
TRADE MARK.

418 S. 15th St.,
OMAHA, NEB.

CENTRAL ELECTRIC COMPANY,

116 & 118 Franklin Street,

CHICAGO.

Connected by Private Wire with Postal Telegraph-Cable Company's System.

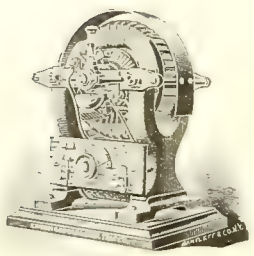
Our Denver Branch:
Electric Power Transmission Co.,

OKONITE
TRADE MARK.

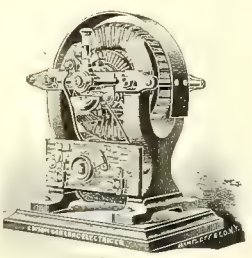
1722 Lawrence St.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.



NEW



ELECTRIC MOTORS.

MINIMUM OF ATTENTION AND REPAIR.

Highest Efficiency,
Slow Speed,
No Sparking.

H. P.	LIST PRICES.	PRICES TO USERS, 45 PER CENT. OFF LIST.
1-12	$ 40	$22.00
1-6	60	33.00
1-3	100	55.00
1-2	125	78.75

Independent Coils,
Improved Lubrication,
Mechanically Perfect.

SEND FOR DESCRIPTIVE CIRCULAR TO NEAREST DISTRICT OFFICE.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

ALEXANDER, BARNEY & CHAPIN,

TELEPHONE BUILDING, 20 Cortlandt St., NEW YORK.

VOLTMETERS. TRADE A.B.C. MARK AMMETERS.

ELECTRICAL SUPPLIES. | ARC AND INCANDESCENT LAMPS.

A NEW BOOK.

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

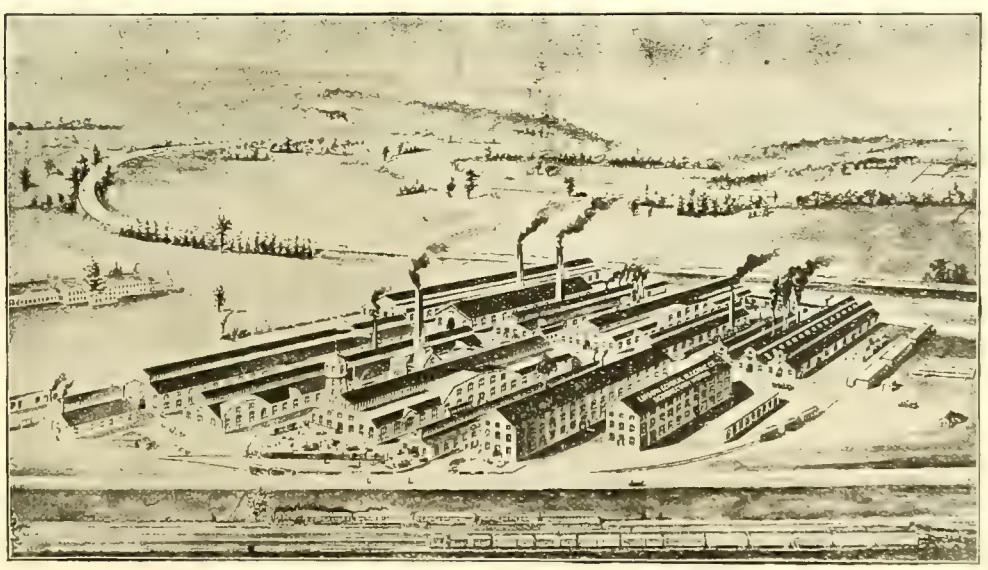
Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

To Electric Railway Companies:

We shall be pleased to make you quotations on Washburn & Moen's hard drawn copper trolley wire, and our own make of Weatherproof insulation feeder wires. Our Weatherproof wire is superior to any other wire of like character in the market.

WESTERN ELECTRIC COMPANY, CHICAGO. NEW YORK.

"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

We Guarantee our Lamps Electrically and Mechanically.

In corresponding please give full particulars, and state voltage.

Electric Construction and Supply Co.,

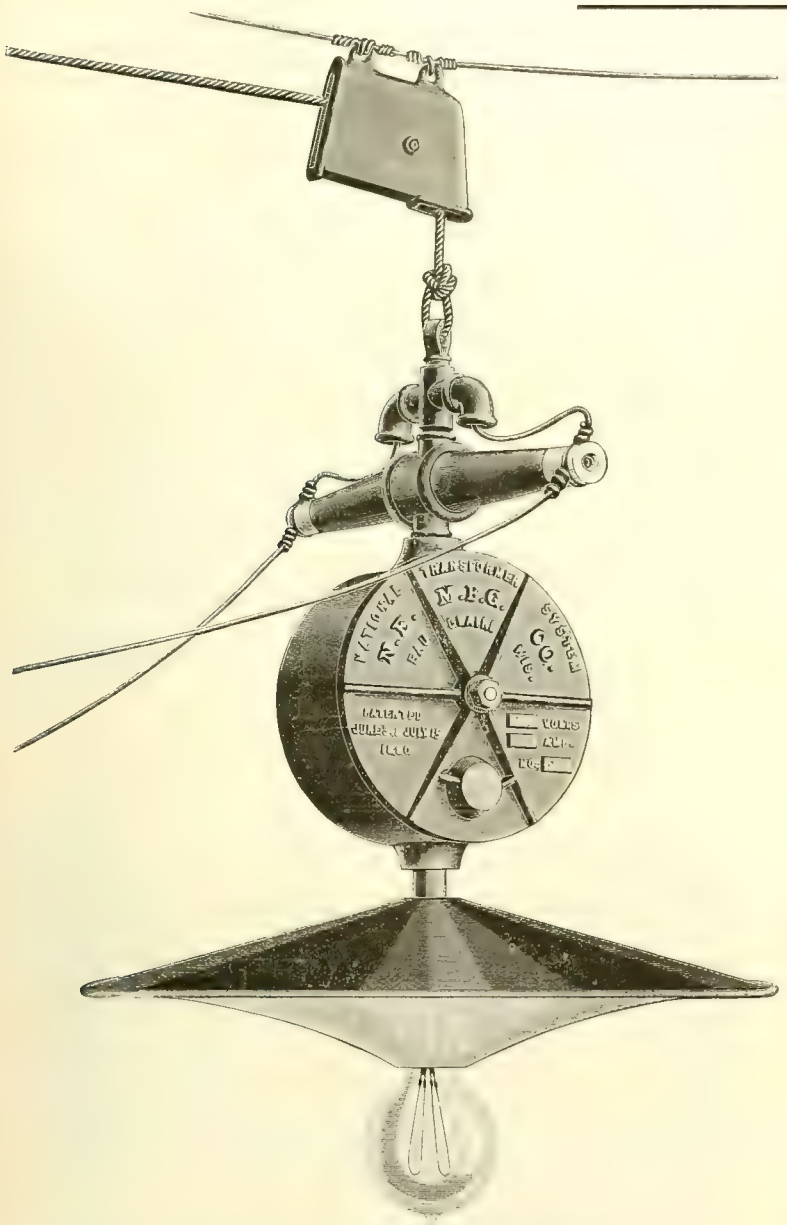
Phenx Building, CHICAGO, ILL.

Established 1881.

18 Cortlandt Street, NEW YORK CITY.

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



INCANDESCENT STREET LIGHT FIXTURE,
SERIES TRANSFORMER, REFLECTOR CANOPY AND 32 C. P. LAMP.

WHY

USE ARC LAMPS

WHEN THE

NATIONAL

SERIES TRANSFORMER

ENABLES YOU TO DO

STREET LIGHTING

ECONOMICALLY
EFFICIENTLY
SATISFACTORILY ???

Send for Circulars and Prices.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
— FOR —
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

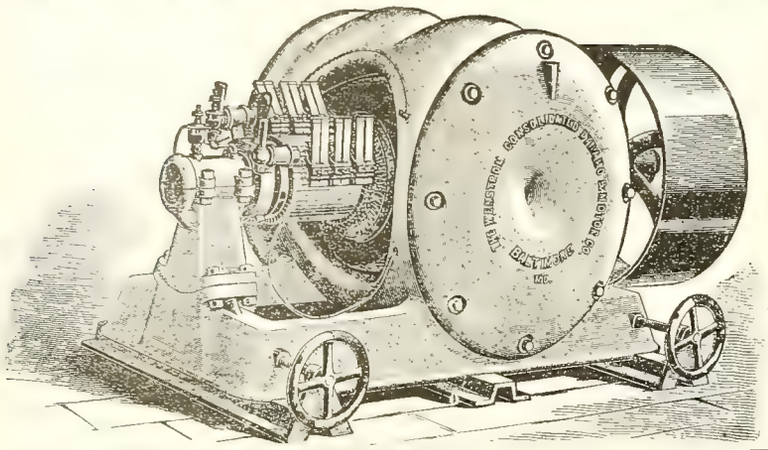
AGENTS:

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.
ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
DETROIT, MICH.,	Commercial Electric Co.
DENVER, COLO.,	The Mountain Electric Co.
WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
SAN FRANCISCO, CAL.,	National Electric Development Co.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

WM. HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

MONITOR CARBON BATTERY

Unsurpassed in Strength and Durability.

LIBERAL DISCOUNT TO THE TRADE.

Write for Quotations.

C. A HARMOUNT, M'gr,

Monitor Electric Company

149 WABASH AVENUE,

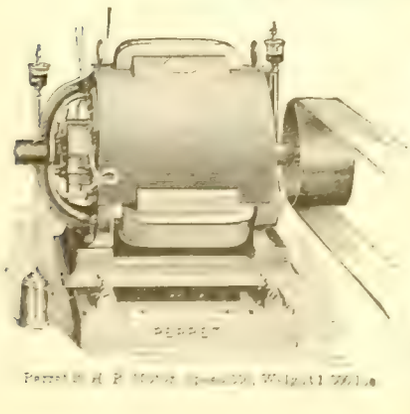
. . . . Chicago, Ill.

Western Agents Alfred F. Moore's Wires and Cables.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

—MANUFACTURERS OF—



Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. *Factories equipped throughout with Electric Power.*
Isolated Plants for Incandescent Electric Lighting.

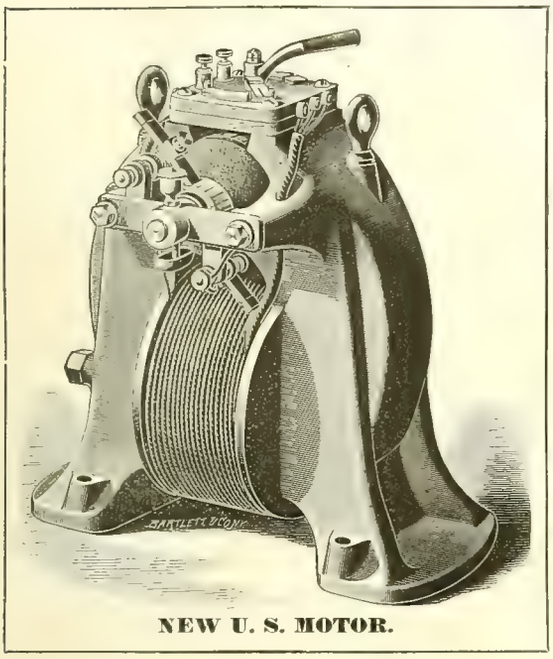
—SELLING AGENTS:—

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.

THE UNITED STATES ELECTRIC LIGHTING Co.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

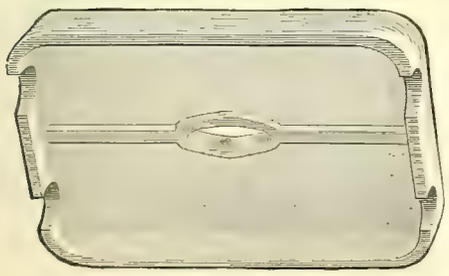
MOTORS and GENERATORS

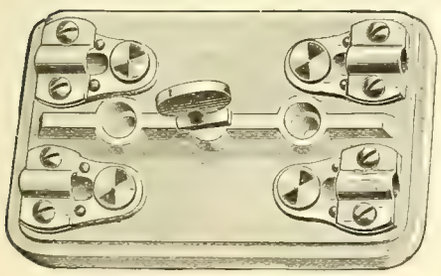
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

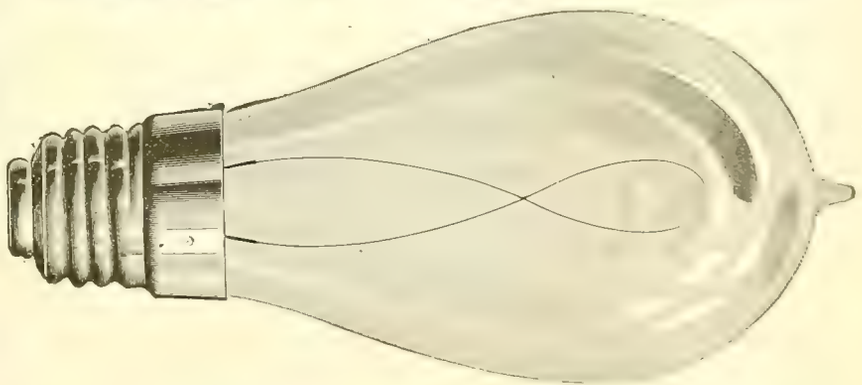
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

ROCKFORD ELECTRIC MFG. CO.,

ROCKFORD, ILL.,

MANUFACTURERS OF

ELECTRIC MOTORS, (Stationary and Railway.)

Incandescent Dynamos and Generators,

(MAYO SYSTEM.)

These Dynamos are specially adapted to Isolated Plants, as they are self-regulating, thoroughly reliable, and any one can run them. The Motors are the most efficient now in the market. See cuts, etc., on page 36, reading matter.

☞ Agents Wanted in Unoccupied Territory. ☜

Experimental Work in Anything Electrical.

FREEMAN, COLEMAN & CO.,

53 and 55 South Jefferson Street. - - CHICAGO, ILL.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia, } 46 SOUTH CANAL ST., CHICAGO, ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. **ST. LOUIS. ST. PAUL.**

THE ONLY GEARLESS MOTOR.

THE SHORT ELECTRIC RAILWAY CO., CLEVELAND, O.

THE NEW CATALOGUE

—OF THE—

UNDERGROUND CONDUIT SYSTEM

OF THE **Interior Conduit & Insulation Company**

IS NOW READY.

Copies mailed upon application to

INTERIOR CONDUIT & INSULATION COMPANY.

EDWARD H. JOHNSON, President.

WORKS, 527 to 531 W. 34th St. and 526 to 528 W. 35th St.

GENERAL OFFICES, 42 & 44 BROAD ST., NEW YORK.

H. M. UNDERWOOD, Gen. Western Agent, Rookery Building, Chicago.

B. FRANK JOHNSON, Gen. Agt. for Pa., Provident Bldg., Philadelphia, Pa.

THOS. DAY & CO., Gen. Agents for California, San Francisco, Cal.

J. W. MASON,

DEALER IN

GENERAL ELECTRICAL SUPPLIES,

SAFETY INSULATED WIRES AND CABLES WEATHERPROOF OFFICE AND ANNUNCIATOR WIRES, TAPES AND TUBING

PROMPT SHIPMENTS. 527 Delaware Street, KANSAS CITY, MO.

H. T. PAISTE,

Paiste Electrical Specialties.

241 THE ROOKERY, CHICAGO, ILL.

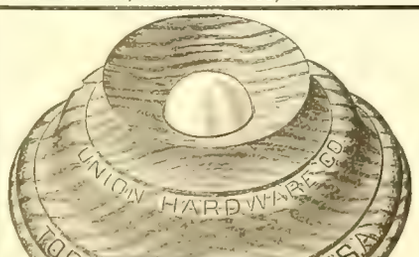
1201 MARKET ST., PHILADELPHIA, PA.

PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.



—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

P AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician

EVERY SATURDAY.

Vol. IX. CHICAGO, JULY 18, 1891. No. 3

Triplex Electric Pumps.

The pumps as shown in the cuts consist of three vertical cylinders, within which are three self-acting plungers, their cranks being hung from the main shaft at an angle of 120°, in order to produce the most even application of power.

The advantages and adaptability of the triplex or three cylinder pumps for electric pumping are found in the fact that the pump offers absolutely even and unvarying resistance to the motor under all conditions and consumes but minimum power in friction.

The first effect is contributed by the action of three-throw crank shafts, in whose stroke there is positively no dead center or point of varying load productive of jerky motion and attendant vibration or water hammer; while the second effect is the happy result of combined ingenuity and skill in production.

Fig. 1 represents a pump with cylinders 6½ inches in diameter and 8 inch stroke with a capacity of 100 gallons per minute against 150 pounds' pressure.

Fig. 2 represents a pump with cylinders 8-inches in diameter and 8 inch stroke with a capacity of 200 gallons per minute against 150 pounds' pressure.

Thomson Houston motors of 7½ horse power and 20 horse power respectively are connected to the pumps by spur gearing. There are rawhide pinions on the counter and motor shaft.

This pump is manufactured by the Gould Manufacturing company of Seneca Falls, N. Y. Tests were made with a 15 horse power motor of special winding with a view to determining the general fitness of the type for deep-mining pressures, and the results have been considered sufficiently satisfactory to warrant the building of a standard line of pumps of from 50 to 500 gallons per minute capacity.

The Gould Manufacturing company intends to build pumps of the same type for pressure upward to 300 pounds, thus making it possible to pump from the lowest levels of mines against a head of upward of 700 feet.

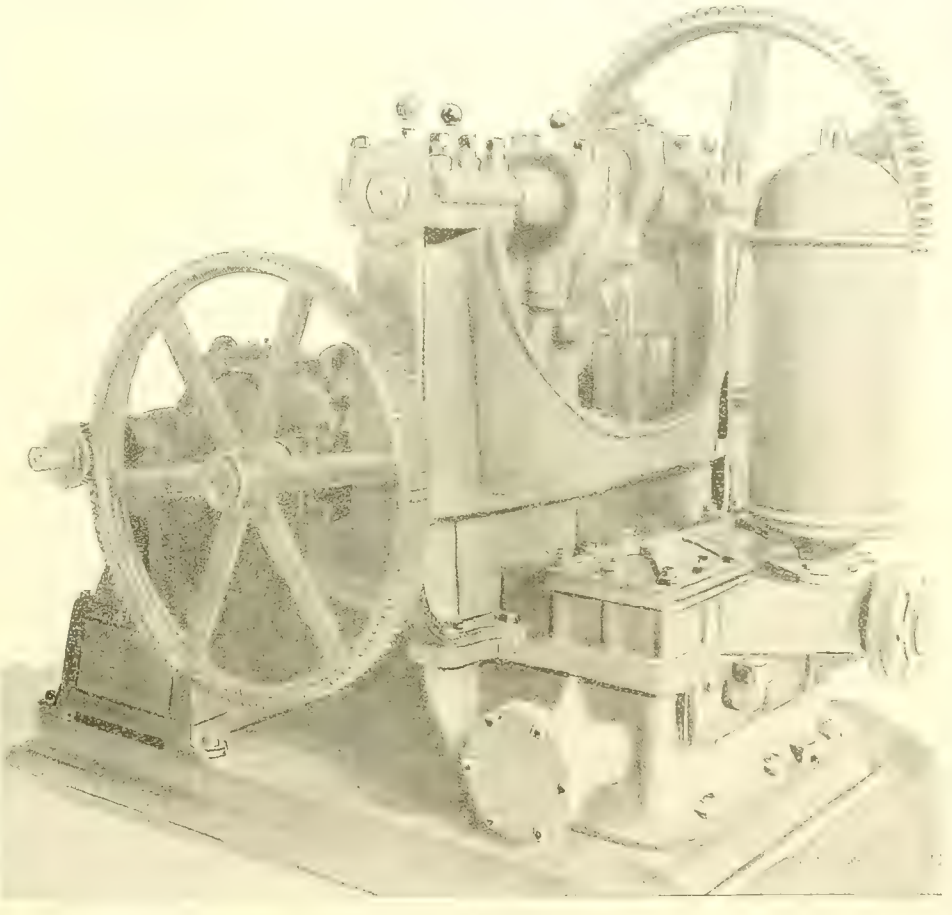


FIG. 1. TRIPLEX ELECTRIC PUMPS.

Thomson-Houston Co. and the Chicago West Side Road Syndicate.

Reports, purporting to come from reliable sources, have been circulated in Chicago and New York connecting the Thomson-Houston Electric company with the syndicate controlling the West Side Elevated railroad. B. E. Sunny, when questioned by a representative of the WESTERN ELECTRICIAN, stated that if any negotiations had been entered into, either for the control of the West Side elevated road or for its equipment with electric power, the business had been carried on through the company's eastern office, and the Chicago branch had heard nothing in regard to it. "Naturally we would have been notified of any such transaction," said Mr. Sunny, "and I therefore regard the report as incorrect."

At the New York office nothing was known of the alleged deal, although the rumors had been quite extensively circulated in electrical circles and on Wall street.

Telegraph Poles in New Orleans.

In the last issue of the WESTERN ELECTRICIAN reference was made to the action of the city council of New Orleans in ordering electric wires removed and poles chopped, and the prompt obedience of the mayor. A press dispatch announces a new turn in affairs. It says: "The Streets and Landings committee of the City Council discussed to-day the request of the Postal Telegraph company to be allowed to put under ground the wires cut down by the mayor. The company presented a special report from experts that the high wire towers upon which it is proposed to string the wires and which it was ordered to use are dangerous even in their present condition, and to string any more wires on them would make them more so. The committee seemed impressed by this showing. It refused, however, to allow the company to use the subway or underground system, and authorized it to erect the ordinary poles for its wires wherever they were necessary, thus pronouncing against both the tower and the underground subway systems, and in favor of the old pole nuisance as the only safe way of stringing telegraph wires."

Canada's International Exhibition.

The electrical features of the Canadian exhibition at St. John, N. B., this year promise to excel all former displays. The preparations for the event are on a more elaborate scale than heretofore, and the management feels warranted in announcing that the exhibition will not only be a great display of electrical and general mechanical appliances but that it will assume the nature of a grand fete. The municipal authorities are making elaborate preparations for the event, and they promise that the city will be arrayed in holiday attire to receive visitors. There will be plenty of attractions to afford amusement and entertainment to strangers in addition to the [illegible] the new opera house now nearly completed it is promised there will be light opera and attractive theatrical arrangements have been made in the St. Andrew's and Palace rinks, as well as Jack's hall. One of the features which will be particularly attractive to lovers of art will be the art exhibition and sale, which is to be held during the exhibition, opening on September 23d and closing October 3d. The promoters of this department have established correspondence throughout Canada, United States, Europe and Australasia, and have the prospect of having one of the best art exhibitions ever held in Canada.

The Moosepath Driving Park association is preparing a very fine programme of races. During the year it has expended a large amount of money improving the course. It is also understood that the Neptune Rowing Club proposes to organize for regattas in which there will be some novel features introduced. No doubt the Amateur Athletic association and the Shamrock club will utilize their splendid grounds for some interesting sports.

As to the exhibition proper it is gratifying to note that it is maintaining its international character, and in addition to the applications from the maritime provinces a number of applications for space have been received from the United States, England, Germany and Italy. It is also anticipated that there will be a very comprehensive Spanish exhibit. Some of the most attractive displays from the Jamacia exhibition are now assured for the St. John's exposition.

Arrangements are being made with the best musical talent for promenade concerts every afternoon and evening during the term of the exhibition. Pyrotechnic displays will be another feature. Machinery hall will be made far more attractive than at any previous exhibition, as it is expected that only machinery in motion will be shown there. Arrangements are in progress for a special electrical display. There is much in and about St. John to attract the electrical engineer. The city is one of the most brilliantly illuminated municipalities in the dominion. There are five central stations, in which Edison, Thomson-Houston, Fort Wayne and Brush plants are installed. In addition the city is now running electric lights of its own in the North End, where it has a Brush plant. D. W. Clark & Son are running the Brush system in the West End, and the New Brunswick Electrical [illegible] company, operating the Fort Wayne system, has completed arrangements for lighting the East End.

Another traction company has been formed in Pittsburg by the syndicate headed by H. Sellers McKee. James A. Chambers, M. A. Verner, Edward E. Denniston and John P. Isley are associated with Mr. McKee. The capital stock of the new company is $1[illegible]. The promoters of the project are interested in many electric street railways throughout the country, notably the Rochester, N. Y., and Buffalo system.

Proposed Electric Road between Chicago and Milwaukee.

Quite a sensation was created in Milwaukee and Chicago last week by the incorporation of the Inter-State Electric Railway company in the former city. The new company, which was capitalized at $10,000,000, at once announced its intention of building an elevated electric railway between Milwaukee and Chicago, and of making the trip between those points in just one hour. The distance is eighty-five miles, and to make the trip in an hour would mean a speed of about a mile and a half a minute. No small amount of incredulity was expressed concerning the enterprise.

The incorporators are G. J. Cox, Portage, Wis.; F. A. Deleglise, Antigo, Wis.; Ira C. Edwards, St. Paul; Charles T. Goodrich, Chicago, and J. W. Dickinson, C. E. Cain and Robert H. Clark, Milwaukee. None of them seem to stand very high in the world of finance. Mr. Deleglise is well-to-do. Mr. Goodrich of Chicago is said to be an electrician, but nothing is known of him in financial circles. The general public has known nothing about the Milwaukee incorporators until the present time. Mr. Cain is an inspector of some kind. Mr. Dickinson is a manufacturer of ash boxes, and of Mr. Clark nothing is known. Mr. Edwards of St Paul is a telegraph operator, and has been more recently engaged in the insurance business. The incorporators claim, however, that wealthy men of Milwaukee, Chicago and St. Paul are backing the enterprise, and that work will be well under way before a year elapses. The capital stock of $10,000,000 is divided into 100,000 shares, 80,000 of preferred and 20,000 of common stock. The management, it is announced, will be in the hands of the incorporators for some little time. The headquarters will be in Milwaukee. The road, it is asserted, will be running before the opening of the World's Fair.

It is claimed by the incorporators that they have the [illegible] use of two patents, which will contribute materially to the success of the enterprise. [illegible] prise the conductor of any [illegible] is the property of Mr. Cain. [illegible] consist of three rails, the middle rail being used as [illegible] houses, one at Milwaukee, another at Chicago, and the third at some intervening point. The company expects to [illegible]

Electrical Development in the Northwest.

By a Travelling Correspondent.

Rapid transit on electric cars is evidently appreciated by the visitors and inhabitants of the progressive city of Helena, Mont., judging from the crowded condition of the cars both afternoons and evenings on the electric line running to the Broadwater. This is the most beautiful and healthful summer resort in the Rocky Mountains. The Hotel Broadwater, with its hot springs and bath house, which, by the way, is the largest in the world (its dimensions under roof being 350 by 100 feet), is located at the foot of Mount Helena, which rises to the height of about 2,000 feet above the hotel and 5,800 feet above the sea level. The distance from the main street to the terminus of the road, at which point the hotel is located, is 3 1-2 miles. It is indeed rapid transit when the cars cover the distance in 18 minutes, including stops, and at times attaining a speed of 25 miles per hour. Thomson-Houston and Westinghouse cars are used on this line, both systems giving perfect satisfaction. The company which owns and operates this road is the Helena Electric Railway company. Two generators are located at the main power house near the business part of the city, while the third is at the Hotel Broadwater. The company was placing in position during the writer's visit a new generator of 100 horse power, made by the National Electric Manufacturing company of Eau Claire, Wis. This is intended for furnishing power for the lines connecting with the railway station. A fare of 10 cents is charged on this as well as [illegible] road.

[illegible] Wash., there are many points of interest to [illegible] here [illegible] we have the great water power for driving dynamos and generators as well as all kinds of machinery. A new road is in course of construction [illegible] company and work is progressing rapidly. Through the main streets new rails are being laid, [illegible] bonded. One fact noted by the writer is the very fine poles used in the line construction of overhead electric railways in this western country. The poles are mostly of cedar, straight as an arrow, and seem to have 8 or 9 inch tops, while 6 to 7 inch tops are used in the East.

The power house of the Ross Park Electric Railway company, while small, is the acme of perfection. Around the oak switch-board and the two 80 horse power generators is a polished brass railing, while the floor is neatly covered with oil cloth. The pulleys and the water wheel are arranged below the floor of the dynamo room, and the absence of large or small steam engines, exhaust steam, smoke, etc., lends a peculiar effect, at least in the eyes of an eastern visitor. Center pole construction is used on this company's line, and on the top of every other pole is placed a five light electrolier, making a pretty sight in the evening.

FIG. 2. TRIPLEX ELECTRIC PUMPS.

Electrical Department, World's Fair.

The applications for space in the electrical building continue to come in in a steady stream. "It is amazing," said Chief Barrett in speaking on this subject a few days ago, "how much interest is taken in the electrical display at the exposition. The number of people who write to make inquiries is astonishingly large. The difficulty will be not how to get exhibits, but how to provide for the people who want to make displays. It looks now as though our building wouldn't be half large enough. However, we will do the best we can, although I doubt if all applicants can have the amount of space requested. But one thing can be taken for a certainty—everybody will be given a show."

It is thought that the electricity building will be roofed over by February next. Secretary Hornsby says that about 175,000 feet of floor space has already been applied for. It should be remembered that April 10, 1893, is the last day on which exhibits will be received. This is a long way ahead, but it is an important date to all prospective exhibitors, and should be borne in mind.

Fulton Gardner of Chicago proposes to bore the deepest hole in the earth at Jackson Park during the exposition by means of his electric drill. Mr. Gardner claims that, with ordinary conditions of soil, there is no limit to the depth of well which his drill will bore. The deepest hole in the earth is in Germany, where a well was driven 4,200 feet. It is a curious fact that this well goes through a bed of salt rock 2,000 feet thick. Mr. Gardner wants to bore a deeper hole than this in Jackson Park.

The committee on classification has been considering the advisability of revising the existing classifications in several departments, including that of electricity. Secretary Hornsby appeared before the committee a few days ago and urged upon it the importance of adopting the revised classification prepared by Prof. Barrett several months ago.

On Tuesday the committee on classification concluded its labors and adjourned. Before doing so it decided to adopt the revised classification of the Department of Electricity, after instituting a minute inquiry into the merits of the new list. This decision will be received with satisfaction by the electrical interests. The present official classification was published in the WESTERN ELECTRICIAN of March 28.

A meeting of amateur electricians will be held in the rooms of the Electrical Department of the World's Columbian Exposition, Thursday evening, July 23d, for the purpose of forming a national amateur electrical society, and arranging for an amateur electrical exhibit at the World's Fair. Secretary Hornsby will be present to aid in shaping the

policy of the association as regards the exhibit, and several prominent electricians have promised to address the meeting.

The Monrath-Devold System of Rope Transmission for Electric Car Trucks.

In the WESTERN ELECTRICIAN of October 18, 1890, there was presented a discription of F. Devold's system of power transmission. This invention, as applied to dynamos, Figs. 1 and 2, consists of a combination of rope and friction transmission so arranged as to reduce friction in

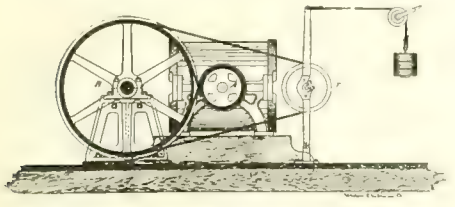


FIG. 1. MONRATH-DEVOLD SYSTEM OF ROPE TRANSMISSION FOR ELECTRIC CAR TRUCKS.

the bearings of both dynamo and main shaft to a minimum. Both pulleys have two or more grooves for the rope and a 2 or 3 inch projecting friction flange on each side. The dynamo, Fig. 1, is placed with its pulley *A* against the driving pulley *B* on the main shaft, as in the case of ordinary friction transmission; but the pulleys, although in contact, do not press hard against each other. A rope is thrown two or three times over both pulleys in the direction shown in Fig. 1, and back to a rope tightener *T*, some few feet behind the dynamo. When the rope is straightened the friction of the rope and the friction of the two pulleys, increased by the pulling rope, will transmit the power, and as the pull of the rope and the press of the flanges are working in opposite directions the loss of energy is materially reduced. In Fig. 2 is shown more clearly the arrangement of the ropes on the pulleys.

Since the publication already referred to, F. Devold and Electrical Engineer Gustave Monrath of Chicago have together devised an application of the system to electric motor cars, and the illustrations Figs. 3, 4 and 5 show the new construction as adapted to the Westinghouse truck.

In making the new application the main object of the designers was to avoid the use of objectionable gearing and to protect the motor against the danger of burning out. The features of the truck as now arranged will be better understood after reference to the lettered parts in Fig. 3, which is a plan view of the Westinghouse truck, fitted out with the Monrath-Devold rigging in connection with a single reduction motor. Fig. 4 is a sectional side view of the truck.

From the cuts it will be seen that a combined rope and friction transmission is employed in which there is a special arrangement in the pulley on the wheel shaft whereby the connection between the motor and truck is rendered flexible. This construction is shown in detail in Fig. 5.

In the plan view *a* represents the pulley on the armature shaft, having in it two or three deep grooves for guiding the rope *b* and also provided with two friction flanges, each about 1-5 the radius of the pulley in width. The flanges of this pulley are in close contact with the flanges of the pulley *c* on the wheel shaft, without pressing too hard against them. The pulley on the wheel shaft is, so to speak, a double pulley, the outside of which has the same proportional shape as the armature pulley. The rope is wound two or three times around both pulleys in opposite directions and back to a rope tightener *d*, which is fastened in a double bracket supported by the

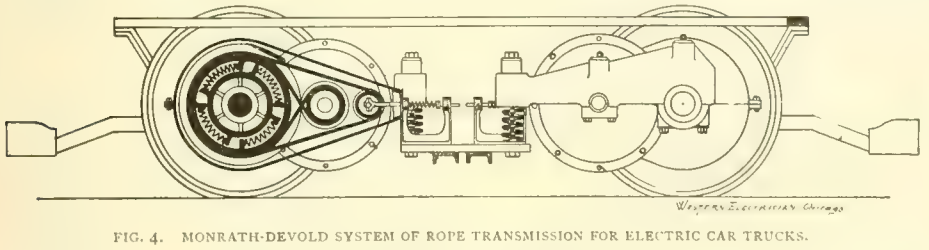


FIG. 4. MONRATH-DEVOLD SYSTEM OF ROPE TRANSMISSION FOR ELECTRIC CAR TRUCKS.

cross bars of the truck. The rope tightener is furnished with a spring *s* and double adjusting nuts *n*. A sheet iron cover *c* made in two parts surrounds both the pulleys and the rope tightener, leaving the adjusting nut free and easily accessible in case the rope needs tightening.

It is claimed for this combination transmission that the power transmitted by the rope with a double turn on the pulleys only amounts to 1-5 of the total power transmitted, and that the friction between the flanges of the pulley produced by the pull of the rope is sufficient to transmit the remaining 4-5 of the power, consequently the size of the rope can be proportionally very small. It is asserted that in the case of the Westinghouse motor the strain on the rope, if ¾ inch in diameter, will not amount to more than 40 pounds or 1.32 per cent. of the breaking strain.

To secure an easy start of the motor there is provided the special arrangement on the truck pulley already referred to and illustrated in Fig. 5. In the cut, which is a sectional view of this double pulley, *A* is the interior part. This is keyed on the shaft and has a concaved rim *a*. This rim *a* is equally divided by four lugs as shown in Fig. 4. The outside portion *B* of this combination pulley has the hub bored out ¼ of an inch larger than the shaft, and the inside of its rim is rounded out in a manner similar to the rim of the inside part. When the two parts are brought together the cavities in both form a hollow spring chamber divided in four sections by the lugs protruding from both parts. In each of these chambers there is a steel spiral spring kept in place by a semicircular projection on the side of the lugs facing the spring. To insert the springs the collar *s* is loosened and the outside part of the pulley drawn toward the truck wheel. The springs are placed between the lugs and a quick push will make the pulley snap together. To prevent the backs of the lugs from striking hard against each other, rubber balls are inserted. By this arrangement it will be seen that the motor will have the benefit of turning one half of a revolution, or even more if desired, before the springs are pushed so tight as to set the car moving. When started the car and the motor will both be riding on the spring, and this interposition of a flexible medium will serve to counteract the effect of jerks caused by the unevenness of the track.

In case the current is suddenly thrown off the motor, the momentum of the armature will be strong enough to prevent the springs from turning the armature back. It is claimed also that the springs and the rope, which are the only part of the transmission apparatus that will wear out, will easily outlast the best gear-wheel, and the quick way of replacing either is superior to the old system. The spring arrangement, as will be understood, may be adapted for gearless motors as a means of connecting the armature with the wheel shaft.

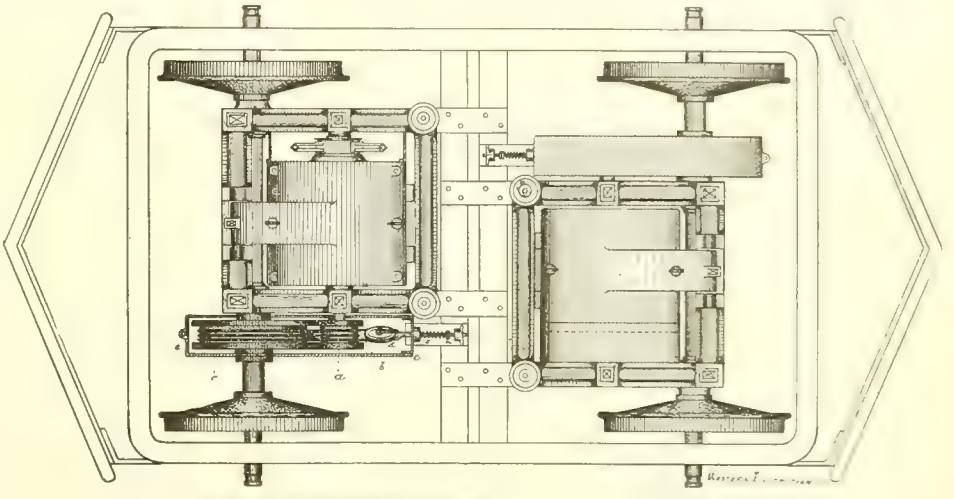


FIG. 3. MONRATH-DEVOLD SYSTEM OF ROPE TRANSMISSION FOR ELECTRIC CAR TRUCKS.

Quarrying at Night by Electric Light.

At Hawthorne, about seven miles from the Union depot, Chicago, on the C., B. & Q. railroad, the visitor will find an industry which constitutes a good-sized village in itself. This is the large stone-quarrying plant of Dolese & Shepard. Hitherto the firm has given employment to some 480 men, turning out about 120 carloads of finished material each day. But within the last two weeks the feature of working by night has been introduced. A Thomson-Houston dynamo of 12,500 watts capacity has been installed. This dynamo supplies twenty-six 2,000 candle power, double-carbon lamps. The lamps are hung from a pivoted arm so that they can be swung in any direction desired. Further than this, at every blast the enlargement of the circular pit necessitates the removal of the lights to a new

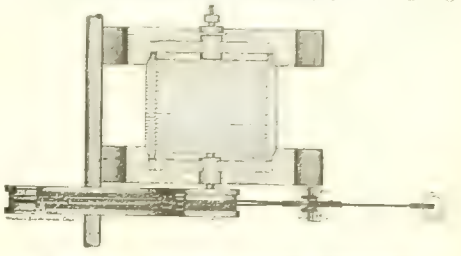


FIG. 2. MONRATH-DEVOLD SYSTEM OF ROPE TRANSMISSION FOR ELECTRIC CAR TRUCKS.

ballasted by rocks to keep it fixed in the required position. W[illegible] being dumped from the platforms, they are easily carried to the new position, the slack wire which has been coiled, being let out to the requisite length. The lights, which are in use at only one of the blasting pits, are giving eminent satisfaction. An interesting fact is brought out, from the comparison of the average work per man during the day and night. From the figures given by the foreman it seems that the company employs about 480 men and the works have a capacity of 120 carloads per day, while 90 men are employed at night the works having a capacity of 30 carloads. From these figures it would seem that three night workers can do the work of four day workers; in other words, the capacity of the night worker is one-third greater than that of the day worker. Reasons for this may be attributed to the greater freedom and ease of the night worker owing to more space and a much cooler atmosphere. No doubt many large concerns would find it to their advantage to follow the example of Dolese & Shepard.

The Marquette City and Presque Isle Railway company, which is operating the Thomson-Houston system, has recently been put in operation. This line comprises three miles of track and is at present operating three motor cars. This is the first road in Michigan equipped by the Thomson-Houston Electric company, and if its first day's operation is any criterion for what is to follow [illegible] nently successful.

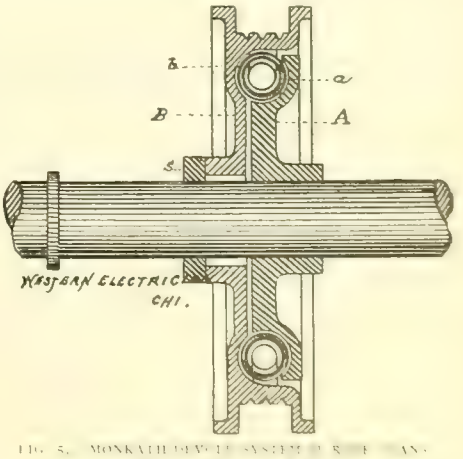
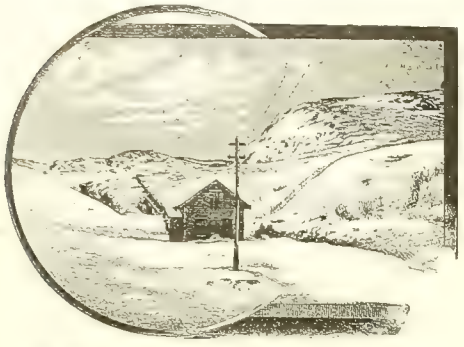


FIG. 5. MONRATH-DEVOLD SYSTEM OF ROPE TRANSMISSION FOR ELECTRIC CAR TRUCKS.

Electric Light Plant in the Land of the Midnight Sun.

The WESTERN ELECTRICIAN has already referred to the electric light station at Hammersfest in Norway, the most northern city of the world, where, during the long winter night, the sun never rises above the horizon for many days. The accompanying illustrations are views of the barren but picturesque surroundings of the plant.

It is the Thomson-Houston system which has the credit of being installed nearest the north pole. The equipment consists of two radial turbines with horizontal shafts, placed about one mile from the city, at a waterfall of great volume.



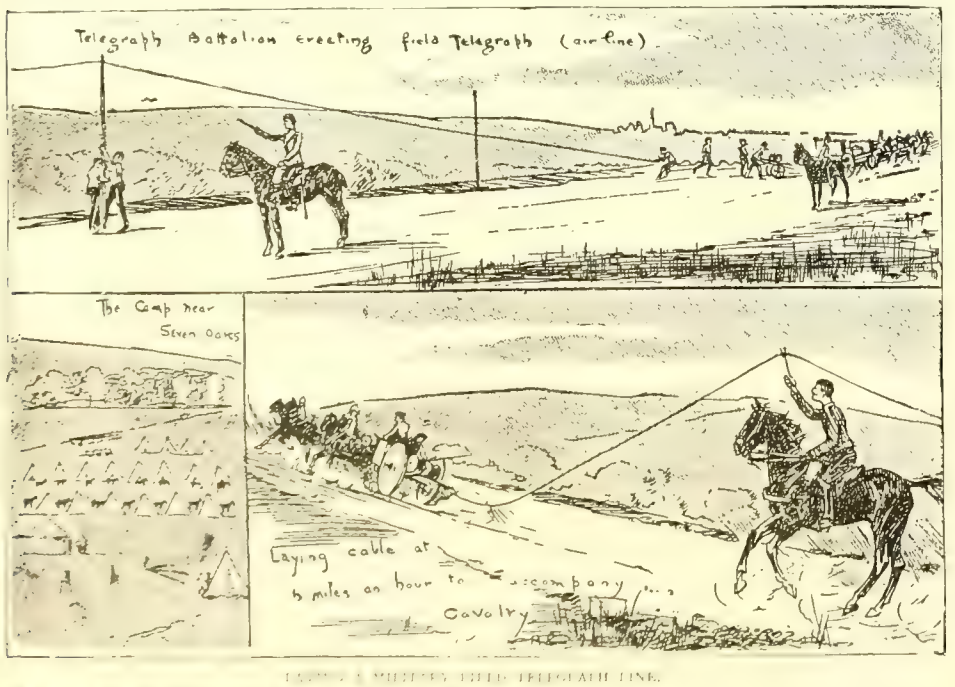
ELECTRIC LIGHT PLANT IN THE LAND OF THE MIDNIGHT SUN.

One of these turbines is directly connected to a Thomson-Houston arc dynamo furnishing current to eighteen 7 ampere arc lamps. The lamps are supported on poles very substantially set so as to resist the damaging hurricanes which prevail in this region during the winter. The second and larger turbine, which was recently put in, is intended to drive a 600 light, 16 candle-power alternating current Thomson-Houston incandescent dynamo. This machine is to furnish current for lighting residences and the public buildings. The plant is owned by the city, and the arc lamps which have been in operation during the last winter have, it is stated, given satisfaction.

One of the cuts shows the power house and the other one of the arc lamps serving as a light for the harbor. The illustrations are reproduced from *Elektrotechnische Zeitschrift*.

Laying a Military Field Telegraph Line.

The first division of the Royal Engineers, Telegraph Battalion, now encamped at Chevening, close to Lord Stanand Chatham. For laying such telegraph lines to accompany cavalry, a light cable is made use of. As will be seen from the accompanying sketch the cable is carried on reels on a wheeled cart. It can be laid, it is stated, at the rate of six to seven miles an hour. The Telegraph Battalion of the Royal Engineers comprises two divisions. One is employed in time of peace under the postoffice in the construction and maintenance of postal lines; the other, stationed at Aldershot, is equipped with field telegraph material. The cut is from the London *Daily Graphic*.



LAYING A MILITARY FIELD TELEGRAPH LINE.

The Incandescent Lamp Suit Decided in Favor of Edison.

The suit of the Edison Electric Light company against the United States Electric Light company in the United States circuit court, is reported as we go to press to have been decided in favor of Edison. According to F. S. Hasting, secretary of the Edison General Electric company and the Edison Electric Light company of New York, the decision was handed down by Judge Wallace on the morning of July 14. As is well known this suit was based on what Edison claimed was his fundamental patent on a filament of high resistance The court orders an injunction restraining the United States Electric Light company from making any more incandescent lamps. The court also orders an accounting for the purpose of ascertaining the profit on all lamps which the defendant company has heretofore made and sold.

Interesting Plant at Weehawken.

The members of the New York Electrical society after the annual meeting last week accepted an invitation to visit Weehawken and inspect the plant of the Palisades Amusement company. They found much to interest and entertain them.

The visitors found that electric lighting had not been altogether neglected. There are 150 arc lamps scattered about the grounds.

The station in which the plant is erected is a two story frame building which stands in a hollow in the rear of the ground back of the grand stand. It is conveniently arranged for water supply and also for receiving fuel from the main road by means of two chutes delivering direct into the boiler room.

The second story of the station is equipped as a store room and repair shop, with a testing room for lamps.

There are three Thomson-Houston arc dynamos, each having a capacity of 53 lamps. The lights are arranged on three circuits.

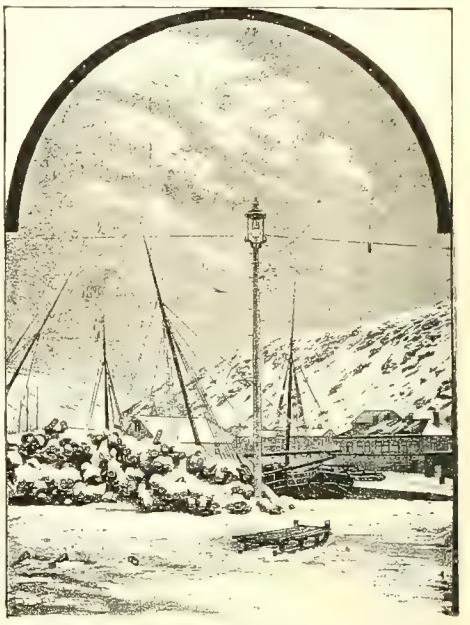
Number 1 circuit controls every other light on the grand stand, in the buildings on the bluff fronting the river at the back of the stage, the lights at all the entrances, a few of the lights about the ground and the lights in the towers of the restaurant building.

Number 2 circuit takes in the intermediate lamps and a portion of the lights on the stage.

Number 3 circuit is woven in and out of circuits number 1 and 2 so that in case of accident to a machine or circuit there will be no part of the ground which will be in darkness, and all important points where crowds gather are covered by the lights of the several circuits.

The lights at the entrances to the grand stand have colored globes upon them to indicate the passages and the towers of the restaurant building are colored, producing a beautiful effect from the river.

There is also installed one Thomson-Houston incandescent dynamo of 700 16 candle power capacity. This supplies the incandescent lamps under the grand stand, in the castle, in the restaurant building, the offices, ladies' reception building, the orchestra and dressing rooms under the stage. The dynamo is of the low tension, direct current type, with automatic regulation, being compound wound. The total num-



ELECTRIC LIGHT PLANT IN THE LAND OF THE MIDNIGHT SUN.

ber of lamps already arranged for is 628. It is proposed to change a number of the 16 to 10 candle power lamps to enable a further increase of the present plant.

The engines are of the McIntosh & Seymour automatic type. One is rated at 60 horse power and drives two arc dynamos; the other is rated at 90 horse power.

There are two 80 horse power single return tubular boilers, working at a pressure of 90 horse power per square inch, and tested to 160 pounds water pressure. The boilers are furnished with heavy cast iron fronts. The engines and boilers, and in fact the whole steam equipment, was installed by Pierce & Thomas of 42 Cortlandt street, New York.

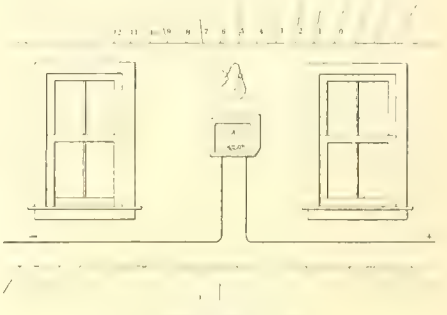
There is one 4½x2⅞x4 inch Worthington & Knowles duplex boiler feed pump with ample capacity to feed the two boilers, and an injector.

There is one number 11 brass coil feed water tower having by-paths arranged to cut the same out in case of necessity.

The electric lighting plant, which is large enough for a town, was installed by the Thomson-Houston Electric company under the superintendence of its representative, Fred. A. Bowman, and the entire work was supervised by W. J. Hammer, consulting and supervising electrical engineer, who was retained as expert by the Palisades Amusement company.

A Simple Indicator.

The accompanying cut represents an indicating device which, though very simple in construction, may prove of



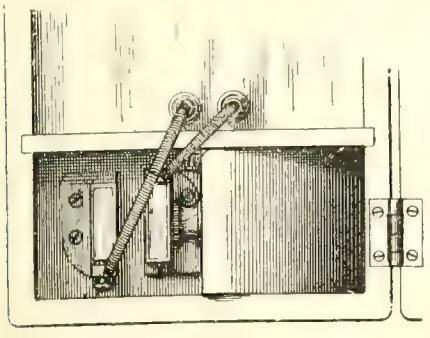
A SIMPLE INDICATOR.

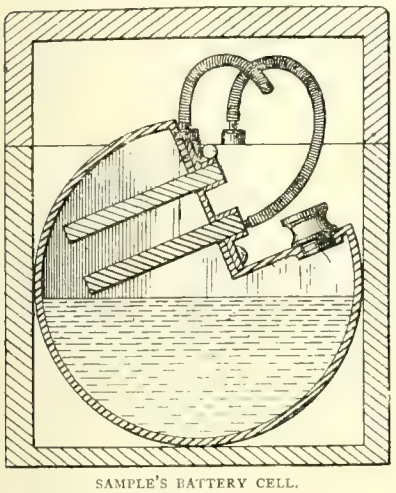
value in many instances. By means of a small mirror secured horizontally to the central pivot of an ammeter, the light of a lamp placed directly over it, is reflected on the ceiling, where numbers corresponding to those on the scale of the instrument are arranged. Thus the instrument, although inconveniently situated, may be read from any part of the room. The reflector must be secured in such a way as not to alter the balance, otherwise it may easily become a source of error. If the center of gravity of the reflector is exactly in line with the center of the pivots of the ammeter, as shown in the cut, the accuracy of the ammeter will not be practically affected.

The arrangement may be fitted to any electrical instrument, though of course it would have to be arranged to suit the special design of the instrument upon which it is to be used. This apparatus was devised and put into practice by Fred. W. Salmon.

Sample's Battery Cell.

The cut illustrates an improved battery cell designed especially for use in connection with portable induction coil outfits. The cell is circular in form, and is made of vulcanized rubber. The valuable feature of the arrangement, as will be readily appreciated after a glance at the



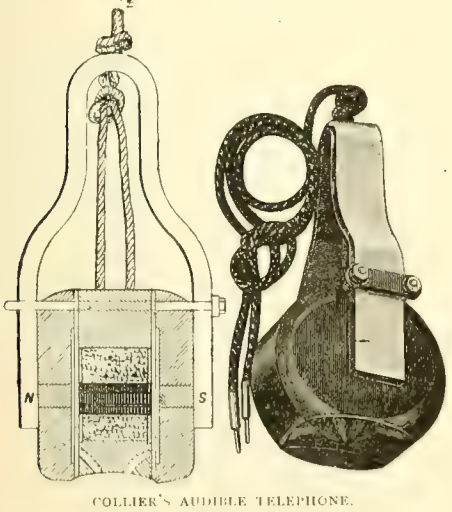


SAMPLE'S BATTERY CELL.

cut, is the roller-like form of the cell. By this construction a battery is provided in which one simple movement of the cell in its receptacle is all that is necessary to immerse the elements in the liquid. The battery is the invention of H. C. Sample of Ravenswood, Ill.

Collier's Audible Telephone.

If the statements in the London *Electrical Engineer*, from which the accompanying cuts are taken, are correct, the new Australian telephone illustrated herewith marks a distinct step in advance in the science of telephony. It is the invention of Rev. Arthur T. Collier, a Congregational minister residing in Australia, who became greatly interested in electrical and mechanical work. Mr. Collier is



COLLIER'S AUDIBLE TELEPHONE.

now living in London, where a company has been formed to exploit his invention.

The claim made for this telephone is that the sensitiveness of the receiver is increased to such an extent that the sound from it during an ordinary conversation is almost sufficient to fill a small room. Indeed, it is asserted that, compared with the efficiency of an ordinary Bell receiver, the sound from the Collier is as a person shouting, to a whisper.

The telephone itself embodies two simple ideas. These are the employment of a soft iron armature placed directly between the poles of the magnet, thus using two poles, and together with this two vibrating diaphragms—one between each pole and the core—and the method of taking the sound of the vibration from inside the diaphragm box instead of outside, as is now usually done. This latter arrangement in itself gives a greater volume of sound, it is claimed, by reason both of the greater activity of the magnetization and also from the additional magnetic variations that go on in the core—effects that have been already noticed, but not used. By combining these ideas and using two diaphragms the telephone receiver, it is asserted, is rendered far more sensitive, and its sound very much louder and more distinct.

The construction of the instrument can be seen in the detail drawings. The core of soft iron, laminated both end and lengthwise, is mounted on an insulating reel, and wound with wire. It is then mounted into a solid block of ebonite, having a ring turned out, as usual, to grip the metal diaphragm. On either side is a pole-piece, the two forming the poles of the magnet, each nearly touching the diaphragm. The magnet itself is placed outside the whole, its poles inclosing the diaphragms in a strong magnetic field. From the inside surface of the two diaphragms three small holes are led up each side to the mouthpiece of the telephone. This mouthpiece has a small cone, as shown, to lead and concentrate the sound into the ear.

One curious claim made for the Collier telephone is the statement that the difficulty with the telephones in India—that the natives of one caste will not use an instrument connected with another placed against the ear of a native of another caste—is now obviated, as it is not necessary to place the telephone close to the ear in order to hear speech-

Electric Percussion Drills at Last Chance Mine, Idaho.

In the accompanying cut is illustrated an electric percussion drill manufactured by the Edison General Electric

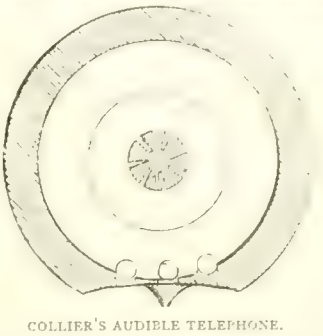
ELECTRIC PERCUSSION DRILL LAST CHANCE MINE, IDAHO.

company, and installed at Last Chance Mine, Idaho. Formerly air drills were used at this mine, but the superiority of the electric drill was so manifest when trial was made that the air drills were discarded for those of the type illustrated. It is reported that two air drills at this mine required five cords of wood for 24 hours, while four electric drills used only one and one-half cords, yet each

consequence of this evident superiority of the electric drill [illegible] air drill.

Growth of Electric Light Plants Operated by Gas Companies.

A significant indication of the [illegible] the increase in the number of gas companies operating electric plants [illegible]



COLLIER'S AUDIBLE TELEPHONE.

a statement of the rate of increase since October 1, 1888. At that time there were 153 companies operating 12,834 arc lights of thirteen different systems. In Brown's 'Directory of American Gas Companies" for 1889 another list was given, which showed that the number of companies which had added electric light plants to their works had almost doubled. The table demonstrated that 266 companies were operating a total of 21,313 arc lights and 55,890 incandescents, while the number of systems employed was 21. From the same authority it is found that the following year the number of companies steadily increased, 38 companies having added plants while two more systems were represented; the total was 304 companies, operating 23 systems, comprising 31,558 arc lights and 132,771 incandescents. Again, taking Brown's Directory for 1891, which has just been published, it will be seen that there has been no cessation to the adoption of plants by the gas companies, as the number has been increased to 317, while the number of systems operated is 24. A total of 42,022 arc lights and 221,411 incandescents are in use. It will thus be seen that in three years the number of arc lights operated has more than doubled, while nearly four times as many incandescents are employed as in 1888.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A KREIDLER, - - Editor and Publisher
J. B O HARA, - } Associate Editors
F L PERRY, - - }
W. E. KELLY, - - }
J L BAKER - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W F OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3 [illegible] for a full year of 52 numbers; in clubs of four or more, $2 50, with free extra copy for eight subscriptions; foreign countries, $5 00 a year; single copies, 10 cents When change of address is requested, the old address as well as the new should be given

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged

ADVERTISING.—THE WESTERN ELECTRICIAN ***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application

CONTENTS OF THIS NUMBER.

PAGE.
[illegible] Electric Pumps. Illustrated ... 29, 30
[illegible] Company and the Chicago West Side "L" Road Syndicate ... 29
Telegraph Poles in New Orleans ... 29
Canada's International Exposition ... 29
New Electric Railway System ... 29
Proposed Electric Road between Chicago and Milwaukee ... 30
Electrical Development in the Northwest, by a Traveling Correspondent ... 30
Electrical Department, World's Fair ... 30, 31
The Monrath-Devold System of Rope Transmission for Electric Car Traction. Illustrated ... 31
Quarrying at Night by Electric Light ... 31
Electric Light Plant in the Land of the Midnight Sun. Illustrated ... 32
Laying a Military Field Telegraph Line. Illustrated ... 32
Interesting Plant at Weehawken ... 32
[illegible] Indicator. Illustrated ... 32
[illegible] Battery [illegible]. Illustrated ... 33
[illegible] Telephone. Illustrated ... 33
[illegible] Drills at Last Chance Mine, Idaho. Illustrated ... 33
Growth of Electric Light Plants, operated by Gas Companies... 33
[illegible] ... 34
[illegible] Apparatus for Automatically Regulating the Firing of [illegible]. Illustrated ... 35
[illegible] Metal Bands on Wooden and other [illegible]. Illustrated ... 35
[illegible] Motor. Illustrated ... 35
[illegible]. Illustrated ... 35
[illegible]
[illegible] ... 36
[illegible]
[illegible] Newark ... 36
[illegible]
[illegible]
[illegible] ... 37
[illegible] Electric Railway ... [illegible]
[illegible]

DEPARTMENTS.

[illegible]
[illegible] ... 41
[illegible] ... 41
[illegible] ... 41
[illegible] ... 41
[illegible]
[illegible]
[illegible]
[illegible]

[illegible] at [illegible] The local [illegible] been approved and the interurban electric line has been de-[illegible]

[illegible] stance is cited in our Pittsburg letter. One electric rail-[illegible] lated upon the excellent street car service these figures prove the local companies give. Surely there is good cause for the popularity of electric railways.

THE end is not yet. Another novel application of the electric current has been devised. For over a year the "dear public" has read with morbid delight the tales of electricity's terrible dangers with which the daily press has seen fit to regale us. The accounts of the recent secret experiments at Sing Sing can also be referred to as being hardly conducive to a timid mortal's peace of mind. It is with a sense of relief, then, that we present to the readers of the WESTERN ELECTRICIAN a description of an invention "deadly" perhaps in a sense, but nevertheless, paradoxical as it may seem, one which some might consider a boon. It has been the lot of a Kansas man to do the work. Calling electricity to his aid, he enters death's habitation and long suffering humanity is given its last chance to regain the foothold seemingly lost forever. The field for this device, we think the reader will concede, is a large one, but it may be presumed that the inventor will meet with some difficulty in obtaining wiremen.

CANADA seems to be awakening to the importance of pushing ahead electrical enterprises. The leading feature of the International exposition this year at St. John, N. B., will be the electrical display. Elaborate preparations are being made for the event, and the leading electrical companies of this country have been invited to make displays. The exposition last year stimulated the local electrical interests and it is promised that visitors this year will find that the city has profited by the experience gained at the last exhibition. Electric lighting is making rapid strides in the Dominion and electric railways are beginning to loom up. At Quebec recently the mining engineers gave a large portion of their time to the application of electricity to mining, and good results are anticipated. Already there are signs of increased interest in this department. The convention at Montreal will no doubt do much to promote the interests of the electrical industries of the Dominion, as it will attract the representatives of all departments of electrical activity in this country.

THE WESTERN ELECTRICIAN does not aspire to be considered as an expert in matters pertaining to electrical executions. Neither does it desire to harrow the feelings and excite the disgust of its readers by recounting again and again the story of the recent secret proceedings at Sing Sing. It cannot forbear, though, to call attention to what is considered a most flagrant instance of neglect on the part of the alleged experts in charge of the inquisitorial proceedings. Those who have carefully perused the accounts of the executions cannot, we think, fail to be struck with the fact that the victims were burned. As we said above, we would prefer to say no more about "smoking electrodes," "burnt flesh," etc., but it does seem singular that the "scientific" gentlemen in charge could not have devised an electrode which would carry the current and remain moist for, say, less than a minute. One would think, judging from the information obtainable, that a bright school boy well up in physics might be able to construct such an electrode. We must decline to do more than point out what seems an unpardonable instance of neglect, or perhaps ignorance. If we are to have electrocution; if the public, in its usual state of blissful blindness to all things which do not affect the majority, sees fit to subject criminals to the experiments of men proficient, perhaps, in all else except this particular work—in the name of humanity let an electrical engineer be consulted, and an efficient method of making contact be devised.

As time goes on the justice of the strenuous opposition made to the electrical building of the World's Columbian Exposition on account of insufficient size becomes more and more apparent. Chief Barrett already sees clearly, from the applications now in hand, that the space at his disposal will be entirely inadequate to the demand made upon it, and is cudgeling his brains to devise an equitable arrangement whereby all exhibitors desiring to make displays in the electrical building can, in some measure, be accommodated. This will be a difficult task, and it is, to say the least, a great pity that the stupidity and stubbornness of the Construction Department, after the defect had been pointed out, made such a parsimony of space necessary. The members of the electrical fraternity have all along regarded the exposition with the greatest friendliness [illegible] intending to make their department completely representative of the very conspicuous position now occupied by electricity in so many avenues of human endeavor; but here is their ardor dampened at the outset. [illegible] have been sacrificed to the arbitrary decree of the architect placed at the head of the Department of Construction. This is perhaps a threshing of old straw, and undoubtedly the plans for the structure can not now be changed, operations having been begun for the construction of the building. But is it too late to provide for an electrical annex? The objection will at once be made that the arrangement of the grounds is such that no unoccupied space is left contiguous to the building now contracted for. But why cannot this design be slightly modified? For instance, what is to prevent a portion of the ground north of the site of the electrical building, now set aside for the "wooded island," being used as the site of an additional building? This annex could be on the north side of the lagoon, connected with the main building by a suitable bridge, or the course of the waterway could be changed so as to permit of the erection of the building immediately adjacent to the present site. The "island" is to be devoted entirely to purposes of recreation, and it would seem as though from its acres of extent enough space could be spared for the necessary building. It seems incredible that some provision of this sort could not be made if the Construction Department went at the matter in earnest. We commend the suggestion to the exposition authorities, assuring them that while the electrical people will make an important and attractive exhibit in any event, their enthusiasm and efforts will be vastly increased if an honest endeavor is made to make amends for the affront put upon them.

FOUR men were executed at Sing Sing, New York, by electricity July 7. The details of the proceeding have been shrouded in mystery, owing to the action of the warden of the prison, who pledged the witnesses to secrecy. There is a strong probability, however, that the veil will be removed, and the public informed of what took place in the execution room. It will be remembered that the Kemmler execution was so badly managed that some of the witnesses were overcome by the revolting spectacle. Public indignation was freely expressed through the newspapers, and there was a strong demand for the repeal of the law. The warden at Sing Sing, evidently fearing a repetition of the scenes at Auburn, took advantage of an unconstitutional provision of the law, and selected a jury of persons who were interested in promoting a favorable opinion of the new method. Not content with this, he required each of the witnesses to pledge themselves under oath not to tell anything that was unfavorable about the proceedings. Furthermore, armed guards were stationed about the walls of the prison to prevent newspaper reporters from gaining any information. Despite these precautions the outlook for a complete exposure of the proceedings is promising. The body of one of the murderers, Harris A. Smiler, was demanded by his wife, and taken to New York for burial. There an examination proved that the body had been burned, and further investigation showed that the doctors had not made a complete autopsy.

This proved sufficient to arouse public indignation, and the daily papers severely criticized all connected with the execution. In their defense the statement was made that after "instantaneous death" the current was again turned on "for the purpose of stopping the muscular action of the heart and lungs."

It was this admission that gave the opponents of the law the desired opportunity. Roger M. Sherman, an eminent New York attorney, who was interested in the proceedings to prevent the adoption of electricity as a means of capital punishment, called upon the coroner to make an investigation. He pointed out that the law had been violated according to the statement of the witnesses. "The repetition of the current upon any pretence," he says, "is in direct conflict with the statute, which requires that it shall be continued until death." Mr. Sherman insists that it is the duty of the coroner to make a thorough investigation of the affair, and require a full statement under oath from every witness of the executions. It is evident, according to his interpretation of the law, that if Smiler was killed in defiance of the statute; if, in other words, the plain prescription of the statute requiring a continued current was found inadequate, and was supplemented by repeated shocks, the death was not lawfully inflicted.

The action of the warden in attempting to prevent disclosures has had another effect. The press of the state condemns the secrecy, and most of the influential papers have pledged themselves to support no candidate for the legislature at the next election who will not pledge himself to work and vote for the repeal of the provision prohibiting the publication of details of executions.

Thus the matter stands. The mystery attending these executions has had the effect of raising grave doubts in the public mind as to the wisdom of the change in the mode of execution, and a repeal of the objectionable statute would not be surprising.

Cuadros' Apparatus for Automatically-Regulating the Firing of Ordnance on Ships.

In firing ordnance on board ship precision is very difficult to accomplish on account of the instability of the vessel. The least shifting of the center of gravity results

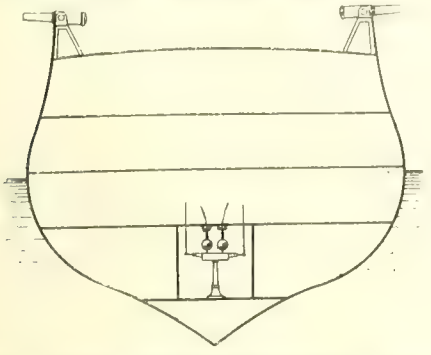


FIG. 1. CUADROS' APPARATUS FOR AUTOMATICALLY REGULATING THE FIRING OF ORDNANCE ON SHIPS.

in a modification of the angle of firing, and in consequence few projectiles are discharged exactly as desired. The cuts illustrate an arrangement devised by M. J. Cuadros of Liege, Belgium, for the purpose of overcoming the objection referred to by providing means whereby the gun is discharged when it is in the determined angle for firing.

An inspection of Fig. 1 will enable the reader to under-

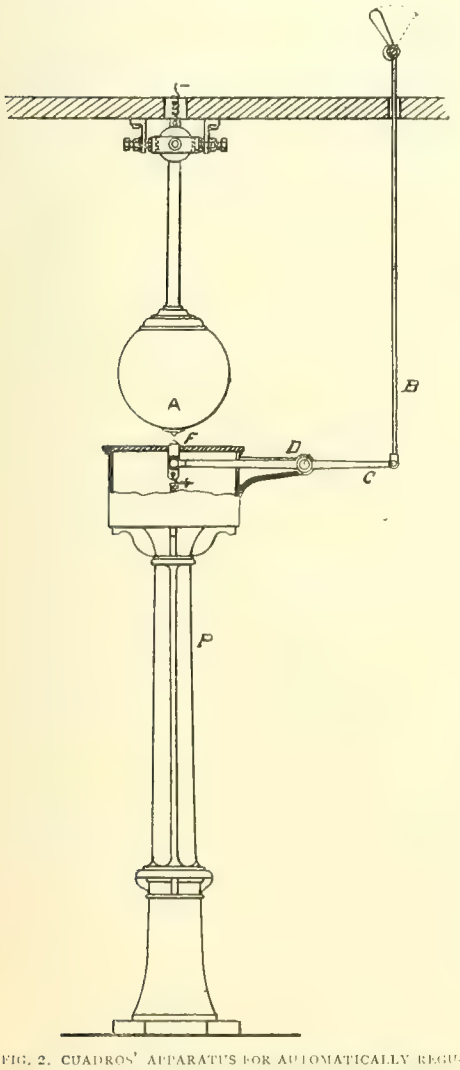


FIG. 2. CUADROS' APPARATUS FOR AUTOMATICALLY REGULATING THE FIRING OF ORDNANCE ON SHIPS.

stand the construction and operation of Mr. Cuadros' mechanism.

A is a pendulum suspended below the deck through the medium of a universal joint. An upright post *F* is rigidly fixed to a part of the vessel, and its upper end is provided with a boxing and bracket, to which latter is pivoted, as at *D*, a lever *C*. This lever is connected at one extremity with a vertical rod *B* and at its opposite end with a contact pin *E*. The contact pin is movable vertically through the top plate of the boxing and is connected with one pole of an electric battery. The pendulum *A* is connected with the other pole of the battery, which in practice is attached to fire the gun when a contact is made between the pendulum and pin. The rod *B* extends up through the deck of the vessel and is attached at the upper end to a handle as indicated.

The operation of the rigging may now be explained. The post and its contact pin *F* necessarily follow all the movements of the vessel, and when the vessel is in its normal position the contact pin is directly under the tip of the pendulum. If at this instant the circuit is closed, by raising the pin by a movement of handle *H* the gun is fired at the precise moment when it is at the desired angle of firing. It will be obvious that when the vessel is in its normal position the axis of the gun will be in the determined angle for firing, but in all other positions of the boat the angle chosen for firing is changed, and although the pendulum remains perpendicular it does not come in contact with the pin *E* unless the latter be raised.

Fig. 2 shows the device in position on a vessel.

Thomson's Method of Securing Metal Bands on Wooden and Other Articles.

In applying metal hoops to pails, kegs and similar articles, the usual practice has been to weld the ends of the band to form the ring, and to slip it when completed on the article.

Prof. Thomson's improvement consists in applying the band and welding it after it is in place on the article.

The cut shows a pail having three grooves into which the bands are to be welded. In the figure to the right the hoops are shown in place and welded.

The apparatus for welding is of the construction indicated below. *A* and *B* are two curved pieces of metal

THOMSON'S METHOD OF SECURING METAL BANDS ON WOODEN AND OTHER ARTICLES.

adapted to encircle the band and hold it in place upon the object during the welding operation. These two pieces are hinged as shown, and are insulated from one another at that point as indicated. The pieces carry the electrodes, which are simply two blocks of metal adapted to bear upon the ends of the band after it is in place. The blocks themselves are connected with the generator. The two curved pieces are lined with insulating material to avoid electrical contact with the band, excepting at the electrodes.

By this method of welding the band may be seated in a groove so that it cannot possibly fall off. This method is of especial value in the case of pails, barrels, or such articles which often fall to pieces owing to shrinkage, which lets the retaining band drop off. It is also of evident importance in the case of tool handles, such as the handles of chisels or similar instruments which require a retaining band, in order that splitting of the wood of the handle may be prevented.

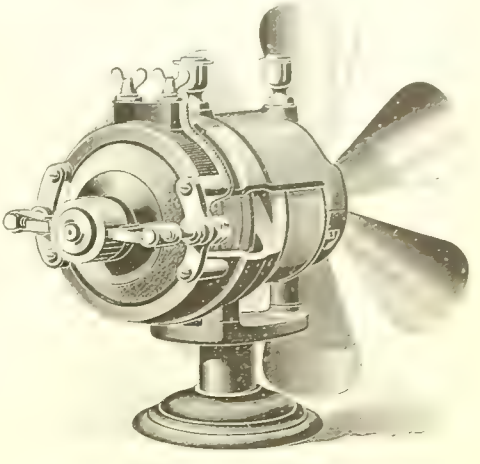
New C. & C. Fan Motor.

The great increase in street railway and other power circuits of a pressure of 500 volts has recently led to a demand for small motors and fan outfits adapted to this voltage.

The problem of designing a $\frac{1}{8}$ or $\frac{1}{4}$ horse power motor for so high a voltage has many factors that do not occur in building larger machines, while some of the main objects to be attained in large machines assume a very different aspect in these smaller sizes. The motor herewith illustrated was designed for 500 volt circuits by F. V. Henshaw of the C. & C. Electric Motor company, New York.

The field magnet is semi-ironclad, being formed of two castings joined at one end and held by a single bolt, while

passes through it, having bearings at each end. As will be seen, this arrangement allows a relatively large diameter of armature without increasing the size of the machine greatly. The armature is of the ring type supported on the shaft by three arms. [illegible]



NEW C. & C. FAN MOTOR.

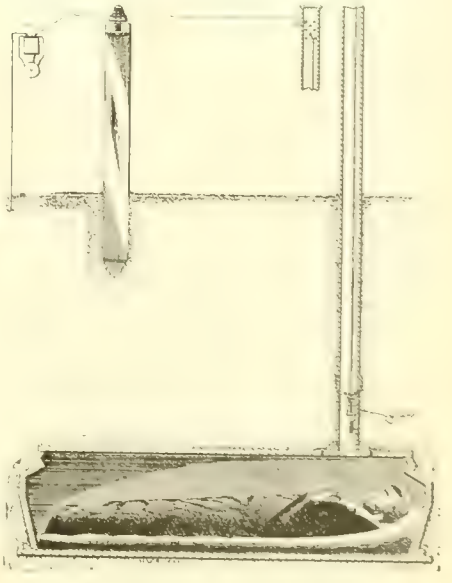
tator is fastened. This disk serves to keep the frail connecting wires in place and also as a protection to the armature. The brush-holders carry two or more round carbons of standard size, which can be replaced by simply turning the holder around, putting in new pieces, and turning back. Both field and armature coils are wound separately on a lathe. With duplicate sets of armatures and field bobbins of the proper winding it is but the work of a few minutes to change these machines from one voltage to another, which is sometimes convenient.

The $\frac{1}{8}$ horse power motors are finished with bearings requiring very little oil, while the larger motors have self oiling bearings.

The C. & C. Electric Motor company of New York is introducing these machines.

An Electrical Grave-Annunciator.

Electricity has been applied to so many things that we are prepared for almost any use of it, no matter how strange. An Illinois man has patented an electrical tooth extractor; a New York man advertises an electrical pad as a universal panacea; but it has remained for a Kansas man to



AN ELECTRICAL GRAVE-ANNUNCIATOR.

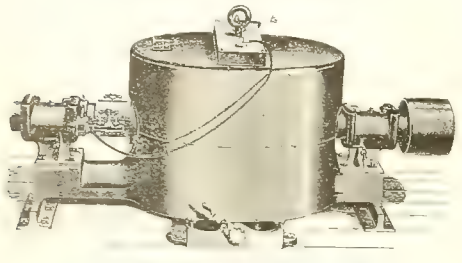
apply it in a device which can literally "raise a man from the grave."

The accompanying cut will show at a glance the purpose and working of the appliance. Supposing the corpse to be a live one, to use a paradoxical phrase, its first action would naturally be to move the hand. As can be readily seen, its first movement will close the circuit and give the signal at the annunciator above. The inventor of this new life preserver, or life detector as [illegible] of Topeka, Kan.

The Mayo System.

The Rockford Electric Works have just completed a new dynamo and motor, the invention of Geo. A. Mayo, the electrician of the company. The dynamo is compound wound, and it is claimed that perfect regulation has been reached, and that no rheostat or resistances of any kind are used.

The new motor has a cast iron shell entirely inclosing



THE MAYO SYSTEM.—IRON CLAD MOTOR.

the field magnets and armature to prevent magnetic leakage, making it possible, it is claimed to use all the lines of force. These motors are to be known as the "iron clad" and are made in size from one-half to sixty horse power. They are provided with self-feeding carbon brushes, self oiling boxes, and other novel details that will undoubtedly materially assist in their introduction.

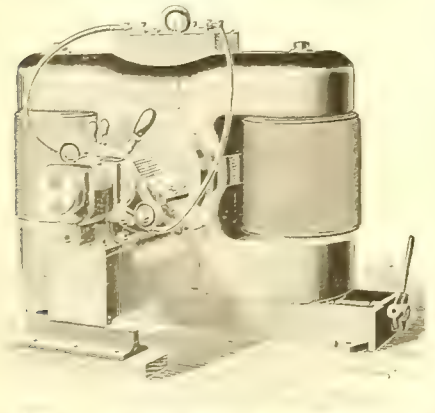
A specialty is being made of isolated plants, several now being under contract. The *Chicago Tribune* is using three motors of this pattern, one of 40 horse power and two of 15 each.

New Line Tools.

The tools shown herewith are manufactured by Mathias Klein & Son, 87 and 89 W. Van Buren street, Chicago. The Havens patent steel eccentric clamp is specially adapted for use on iron wire and is made in two sizes for light and heavy work. The Klein clamp is designed for stretching hard drawn copper wire, the wire being held between two flat brass jaws which open and close automatically. The jaws have a long flat grip, and it is claimed will hold the wire without the least danger of bruising or kinking. The steel tie wrench is also designed for use on hard drawn copper wire and has been adopted by the Western Union to the exclusion of all other tools of this class. The loops or ears are put in so that a tie can be made close to the insulator, and it is claimed the wrench is specially suited to this purpose, or in making splices. The tools have just been brought out and are made of the best steel.

Faraday's Religious Life.

Some curious reminiscences of Faraday are given in the *Referee*, an English publication, by G. R. Sims It seems that the present Mr. Sims and his father knew the eminent scientist in a peculiar way. They were of the persuasion known as Sandemanian, and worshiped in a little court off Aldersgate street. The Sandemanians were Bible Christians, and their faith was simple and primitive in the extreme Michael Faraday was an elder of this chapel, with a butcher, a gasfitter and a linendraper. In

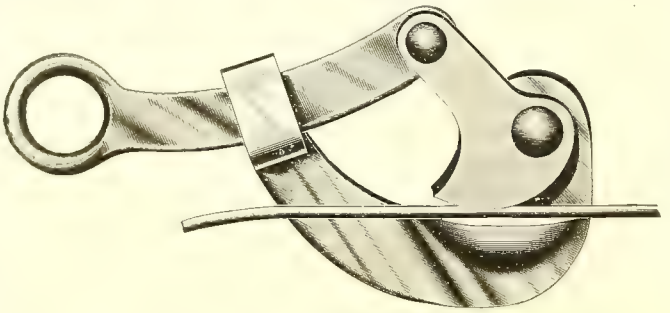


and a blessed peace fell on the little meeting-house. Faraday Mr. Sims remembers best as an elder, though he often met him at the elder Mr. Sims' house at Peckham. He had a very winning way with children, and they all liked him. The Sandemanians liked him very much as a man, but they preferred the butcher as a preacher, and they considered it a terrible thing for a good man to devote himself to such doubtful subjects as electricity, instead of reading the Bible and being satisfied with things as they were.

Proposed Electric Road from Jersey City to Newark.

Gradually electric lines are spreading in the environs of New York, and in time they can be relied upon to dissipate the distorted and senseless idea now seeming to pervade the minds of the people of that city in relation to electric traction. Newark has two electric railroads, which have been in operation nearly a year. Jersey City has another, which in the short time it has been running has demonstrated its practicability. Now there is a scheme on foot to join Jersey City's road with those in Newark, and to run electric cars from the ferry to Irvington and Orange. The route laid down is the old plank road, which belongs to the Pennsylvania railroad. It is proposed to lay tracks out through Marion and across the meadows through about three and a half miles of waste land, from which no profitable traffic can be expected for many years. At each end of the projected line there is a large population, and it is believed that the road will pay well from the start.

C. B. Thurston of Jersey City, president of the Newark Plank Road company, one of the few toll roads still existing in the vicinity of New York, and also president of the Jersey City and Bergen railway, says that the electric railroad project is to go through. It is proposed to lay tracks upon each side of the plank roadway, with an overhead trolley construction. In the cities the cars can run at ten or twelve miles an hour, and across the meadows the speed may be accelerated to twenty-five or thirty miles without danger. The fare will probably be 5 cents anywhere in Hudson county and 10 cents to any part of Newark or its suburbs, including ferry tolls. The present rate of fare on any of the steam roads is 15 cents straight, or 25 cents for an excursion ticket, with monthly ticket rates of 10 cents. The scheme involves the consolidation of the interests of four corporations.



NEW LINE TOOLS.—STEEL ECCENTRIC CLAMP.

The Electrical Executions.

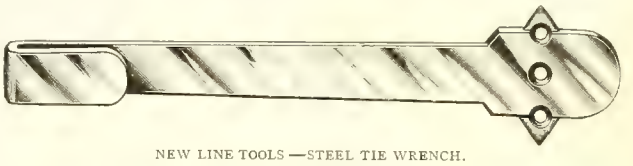
The execution of four murderers at Sing Sing last week under the electrical execution law was announced in the WESTERN ELECTRICIAN, but as the executions took place too late for an extended notice only a brief statement of the fact was made. Although the witnesses were sworn to secresy, some facts have become known which indicate that the horrors of the Kemmler tragedy were not entirely absent from the execution at Sing Sing last week. It was at first announced that the executions had been eminently satisfactory, and that there had been no hitch in the proceedings, but when the body of Smiler reached New York it was found that the face had been burned, and the undertaker added that the calf of the leg on which the electrode was bound showed plainly that it too had been burned. According to the press dispatches, "The eyes were sunken so far into their sockets as to cause many of those who saw them to exclaim that they had been burned out. When the tightly closed lids were raised the burned flesh was displaced. On each cheek there was a large blister. The hair and mustache had been carefully trimmed where they had been singed."

Drs. Ward and McDonald, who witnessed the execution, at first stated that everything had passed off satisfactorily but when the statement concerning the burning of Smiler's body was shown them they did not deny it. Furthermore, they admitted that the current was turned on twice, and that on one occasion the electrodes burned out and the flesh of the victim was roasted.

One of the clergymen who attended the murderers is quoted as saying that when the whole story was disclosed it would be found that all of the men were burned.

The fact that the warden undertook to withhold all details of the execution from the newspapers, and that in order to do this he stationed armed guards about the prison [illegible] executions commented upon by the daily papers of New York. It is assumed that the provision of the law prohibiting the publishing of details of the execution is unconstitutional, and the daily papers, as a matter of course, are prepared to fight it. The *Sun* has led the way by announcing its intention of supporting only such candidates for the legislature who will pledge themselves to repeal the obnoxious law. This opposition is not confined to the metropolis, but is pretty generally echoed throughout the state. A very sensible review of the situation appeared in the Rochester *Post-Express* the day of the execution. It is herewith appended:

"The law for electric execution was passed because the public conscience revolted from the brutality of hanging. It was passed on the theory that killing by electricity would be quick, certain, painless, and unsensational. If it does not serve the purpose for which it was passed it should be



NEW LINE TOOLS.—STEEL TIE WRENCH.

repealed. The provision as to secresy, if carried out, would prevent the public from ever learning the actual facts; and leaving the public conscience, which is the ultimate sanction for the law, unenlightened.

"We know that the first electric execution was a horror; those that took place yesterday may have been worse or better. The presumption to be drawn from secresy is that there was something dishonorable or horrible to hide.

"It has been our opinion steadily that the people of the state of New York ought to know that their condemned murderers are actually executed, and ought to know how they are executed. Otherwise the people of the state of New York have no right to provide for the trial and conviction of murderers. We cannot put aside an iota of responsibility in this awful business of avenging a human life. We cannot turn over a criminal to star-chamber processes and to the secret manipulations of professional charlatans.

"We argued last year for the amendment of this electric execution law. We say now that no man should be chosen to the legislature who is not ready to move for its amendment. It bears on the face of it an insult to the press and a menace to free discussion; and no newspaper of either party should consent to support a candidate who means to defend it.

"It must be always, as it stands, a source of suspicion and sensationalism at least, and may be the source of worse things.

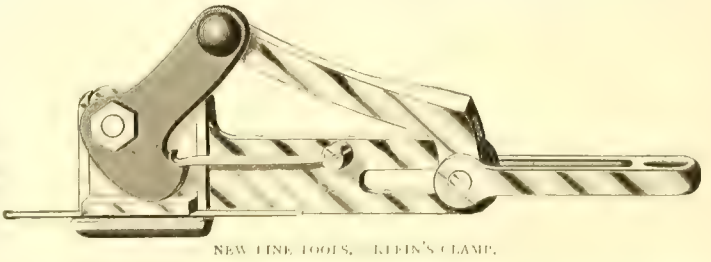
"In the meanwhile the people of the state of New York remain in beautiful uncertainty as to whether they are to consider themselves as philanthropists or brutes—with the strong probabilities in favor of the brutality horn of the dilemma.

"Suspicion and sensationalism have full swing; and an old-fashioned hanging begins to seem like a steady-going and reposeful pastime."

There is a strong probability that some of the witnesses of the Sing Sing prison tragedy will be put in an embarrassing position in regard to their promises to Warden Brown not to reveal the details of the tragedy. Coroner Levy, upon reading Roger M. Sherman's letter on the legal questions involved declared his belief in its statements and his intention to follow the course they suggested. The grounds given in the letter for a coroner's intervention were allegations that the law was violated by a repetition of the electric shocks, and that it was the duty of a New York coroner to hold an inquest on the death of Smiler, he having been buried in New York county. "This is what I propose to do," said Coroner Levy, "and I shall subpœna all those who saw the execution and over whom I have jurisdiction. They will be made to tell the things that went on in that death room to a jury who will know the difference between reflex action and respiration—a jury of prominent and intelligent citizens."

If the coroner can carry out his plan, the facts in regard to the execution will be brought out under oath, and, under the absurd provisions of the law as it stands, no newspaper can publish the proceedings of the coroner's jury without the commission of a misdemeanor.

Warden Brown announces that he will not submit to



NEW LINE TOOLS.—KLEIN'S CLAMP.

Coroner Levy's authority unless compelled to do so; and altogether this business of secret execution will probably be the result of endless discussion and a series of sensations.

The Western Union Telegraph company has placed new furniture of the latest antique oak pattern in its receiving department at Toledo, O. New floors, new ceiling of corrugated iron and incandescent lights are among the improvements noted.

The Electro-Magnet in Eye-Surgery.[1]

By Silvanus P. Thompson and J. Tatham Thompson.

For many years past ophthalmic surgeons have used both steel magnets and electro-magnets. Indeed, the use of the loadstone has been known for two centuries,[2] for the purpose of extracting from the eye-ball chips of iron which have by accident lodged therein, as frequently happens in engineering workshops to fitters and metal turners. Later, in 1745, Dr. Milnes, in his "Observations of Medicine and Surgery," describes how he applied a loadstone to remove a piece of iron from the iris. Probably this was not strictly the case, as he says, "Immediately it jumped out." It is more likely that he meant that the fragment of iron was embedded in the cornea in front of the iris. According to Hirschberg,[3] Dr. Meyer of Minden was, in 1842, the first to use a magnet in extracting fragments of metal from the actual interior of the eyeball.

In the middle of this century cases of successful removal were recorded by Critchett,[4] Dixon, White, Cooper and others. There seems to have been little advance until 1874, when Dr. McKeown of Belfast recorded in the *British Medical Journal* several successful cases treated by means of a permanent steel magnet tapered at each end to facilitate its introduction.

In 1880 Gruening of New York employed a permanent steel magnet composed of a number of "cylinders" (*sic*), united at each end and fitted at one extremity with a needle-shaped pole.

The first use of the electro-magnet in this connection is accredited to Hirschberg of Berlin in 1877.

In this country Snell[5] of Sheffield has been the chief advocate of its use, and in his hands splendid results have been obtained. In the *British Medical Journals* for 1881 he describes his instrument and records the result of several operations. His experiments have steadily progressed since then, and in a recent number of the same journal he brings up the number of his recorded cases to 77.

The thing needed for this special service is an electro-magnet which can be fitted with polar appliances of various elongated forms which can be introduced into the wound in the eyeball to a sufficient distance to enable the particle of iron to be attracted and withdrawn. It is necessary at the same time that the electro-magnet should not be too heavy to be conveniently held in the hand of the operating surgeon, and that it should be capable of being excited with current from a battery of moderate size, such as an oculist might be expected to be able to manage and maintain without having to call in a skilled electrician at every occasion of its use. It is obvious that, other things being equal, a magnet of considerable projective power is desirable; hence one with a long core or with an iron expansion at the posterior end of its core, is preferable to a short one. Possibly in some cases the placing of a mass of iron behind the patient's head during the operation might aid the electro-magnet to project its magnetic field to the desired depth. Various forms of magnets have been devised by various experimenters

Snell's instrument, which may be quoted as the typical form commonly used by ophthalmic surgeons in this country, consists of a soft iron core surrounded by a coil of insulated copper wire inclosed in an ebonite case. At the one extremity are the terminals for the battery connections, and at the other the soft iron core is tapped to receive the variously shaped and sized needle poles. He recommends the use of a single quart bichromate cell to generate the current.

Hirschberg's instrument consists of a hollow cylindrical core with two curved pointed poles of different thickness for external and internal use.

Bradford of Boston devised an instrument almost identical with Snell's, and simultaneously with the latter. It is, however, a much heavier and more powerful agent.

McHardy of King's College Hospital used a very similar instrument, but of much reduced size and weight.

The latest form, shown in the cut, is that brought out by Tatham Thompson of Cardiff, and is a further modification of Snell's instrument, but for the same weight and bulk additional power is claimed, as the magnetic circuit is perfected by means of a collar of iron continuous with the core projecting forward over the insulated coil toward the manipulative pole piece.

The core is tapped at its extremity to receive the differently shaped poles or an intermediate polar extension where deeper probing is required. The battery used with this consists of one or more quart bichromate "dip" cells. This instrument is shown in the illustration in its actual size, and its weight is only about five ounces.

The most frequent use of the instrument is in removing fragments of steel or iron from the surface or embedded in the coats of the eye, and by its use much disturbance and laceration of the delicate structures is avoided, which the older methods of cutting out or withdrawing by means of forceps, spuds, or curettes too often involved. Its most valued properties are, however, best demonstrated where it is used for the removal of foreign bodies which have penetrated the walls of the eye. It is not too much to say that in many cases it has been the only possible means of preserving sight.[6]

In the first place, it is of diagnostic value, for where a fragment, for instance, has perforated the cornea or anterior transparent part of the eye, it can often be proved whether it is steel or iron by observing whether it is acted on by the close approach of the instrument. If no movement is observed, and no peculiar sensation of dragging pain felt by the patient on the approach of the magnet, it may be due either to its not being a magnetizable metal or to its being gripped by the tissues, or encysted with inflammatory material thrown out by its irritating presence. If in this case a very lightly suspended needle be magnetized and held close to the eye, it may sometimes be found to dip toward the foreign body. If it should chance to be a steel fragment, this effect is greatly increased by holding the electro-magnet close to the eye for a time, so as to magnetize the offending particle.

Further still, the instrument is at times of immense use in moving the fragment from one part of the eye where it is inaccessible, and dropping it in a more favorable position for subsequent removal. For instance, suppose the fragment of steel or iron has penetrated the cornea and lodged in the crystalline lens, it has happened in several cases that by applying the electromagnet to the cornea the metal has been attracted forward through the lens substance, across the aqueous humor contained in the outer chamber of the eye and then dropped by opening the circuit on to the floor of the outer chamber; then a small opening being made at the most dependent part, the pole of the instrument introduced there, and the fragment readily removed.

In at least one recorded case a sharp-pointed fragment, which had penetrated deep into the lens, has been seen to force its way forward through the lens substance and lens capsule, through the iris, and actually be drawn through the cornea, and so removed completely without involving any cutting operation whatever.

It is, however, in those cases where the foreign body has penetrated the posterior or vitreous chamber of the eye that the wonderful results obtained by the electro magnet are best seen. Where only the outer chamber or the lens is the seat of the mischief, other means may possibly succeed; but when a fragment has penetrated the vitreous chamber, we require an instrument not to go blindly searching round, disturbing the delicate structures and risking the escape of the semi fluid contents, but one which will attract to itself the offending particle, and this is where the instrument which we are considering reaches its highest achievements.

Many successful cases have been recorded by Snell, Hirschberg, Lloyd Owen, McHardy and others of fragments of steel thus removed from eyes which otherwise must have inevitably been lost.

ELECTRO-MAGNET IN EYE SURGERY.

The most serious and desperate cases of all are where the metal has actually traversed the inner chamber of the eye and become embedded in the delicate retina and choroid lining the posterior wall. So far as can be ascertained only three successful cases of removal from this position have been recorded. The first by Galezowski, in 1882, where a fragment of iron had passed through cornea, iris and lens, and was lodged in the retina. Its position was noted by means of the ophthalmoscope, an instrument employed by ophthalmologists for examining the interior of the eye. An incision was made in the sclerotic or white coat of the eye over the situation, and the fragment removed by means of the electro-magnet. The second, was recorded by Hirschberg in 1888. The third was by Tatham Thompson of Cardiff in 1890. Some detailed account of this will illustrate the method of the procedure.

The patient was a blacksmith employed at one of the South Wales collieries, and on December 8, whilst "stamping" a new "pick," was struck on the left eye by a fragment of the new tool. The fragment struck him on the sclerotic or white of the eye, about a quarter of an inch from the margin of the cornea. He felt little pain at the time, but two days later dull pain supervened, and considerable irritation and dimness of vision, not only in the injured but in the sound eye.

He was sent to the Cardiff Infirmary on December 10. When examined there, a small wound was found at the point where the fragment had entered on the inner side, and on ophthalmoscopic examination, the piece of steel could be seen embedded in the retina at the upper and outer part. The track which it had made in traversing the vitreous chamber could also be distinguished by slight opacities in the humor. The uninjured eye showed distinct signs of sympathetic irritation. The next day the patient was put under the influence of ether, the wound of entrance slightly enlarged to allow the introduction of the pole of the electromagnet. This was passed across the vitreous chamber in as nearly as could be calculated the direction originally taken by the fragment. On withdrawing the first time nothing resulted, but at the second attempt the piece of steel came readily through the wound "in tow" of the pole. Only a very small bead of vitreous humor escaped, and the eye was dressed antiseptically and bandaged. At the end of 24 hours he could count fingers at four feet distance, was quite free from pain and dread of light, and the dimness of the other eye had largely disappeared. The wound healed in three days, and the sight steadily improved, till on December 30 he could read moderately sized print. Examined by means of the ophthalmoscope, the scar formed in the retina at the point where the fragment had lodged could be distinctly made out, as well as some patches of hemorrhage caused either by injury from impact of the fragment or by injury of retinal vessels at the time of its removal.

On January 13, 1891, he could read small print; his [illegible] respecting [illegible]

The [illegible] general surgery for the removal of needles from the soft tissues of the body or limbs.

1. From the London *Electrician*.

2. Fabrivius Hildanus, *Opera observationum et curationum*, Frankfort, 1646. Of this rare work we have not seen a copy

3. Hirschberg, *Der Elektro-magnet in der Heilkunde*, Leipzig, 1885.

4. The *Lancet*, April, 1851, p. 358

5. Snell, "The Electro magnet and its Employment in Ophthalmic Surgery." London Churchill & Co., 1883.

6. In addition to references previously given, see Mellinger, [illegible] *die Magnet Extractionen an der Basler Ophthalmologischen Klinik* (Inaug. Dissert.), Basel, 1887.

Construction and Operation of Cable and Electric Railway.

In the discussion on the construction and operation of cable and electric railways before the Engineers club of St. Louis the following remarks were made

W. H. Br[illegible] cost of power on cable and electric roads. The unfavorable results shown by one of the electric roads were attributed by the speaker largely to the fact that high speed engines belted direct were used, the inference being that if large slow speed engines with countershafting had been employed, the cost of the power would have been greatly reduced. I have not been able to secure any data bearing directly on this point, but there is much to be said in favor of the opposite view. Two years ago in a paper read before this club, I discussed this subject at some length. The conclusion which I reached then was, that for approximately constant loads, the large engines with shafting were preferable, but where the work varied largely, the high speed engines belted direct would be found more economical. I have taken every opportunity since then to study the question further and can see no reason for changing my view. The unfavorable results cited by Col. Meier, could, I think, be traced to other causes. The largest builders of electric roads have not yet reached a conclusion—one of them preferring large low speed engines with shafting and the other high speed engines. The practice of the latter company is based on experience gained in operating large incandescent electric light plants, where the load is subject to wide fluctuations, though not as sudden or severe of course as in railway work.

Compound high speed engines are, under similar conditions, at least as economical as the single cylinder Corliss engines, generally used. If however, we compare the latter with single cylinder high speed engines, the Corliss engines will probably show a saving of 15 to 20 per cent. in fuel. The large countershaft required with the low speed engines consumes a constant horse power—varying from about 10 per cent. of the maximum load, and 15 to 25 per cent. of the average load up to as much, or more than the useful output under light loads. It would appear, therefore, that the superior economy of the low speed engine is almost fully balanced by the excess of power lost in driving the shafting. A further advantage is that during those hours when the load is light, several of the small engines may be shut down, leaving the remaining engines to run at more economical points of cut off. The large engine, however, must run all the time together with most, if not all of the shafting. Under light loads, therefore, the large engine will cut off at a very early point in spite of the excessive dead load, while the smaller high speed engines would do only useful work, and under conditions far more favorable to economy. It would seem, therefore, that the net fuel economy for a whole day's run would be in favor of the high speed engines.

Closeness of regulation seems also to be in their favor. I was told yesterday that the variations in speed in a certain low speed station in this city are three times as much as in a corresponding high speed plant here. This is as might be expected for the changes of load are felt directly by the governor instead of having to be transmitted through the heavy shafting; besides which the engine itself has more than three times as many opportunities to adjust its speed in the same time.

The high speed permits the plant to be installed for the least first cost, and to occupy the least space. The necessary reserve engine also requires a much smaller investment of idle capital and space. These items affect the fixed charges seriously. An accident to one of the large engines is a serious matter, as it means a large reduction in the capacity of the station, while one of the smaller high speed engines could be spared almost without being missed, it being so small a part of the total capacity.

Electric railways have an advantage over cable lines in that the power station may be located at some distance from the line, thus getting the benefit of cheaper land, switching facilities for coal and ashes, cheap water—and sometimes water power. The cost of increased length of circuits, cost of maintenance, and losses due to leakage, drop, etc., must all be taken into consideration in determining how far away it will pay to go

Prof. Nipher: This discussion seems to me to be like an attempt to determine whether it costs more to support the family of a lawyer than a physician by an exhibit of the family bills of a dozen cases, selected by the champions of the two sides for the purpose of making a case.

I do not know of another industry that has grown in so short a time to such tremendous proportions, as the electric railway business has assumed in the last two years. It is certainly proper for those who oppose the system to work with diligence. The rapid growth has, however, brought some disadvantage. The manufacturing companies have not only been pushed to the utmost to fill orders, but they cannot find the men to properly install the plants they sell. It has, therefore, happened that men who might perhaps succeed in building a telegraph line, are sent to install a railway plant. The steam engine part of this plant has been given into the hands of some one who had an engine for sale.

Nothing has surprised me more than the large slow-speed engines and immense countershafts with which some of our power stations are adorned. To establish such a plant is to ignore the acc[illegible]

In the first place the countershaft at once wipes out the gain in efficiency which a large engine [illegible]

yield. It is again wiped out by uneconomical operation of the engine during the hours of light load.

Again, a large engine takes no notice of the distress of a single over-loaded dynamo. It is more difficult to make individual dynamos carry their proper share of the load. As is well known, when dynamos are working in parallel, if the potential of one falls three or four per cent. it ceases to act as a generator, and may even be driven as a motor. If it were a plain shunt dynamo, it would aid in driving the countershaft, but the other machines acting as generators would be overloaded, and a great loss of energy would be the result. The situation is then, that only part of the generators are sending current to the line, and they are dividing their current between the line and the dynamos which they are operating as motors.

But in the operation of a railroad, where great and sudden changes in load may occur, a compound dynamo might and probably does reverse and work against the engine in such a case. This is due to the self induction in the shunt coil, which causes the series coil to act first in case of a lagging dynamo.

Such experience has long ago been met in electric lighting, and the way of providing against it is well known. When the Edison central station was started in New York, they had separately driven dynamos. The engines used were in good standing, but they were finally thrown out because they were not well enough governed. Another engine was substituted, and it succeeded, and was given a great reputation as a well governed engine. It is now known that the first engine failed because it was a well-governed engine. If one or two dynamos began to carry the rest of the plant as well as the light, the engines maintained their speed until something gave way and the lights went out. The second engine placed under the same circumstances, slowed down and shifted an equitable share of its surplus load to the lagging dynamos.

In a cable system, if a load is suddenly thrown on, the shock on the engine is cushioned by the lifting of slack cable along the line. In an electric system, the change is instantly felt in the power house. The moving masses in the power house of an electric railway should be small, and the engines should be high speed engines not too well governed. To build an electric power plant in imitation of a cable plant, is to abandon some of the main advantages of an electrical system. Such plants, however, serve to aid us somewhat in the practical solution of a somewhat famous mechanical conundrum which interested men in a former age more than it does now,—what will happen if a body moving with resistless energy, collides with a body which cannot yield?

There are plenty of electric roads which are being operated in a most satisfactory way. We hear nothing of them. We need go no further than Kansas City to see a most impressive case, where five miles of electric road and five miles of cable road are being operated from the same station. They have the same number of cars, and the cars are worked to their full capacity. A mere inspection of those two plants will satisfy any person that a properly installed electric plant needs no defender when compared with a cable plant. When an electric road behaves like those of which we have heard to-night, you may be certain that there has been a mistake somewhere. And it takes time to educate the employes of an electric road. They now destroy a great deal of machinery, because like most people, they cannot learn from the experience of others, and cannot think quickly in new emergencies. Our cable friends should be patient, for there is every evidence that the electric road is here to stay.

Electricity Beneficial to Gas Interests.

[illegible] says: "In a circular recently issued to the shareholders of the Standard Gas Light company, New York, it is stated that President Andrews, at the last annual meeting asserted that statistics proved that the growth of gas consumption in New York City, for forty years prior to the introduction of electricity for lighting purposes, averaged about ten per cent. per annum. That is, the gas output doubled every ten years and that the city had doubled in population every seventeen years. Since the first introduction of the electric light, however, the increase in New York of the consumption of gas has been much more rapid. It almost immediately [illegible] per cent per annum, and in 1887 showed a growth equal to about 14 per cent. per annum, a ratio of growth that was still further exceeded in [illegible]. In fact he was willing to stand [illegible] the gas output of New York was [illegible] and one half years, [illegible]. He thought one reason [illegible] to the fact that the [illegible] eye [illegible] that people are not [illegible] that formerly satisfied them. Again, a more luxurious mode of living is [illegible]

New Electric Railway System.

[illegible]

CORRESPONDENCE.

New York Notes.

NEW YORK, July 11.—The topic of the week is the quadruple electrocution at Sing Sing last week. There seems to be no shadow of a doubt that the electrocutions were this time successful. None of the hitches that occurred at Auburn in the Kemmler killing were repeated, and according to reports everything worked smoothly. Some of the daily papers praise the method and express their approval in such terms as these: "To-day New York may claim the proud distinction of leading the world in this feature of its penal system. It has not only substituted the electrical chair for the gallows but has proved the superiority of the former over the latter. * * * No doubt other states will follow the lead of New York in adopting the greatest reform of the century in criminal administration, and even Europe may study with advantage the reports of what took place on Tuesday morning within the prison walls on the banks of the Hudson. Electricity is destined to become the motor power of the world, and the means of illumination as it already is the agent of communication. Why should it not become in time the universal method of inflicting the death penalty?"

The *New York Herald*, so great was its enthusiasm over the subject, even went so far as to cause an autopsy to be made on the body of Smiler, which his widow was allowed to remove for burial. The autopsy showed that death was instantaneous and painless. The brain was found to be in an almost perfectly normal condition. The temples, with which the electrodes came in contact, were slightly disfigured but not even the eyebrows were singed and the delicate optic nerves were unimpaired. It appears that although an autopsy was made previously by the prison officials it was not complete as the brain was not opened. The *Herald* criticizes on the warden and physicians for this omission, in revenge for the muzzling that the press was subjected to, and declares that they were all guilty of misdemeanor, as the law requires a post mortem examination of the body of the convict immediately after the execution. A legal autopsy naturally includes an examination of the brain, and as this was only performed on one of the four bodies, according to the statements of the physicians themselves, the law was evidently violated.

The daily press was unanimous in condemning the secresy with which the executions were conducted, and a loud howl of indignation has gone up, the echoes of which have not yet died out. Warden Brown stationed armed guards in the road ouside the prison with orders to shoot any reporter who should step over the line he had marked as the limit to their zeal. He also pledged all the witnesses of the execution to secresy, and so he had the reporters entirely at a disadvantage. Consequently he has been the worst abused man in New York state this week, and his "star chamber proceedings" have been bitterly denounced in newspapers of all shades and classes. It would not be surprising if the efforts to maintain secresy were relaxed somewhat in future, in view of such general protests.

The *New York Times* recently had an interesting editorial on "Electricity and Vegetation" based on an article published a few weeks back in the WESTERN ELECTRICIAN in which were described numerous experiments made in France and in Finland to acertain the effect of electric currents on growing vegetation. In the editorial in question the results of such experiments are briefly summarized and this prophecy is made: "It may be that in the course of time the electric current will be used profitably by market gardeners, and in connection with hothouse culture."

The *Times* is a newspaper that shows a very healthy interest in scientific matters,and this week it published an interesting article in which the discussion on the proposed rapid transit scheme is very pointedly summed up. The underground electric system is indorsed as the "ideal rapid transit system for cities," and the objections to it are characterized as emanating from two main sources—from those who don't know and from those who won't know. The objectors chiefly state that the tunnel railway would be dim, stuffy and unwholesome, and that electric motors cannot do the work. The facts are that the tunnels and stations of the London line are well lighted and well ventilated and there is absolutely no odor. As to the motor question no reader of an electrical journal needs to be told that electric motors can be made of sufficient power to draw a [illegible] of four or five cars, [illegible] as well as they [illegible] three cars. [illegible] line on the Great [illegible] London and other parts of England, so unqualified a success has the first been in [illegible] approval [illegible]

The annual meeting of the New York Electrical society was held last night. The gain in members during the year has been large and the quality of papers read unusually good. A large number of the members are young men, students and employes of electrical companies, and the policy of the society is to secure practical papers on electrical applications and development rather than those dealing with theoretical questions. This plan of proceeding is heartily appreciated by the members and the attendance at meetings is always satisfactory in point of numbers. The action taken by the society in severing its connection with the American Institute has been generally indorsed by the members. Since the declaration of independence the society has undoubtedly gained in vigor and standing. Its financial condition is healthy, as the treasurer's report showed a handsome surplus over last year's expenses and there are no debts. The officers elected for the ensuing year are: President, F. B. Crocker; vice-presidents, T. C. Martin, E. L. Bradley, G. H. Stockbridge, C. Steinmetz, W. J. Hammer and F. J. Sprague. A committee of three, F. B. Crocker, George H. Guy and Herbert Laws Webb, was appointed to select a fixed meeting place for the society. The society will be officially represented at the Montreal Convention of the National Electric Light association. After the business meeting the members of the society and their friends visited El Dorado, Bolossy Kiralfy's summer resort at the Palisades on the New Jersey bank of the Hudson river. The visit was made at the invitation of the Palisades Amusement company and the Thomson-Houston company. The members of the Electrical society greatly enjoyed the spectacle of the "Destruction of Jerusalem," the concert and the fireworks, and an inspection of the magnificent electric lighting plant of the Thomson-Houston company. El Dorado is a very spacious amusement resort and is visited nightly by some 8,000 to 10,000 persons. The ground and the amphitheater are splendidly lighted by arc lamps.

The subject of cable communication with light ships is still being actively discussed. It is especially urged that the New South Shoal lightship, off the southern shore of Nantucket, should be connected by cable with that island. This light ship lies just to the northward of the track followed by all the great Transatlantic steamers bound to New York, and it marks the southern edge of the dangerous Nantucket Shoals. Were this lightship made a telegraph and weather signal station, not only could almost all incoming European steamers be reported in this city some eight or nine hours before reaching Sandy Hook, but vessels passing the South Shoal could be forewarned of dangerous gales passing northward along the gulf stream, or approaching from the west. Such weather warnings would be of very great utility to all shipping, big and little. By a curious coincidence an example of the valuable services that this particular light ship might render to shipping had it telegraphic communication with the mainland, was afforded this week by the breakdown of the Servia. When the vessel's crank-pin broke she was dangerously close to Nantucket Shoals and a few hours of strong southeasterly wind would have carried her into the breakers. She might easily have anchored within signaling distance of the light ship, however, and assistance could have been telegraphed for to New York and Boston, assuming the light ship to have cable communications with Nantucket. The *Herald* points out that the Five Fathom Bank Light vessel off Cape May, Cape Charles Light vessel and the new Outer Diamond Shoal Lighthouse off Cape Hatteras, are important stations which ought to have telegraphic communication to enable them to give storm warnings to vessels at sea. "Give these outlying stations the means of communicating electrically with the mainland, and they could easily signal to hundreds of vessels running into the teeth of a West Indian hurricane, a gale or a blizzard in time to enable shipmasters to avoid the danger."

Among the many suggestions for something startlingly big for the World's Fair, has been the proposal to erect an immense dome one thousand feet high. A correspondent of the New York *Tribune* improves on the idea by suggesting that the dome be built in the exact shape of the Northern hemisphere, with all the principal geographical characteristics of that hemisphere represented in relief on the outer surface of the dome. This includes continents, oceans, mountain ranges, islands, lakes, water sheds, river-basins, etc., all to be correctly represented in proportionate elevations and depressions. Besides this all the principal railway lines should be represented by paths or flights of steps so that visitors might take a trip in miniature through the different countries. The course of Transatlantic liners and coasting fleets and the routes of submarine cables would be illustrated on the oceans. The interior of the dome could be used to good purpose, es-

pecially at night, for illustrating the constellations and planets of our solar system. Electric lights of various intensities would correspond to stars of different magnitudes. They should be so hung as to occupy a place in the dome to correspond to the actual position in space of the bodies they represent, so that from a given point (the one occupied by the earth) the lights would show our familiar groups of stars, but from other points new forms and groupings would appear, so that our well-known constellations would no longer be recognized as such, and our fancy would be free, as was that of the ancient astrologers, to imagine new outlines in the sky, and to name new constellations. This last part of the scheme seems to be scarcely practical, but the idea as a whole is an excellent one and if it could be carried out the geographical astronomical dome would be, as its originator says, a marvelous demonstration of the constructive powers and of the scientific status of our nation at the present time.

Death by electricity lurks in the ice cream freezer. A physician writes to the *Medical Record* giving the results of experiments with ice cream freezers in which he discovered galvanic action between the paddle and the containing vessel, the cream acting as the electrolyte. Salts of copper and zinc are formed and to those he ascribes the cases of ice cream poisoning which frequently occur. It is not readily apparent how copper salts can be formed by galvanic action in a zinc copper couple, since zinc is electro positive to copper, but if acid substances are used in the cream, copper salts could easily be produced without galvanic action. In any case a perfectly simple remedy for the danger suggested is to have all parts of the freezer of the same kind of metal, in which case there can be no galvanic action at all.

Judgment for $35,466 was yesterday entered against the Manhattan Electric Light company and the Harlem Electric Lighting company in favor of the Thomson-Houston Electric company on seven promissory notes of $5,000 each, made in October, 1890, by the Harlem company, and indorsed by the Manhattan company. Both these companies are closely connected in business. On June 12 last the Manhattan company obtained a judgment for $142 802 against the Harlem company. The latter company has a capital stock of $250,000 and that of the Manhattan is $2,000,000. The defendants claimed that the notes were accommodation notes and should have been paid into a certain syndicate; they have taken proceedings to set aside the judgment.

The trolley system has won a victory in Brooklyn after all. The State Board of Railway commissioners, after hearing further arguments reversed former decisions and gave Deacon Richardson permission to use the trolley system on about twelve miles of surface railways in Brooklyn.

W. L. H.

Minneapolis, Minn.

MINNEAPOLIS, July 11.—There is quite an interesting controversy going on between the Edison and the Thomson-Houston motors for precedence in the favor of the Minneapolis Street Railway company. The company has 110 Edison motors, 40 of them under 16 foot Jones cars, 60 under 18 foot Laclede cars, and 10 under Laclede open cars. Fires have rendered a number of these motors unserviceable and there are probably not to exceed 100 in actual use. The balance are Thomson-Houston motors, with which two or three of the principal local lines are equipped. Although no official announcement of the fact has been made, Thomson-Houston motors will be placed in all of the new cars. The inter-urban line equipment is now Thomson-Houston and is giving very excellent satisfaction. So far as that is concerned the general public is satisfied with either motor as the service on all lines, both inter-urban and local, is first class in every respect.

Local postoffice officials have received notification from Assistant Postmaster General G. F. Stone that the plan for inter-urban electric mail service has been deemed satisfactory by the department and that the inter-urban line has been declared a postal route, dating after the first of August. Mails will therefore be run every half hour between Minneapolis and St. Paul upon the electric railways after that date. Superintendent Perkins of the railway mail service, has announced that everything is in readiness to put this route in operation at that time. Twelve cars will carry mail boxes at first, and this number will be increased as necessity requires it.

The Brush Electric company will within a very few days award a very large contract for its underground work. The bids that have been submitted average about $100,000, but it is stated that the contract will be awarded for $93,000. The council committee on underground wires will have to take the matter under advisement and give its ratification before the contract can be closed, but it is expected that this committee will coincide with any suggestions that the Brush company may make.

The Stillwater, Minn., Electric Street Railway company is negotiating for a number of 50 horse power motors to take the place of the 30 horse power motors now in use on their line. The hilly nature of the city renders it necessary for them to have more power. It is also stated that they are about to use water power of the St. Croix river near Stillwater for generating electricity.

The car shop of the company in the interurban district is rapidly approaching completion and will afford facilities for all the cars used on the interurban lines. Pending its completion a long switch is used on University avenue, and some inconvenience is experienced in handling the cars necessary for the traffic on that line. The car shops in Minneapolis are now substantially completed, and the company is engaged in laying tracks from the east side lines to the building. The structure covers nearly the entire block and is one of the largest of its kind in the country. It is so situated that it is readily approachable from all the lines in the city, and a break-down need, therefore, cause very little, if any, delay. During the recent heavy thunderstorm in this city the power house of the company caught fire, and the building inspector claims that wires defectively insulated were responsible for it. Little damage was done.

The street railway company has determined to reject the renewal of the contract offered by the postoffice department for carrying letter carriers at the uniform rate $2 10 a month for each carrier. The government allowance is $900.00 annually, which is in addition to the $2.10 a month which each carrier has to pay. Hereafter the postmaster will purchase checks at 3 cents each, which will be given to carriers residing at the greatest distance from the postoffice, and if the carrier wishes to ride he must pay his fare as an ordinary citizen.

People in certain suburban d'stricts are waging unrelentless war on the electric companies, which still occasionally attempt to place poles or string wires on the streets. The manager of the telephone exchange and chief of the fire department joined in a consultation with the chief of police and building inspector the other day with reference to this work and the matter was finally compromised by giving the telephone company permission to string wires outside the conduit limits, and all opposition was withdrawn to the stringing of fire department wires. The street railway company has also had more or less difficulty in pushing its work on account of the objections constantly brought in to the city officials.

The Como avenue division of the University line will not be put in operation for some little time, as the viaduct over the Great Northern track on Fifteenth avenue, southeast, is not yet completed and there is no way of getting around it.

The street railway management has adopted a novel scheme for keeping the interurban line in good condition for travel. A number of street sprinklers have been arranged on motor cars and they will be run at regular intervals during the dry and dusty weather, on University avenue, between Minneapolis and St. Paul. These sprinklers are in readiness to be operated now and will be put on as soon as the condition of the avenue demands it.

F.

San Francisco, Cal.

SAN FRANCISCO, Cal., July 9.—For the past year or so the work of installing an incandescent electric lighting plant in the famous Palace hotel of this city has been progressing slowly, and now about 1,000 lights have been placed, and are burning nightly in the main offices, the great court and in the various parlors, dining hall, cafes, reception and billiard rooms. The Slattery alternating system is used, and the plant, when completed, will consist of at least 4,000 lights, making it the largest isolated incandescent installation on the Pacific coast, that of the Hotel del Coronado, Coronado, Cal., with 3,000 Mather lights being second. In the Palace hotel installation two 1,000 light Slattery alternating dynamos are placed in the basement of the hotel directly under the city cafe, and the noise proves quite disagreeable. To avoid this the dynamos are to be moved to the basement of a new seven-story office building that is soon to be erected on an adjoining block by the owners of the Palace hotel. The dynamos generate a potential of about 1,200 volts which is distributed throughout the basement and the courts of the building to the converters, the secondary current being at 50 volts, with a few circuits at 100 volts. The interior primary circuits are of Okonite wire, each being incased in interior conduit, then placed in individual moldings. All secondary circuits are of some solid rubber insulation, generally Okonite, and inclosed in conduits throughout their entire length.

John I. Sabin, general manager of the Pacific Telephone [illegible] will, when completed, be perhaps the finest in the city, and will be the pride of electricians generally. The new car- [illegible] the building.

A number of [illegible] meeting at [illegible] pany which will build and operate an electric railway from the Southern Pacific depot at Ione to Sutter Creek, a distance of [illegible] Jackson. The total length of the road will be about 25 miles. One hundred thousand dollars in stock was subscribed, ten per cent. of which was paid down, and already the surveys for the road are under way. This road will run through the section of country made famous during "the days of '49."

Theodore Meetz has made application to the trustees of Alameda, Cal., on behalf of the Oakland, Alameda and Piedmont Railway company, for an electric railway franchise along Santa Clara avenue to Versailles avenue, thence to Park street in Alameda, whence it will go northerly to the city limits. It is stipulated that work shall commence as soon as Santa Clara avenue is opened. No choice of system has yet been made.

Mr. Blaisdell of Alameda has also asked for a franchise for an electric road, which is to start from an intersection with the Meetz electric road at Park street and Twenty-third avenue, thence along Twenty-third avenue to the boundary line of Oakland, whence it is to be continued through Fruitvale and on to Highland Park. Work is to be commenced within six months after the granting of the franchise, and to be completed in one year.

Chas. F. Crocker, vice-president of the Southern Pacific company, which owns the horse cars and steam motor line running between Oakland and Berkeley, via Telegraph avenue and North Temescal, states that the Southern Pacific company has definitely decided to change the equipment to an electric road.

The Pelton Water Wheel company of San Francisco has shipped a plant of 400 horse power to an electric lighting and railway company in San Jose, Gautemala.

The tiny little brown wooden power house of the Spokane Cable Railway company at Spokane Falls, which stood picturesquely on the edge of the rapids of the Spokane river, has ceased to be an object of interest to those who cross the bridge below the falls to North Spokane. The equipment of the cable line has been changed to an electric road and now forms a branch of the electric system that has been constructed throughout the city by the Spokane Street Railway company. The present electric equipment consists of two 80 kilowatt Edison generators and sixteen cars, each having two 15 horse power motors of the Edison type.

The contract for the overhead and rail equipment of the Santa Cruz and Capitola electric railway has been awarded to the California Electrical Works. Dr. Thomas Addison of the Thomson-Houston company secured the contract for the car and station equipments.

Among the most recent visitors to the Pacific coast were: H. L. Lufkins of the C. & C. Motor company of New York; Chas. E. Brown of the Central Electric company, Chicago; C. M. Spaulding of the Electrical Supply company, Chicago; and C. F. Blackwell, president of the American Fire Alarm company of Boston.

Citizens of Santa Cruz, Cal., propose to place an electric street railway system in that city, while the people of Healdsburg, Cal., are endeavoring to organize an arc and incandescent lighting plant.

The Pacific Auxiliary Fire Alarm Telegraph company has shipped 200 auxiliary boxes to Seattle, which will be the second city on the coast to be equipped with that system. San Francisco has a great many auxiliary boxes, and the additional protection afforded by the system is recognized by the Pacific Insurance Union, which makes a reduction of from 5 to 10 cents in insurance rates.

A Los Angeles newspaper has made the prediction that the Electric Street Railway company of Los Angeles will eventually acquire most if not all of the horse and cable roads in that city. The purchase of the Second street depot line, reported about a month since, has been confirmed, and last week the Los Angeles & [illegible] road was absorbed, and will form a branch of the new system.

The Olympia, Wash., Light & Power company has offered to equip the existing horse car line in that city with electric cars for $10,400, and to operate the same, giving twelve minute service, for $120 per month. The line is two miles in length. It is proposed to install the Edison system, power being obtained from the Tumwater river.

The San Francisco Bridge company, which holds the

contract for grading and bridging about fifty miles of the Great Northern railway from Sand Point, Idaho, westward along the Pend d'Oreille river, has closed a contract with the Edison General Electric company for the Edison electric drill to be used in blasting. Throughout the entire distance the road will run along the river. The dynamos for operating the drills are to be placed on a barge, and current will be furnished from them to the shore, the barge being floated down the river as the work progresses. It is believed that this is the first time that electric drills have been used in railway construction.

An article appeared in one of the San Francisco newspapers recently announcing that the California Electric Light company contemplated the placing of an Edison station in San Francisco and that at least one million dollars would be put into the new enterprise. For two or three months it had been known that negotiations were in progress regarding station equipment of the California Electric Light company. For three or four years it had been remarked that its Jessie street station was altogether too valuable property for an arc lighting station, and that the site was an ideal location for an incandescent station.

The article referred to quoted Geo. H. Roe, secretary and general manager of the California Electric Light company, as saying that the details of the new scheme were not in shape for the public, but that they would be shortly. Mr. Roe has since stated that the Edison General Electric company has intended for a long time to establish a central station in San Francisco, and a number of its agents have been here at different times during the past two years. Nothing definite was accomplished, however, until quite recently, when Samuel Insull, vice-president and general manager of the Edison company was here to look over the ground, and, after concluding that a plant in San Francisco would prove a paying investment, offered to purchase the entire electric light and power plant, franchises, etc., of the California Electric Light company. This offer was considered by the Board of Directors of the local company and finally accepted. On July 1st last the Edison Light & Power company was incorporated with a capital stock of $3,000,000 and on the following day the entire plant, franchises and other property of the California Electric Light company used in central station lighting in San Francisco was transferred to the new corporation. The consideration for that transfer was $1,000,000 worth of stock of the Edison Light & Power company. Mr. Roe further stated that the new company would immediately commence the construction of its central station and expend $500,000 within the next six months.

In addition to the valuable franchises, etc, the plant turned over to the new company consists of about 3,000 horse power in Brush and Thomson-Houston arc lights, Brush constant current motor and Brush alternating incandescent circuits. The plant is divided between two stations, the old station being the Jessie street station referred to, which runs through from Jessie to Stevenson street in the block bounded by Market, Fourth, Mission and Third streets. The new station called Station "B," is down on Townsend street, between Third and Fourth streets and near the sea wall and railroad yards. Station "A," or the Jessie street station, is right in the heart of the city, being within half a block of the junction of Kearney and Market streets, the Palace Hotel and the *Chronicle* and Crocker buildings. It is admitted, therefore, that it is the intention to move the entire electric equipment to the Townsend street station and to convert Station "A" into the Edison station. To do this radical changes must be made and possibly a part of the building will have to be reconstructed. This arrangement will place all the high potential apparatus in the Townsend street station, where real estate is not held [illegible] can be [illegible] almost [illegible] station will be operated by the new company and all Edison circuits will be placed [illegible] that the new multi [illegible] triple expansion [illegible] for the Edison [illegible] the new station, [illegible] will be set up as the initial plant.

[illegible] light com- [illegible] present. [illegible] The [illegible] tem and patents for California, Oregon, Washington and [illegible] very valuable. The company still holds extensive interests [illegible]

company also proposes to enter actively into the electric railway business, and it is presumed that it will handle the Short system. S.

Milwaukee, Wis.

MILWAUKEE, July 13.—The city's street lighting contract with the Badger Illuminating company will expire on December 15th. The common council has adopted a resolution, which the mayor has signed, instructing the Board of Public Works to advertise for bids at once. The Badger Illuminating company tried to show that the resolution was illegal, and did its utmost to prevent the mayor from signing it. The Badger, with wires strung all over the city, has the inside track, but the Milwaukee Power & Lighting company, it is thought, will prove a more formidable competitor for the new contract than it did for the present one. They are the only companies operating arc lights in this city.

The Western Union Telegraph company is seeking to get permission from the common council to string all its wires in aerial cables running through the alleys, but Mayor Somers is determined that all electric wires, except those used for street railway purposes, shall be buried, and he will probably balk the Western Union. There is little doubt that he will veto a resolution extending the Western Union company's time for burying its wires until August 15th, by which time the aerial cable question will be decided. The Mayor seems to have the support of the people.

The interested parties have practically agreed upon an ordinance for the burial of electric light wires. It provides that all such wires shall be placed underground within five years from January 1, 1892; not less than 5 per cent. the first year, 10 per cent. the second year, 25 per cent. the third, 30 the fourth, and 30 the fifth year.

The common council has taken favorable action in the matter of extending the Milwaukee Power & Lighting company's franchise.

The injunction restraining the Milwaukee Street Railway company from building on the Mukwonago road to the Soldier's Home has been dissolved, the company having made a money settlement with the plank road people.

The work of transforming the Villard lines into an electric system is progressing slowly. The Illinois Steel company is slow in turning out the girder rails contracted for, and heavy flat rails are being used on Farwell avenue. C.

Pittsburg, Pa.

PITTSBURG, Pa., July 11.—About as quick a piece of electrical work as has been heard of in a great while in this part of the country was done by the Ohio Valley Electric Light & Power company of Sewickly, when the electric light plant was moved from the leased quarters on Centennial avenue to the company's power house at Quaker Valley. In order not to leave Sewickly streets and many houses in darkness it was necessary to move the plant and re-establish it between sunrise and sunset. Accordingly President E. P. Young, J. M. Uptegraff, the company's chief engineer, and several assistants took the work in hand at dawn. The machinery to be moved included two dynamos, which supply the current for forty arc lights on the streets and seven hundred and fifty incandescent lights in houses, and which weigh nearly two tons each, and a Westinghouse engine weighing nine thousand pounds. As soon as it was daylight, and while the engine was still so hot that the men in handling it were forced to use cotton waste, the work began, and by means of differential blocks the heavy machinery was hoisted on a heavy cart, which had been strengthened with big timbers, and was drawn by four horses. So diligently did the men work that by noon all the machinery had been hauled to the house at Quaker Valley, a mile away. There foundations had been prepared for the dynamos and the engine, but in addition to making them fast the pipes from the boiler to the engine had to be cut and fitted after the latter had been bolted down. But everything went right, and at seven o'clock, sooner than was really needful, the engine was in motion and the dynamos furnishing current as usual. Mr. Young and his colleagues are greatly pleased, as very few people in Sewickly are even to-day aware of the fact that the electric light plant has been moved at all. The electric plant is supplied with Westinghouse apparatus.

The Birmingham, Allentown & Knoxville Traction company was chartered yesterday at Harrisburg. The company is a [illegible] corporation, and the directors of the Birmingham Traction company are all interested in the new venture, which, according to the charter, has been organized for the purpose of establishing a factory for the manufacture of electric motors. It is supposed that the company will go into the manufacture of street railway motors, but under whose patent it will work and what style of motor it will turn out has not yet been developed. H. Sellers McKee, a millionaire of this city, is at the head of the enterprise.

The last Fourth of July was a great day for the electrical rapid transit companies of this city. The city has lately been presented a very beautiful park, of about three hundred acres, by Mrs. Mary Schenley, a Pittsburg lady and probably the richest woman in America. The Fourth of July had been decided upon by the city authorities as the occasion to give the first public demonstration of joy at the possession of such a beautiful piece of property, and in the evening about $5,000 worth of fireworks were let off for the amusement of the people. This of course made Schenley Park the Mecca for all Pittsburgers on the evening of that day, and as most of the electrical street car companies run their lines in the direction of the park they did a great business. It is estimated that the Pittsburg Traction company carried on that day about seventy thousand passengers; the Duquesne Traction company sixty thousand and the Second avenue Electric Street Railway company about thirty thousand. The low figure of the last named company is accounted for by the fact that its course does not go to the park direct. B. L. W.

Indianapolis, Ind.

INDIANAPOLIS, July 11.—The Board of Public Works has held two meetings to open bids for street lighting, but none was received, although numerous agents for the different companies have been in the city.

President Fowler of the Citizen's Street Railway company, closed a contract last week with the Thomson-Houston company for motors for new cars, and with a St. Louis car company for a large number of cars to equip the new lines. With the new machinery now being placed in the power house this company will be able to generate nearly 1000 horse power.

The Broad Ripple line is apparently abandoned. The contractors for laying the track, grading, etc., have brought suit against the Edison General Electric company for $12,000 damages for failure to comply with their contract and have levied on the wire, iron and other property in sight. M.

Detroit, Mich.

DETROIT, Mich., July 11 —At a session of the common council of this city last week the Detroit Street Railway company (which is merely a reorganization of the present City Railway company and the Grand River Street Railway company) and the Fort Street Railway company were granted franchises for a period of thirty years. In return the companies agreed to adopt some method of rapid transit, and also make some minor concessions in the matter of change of tickets, etc. It had been reported that the franchise was obtained through corruption of the aldermen, and this, together with the general dissatisfaction with the accommodations and service of the street railway companies, led to an indignation meeting, which was attended by all classes of citizens, and at which the action of the council was emphatically denounced. At the next meeting of the council last Tuesday the council room was filled with citizens, and the session terminated almost in a riot. The mayor sent in vetoes of all the ordinances extending the franchises, and his vetoes were sustained. There is no doubt that the street railway companies intend to introduce rapid transit, but they have not yet publicly announced their plans.

A new passenger transportation company has just been organized here with a number of three-wheel conveyances drawn by horses. They will carry eighteen passengers, and the intention is now to run regular trips on one or two of the main streets. The carriages arrived to day, and were paraded through the streets on exhibition.

Fire broke out in the engine rooms of the dynamo station of the Bay City Electric Light Works on the night of June 24th. The engines and dynamos were ruined; loss about $25,000. The city is left in darkness. It will take a week to put in new engines and dynamos.

Work is to be started on a new street railway in Grand Haven next week.

Justice Brown of the United States Supreme Court has decided a street car muddle in Grand Rapids by refusing to grant a permanent injunction restraining the Reeds Lake Electric road from coming down town into Grand Rapids by straddling the Valley City road for two hundred feet. The District Court held that the straddle was an infringement of the Valley City company's road rights, but Justice Brown held that the straddle was only a crossing, although a peculiar one, and therefore not to be stopped by the Valley City company. D.

Swedish telephones are furnished with an automatic contrivance for regulating the number of conversations.

PERSONAL.

Thos D. Lockwood was in Chicago last week.

W. A. Childs, president of the Law Telephone company, New York, left last week for an extended business and pleasure trip through France, Germany and other parts of Europe. He will not return before the 1st of November.

NEW INCORPORATIONS.

Equitable Electric company, Jersey City, N. J.; capital stock, $250,000; to manufacture and sell electrical devices of all descriptions.

Baehr Electric Manufacturing company, Newark, N. J.; capital stock, $50,000; buying, selling and manufacturing electrical apparatus.

Carolina Light & Power company, Aiken, S. C.; capital stock, $20,000; to furnish and supply Aiken with electric light and water, etc.

Herzog General Electric company, Newark, N. J.; capital stock, $1,000,000; to manufacture, sell and exploit all kinds of electrical appliances.

Eastern Electrical Supply company, Portland, Me.; capital stock, $250,000; to manufacture and deal in electrical appliances and supplies of all kinds.

Edison Light & Power company, San Francisco, Cal.; capital stock, $3,000,000; to generate, transmit and sell electricity, electric light, heat and power.

New England Electric Brush company, Portland, Me.; capital stock, $500,000; to manufacture and sell electric brushes under the patent of Alexander Stanton.

Inter State Electric Railway company, Milwaukee, Wis.; capital stock, $10,000,000; to construct and maintain an electric railroad between Chicago and Milwaukee

Enterprise Construction & Supply company, New Orleans, La; capital stock, $50,000; to buy, sell and manufacture electrical and other machinery and supplies.

Kennebunk Electric Light company, Kennebunk, Me; capital stock $100,000; supplying the towns of Kennebunk and Kennebunkport and Wells with light, heat and power.

Shelbyville Water & Light company, New York, N. Y. (incorporated in West Virginia); capital stock, $50,000; operating electric light plants, gas, water and power works at Shelbyville, Ill.

Birmingham, Knoxville & Allentown Traction company, Pittsburg, Pa.; capital stock, $1,000,000; construction and operation of motors and cables or other machinery for passenger railways, etc.

San Antonio Light & Power company, Pomona, Cal.; capital stock, $240,000; to manufacture, produce, generate and otherwise obtain electric light, power and heat from the waters of San Antonio Creek.

Amador Electric Railway & Light company, Sutter Creek, Amador county, Cal.; capital stock, $500,000; to construct, acquire, operate and maintain a line of railroad, and maintain and operate telegraph and telephone service along the line thereof.

Brighton Park Mutual Home & Investment company of Branchville, Prince Georges county, Md.; capital stock, $250,000; buying, selling, leasing, mortgaging, improving land; construction and equipment of a railway, and gas and electric lighting.

Vendomatic Apparatus company, Pittsburg, Pa.; capital stock $10,000; to manufacture and sell and operate automatic pneumatic or electric machines, or appliances for the display of cards, photographs, and other articles of trade. Incorporated in West Virginia.

ELECTRIC LIGHT.

An electric lighting plant is talked of in Arkansas City, Ark.

A St. Louis capitalist contemplates establishing an electric light plant in Batesville, Ark.

At Tallapoosa, Ga, the Vernon Light & Power company will, it is stated, double the capacity of its electric light plant.

The Badger Electric company of Racine has secured the contract for lighting the city with 150 arc lights for a period of three years.

Large gangs of men have been engaged for weeks in Louisville erecting poles and stringing wires for the electric lights with which it is intended to illuminate the streets of the city.

At a special election of the residents of Fairmont, Minn., it was decided to issue $15,000 worth of bonds for the purpose of instituting a system of waterworks and installing an electric light plant.

The Badger Electric company of Racine, Wis., has placed an order for an additional 18x42 Reynolds-Corliss engine. The company is at present engaged in remodeling its station, adding two condensers, another Thomson-Houston 1,300 light alternator and two 50 light Thomson-Houston arc dynamos.

A. N. Brady of Troy, N. Y., has purchased the property and plant of the Troy Electric Light company for $90,000. The sale is said to be a part of the plan begun by the Troy Gas company in the consolidation of the three gas companies some time ago to obtain control of the gas and electric light corporations in that city. Mr. Brady is a director of the Troy Gas company.

W. S. Coon, M. A. Smalley of Wyandotte county, O., W. W. Taylor of Philadelphia and others have incorporated the Central Construction company at Newport, Ky., to erect electric light plants, construct waterworks, etc. The capital stock is $500,000.

According to statistics published by M. Wybauw, a Belgian authority, there are 544 arc and 9,507 incandescent lamps in use in Brussels; 240 arcs and 1,481 incandescents in Antwerp; 220 arcs and 4 931 incandescents in Ghent; 384 arcs and 2,040 incandescents in Liege; 665 arcs and 2,423 incandescents in Verviers; 1,500 incandescents in Chareleroi, and 1,100 lamps of both kinds in Ninove.

ELECTRIC RAILWAYS.

The Rochester, N. Y., Railway company will extend its Sophia street line to the Driving Park.

The Raleigh, N. C., Street Railway company has let the contract for the erection of its electric power house, which is to cost $10,000.

The Houston, Tex, Street Railroad company has completed about twelve miles of electric lines, and will equip ten miles more within a year.

The contract for the construction of the West Asheville, N. C., and Sulphur Springs Electric railway, four and one-half miles long, has been let. It is stated that the Thomson-Houston company will furnish the electrical equipment.

The franchise for building an electric railroad from the Union railway station in Lynchburg, Va., to the Lynchburg & Durham station, which was granted a company represented by R. L. Miller, has been extended by the city council. The company has, it is stated, awarded the contract to the Edison General Electric company for building the road.

Suit to restrain the Cicero & Proviso Electric Railway company of Chicago from crossing the tracks of the Minnesota and Northwestern Railroad company at grade in Harlem has been begun by the latter corporation. The complainant company avers that the crossing will interfere with its business, and that no condemnation proceedings have been instituted.

The South Harvey & Harvey Electric Dummy Railway company of Chicago has been incorporated with a capital stock of $50,000. The road will start at Homewood Station on the Illinois Central run east to Ashland avenue, thence north through South Harvey on Ashland avenue to One Hundred and Sixty-fourth street, and east to the steam railway station in Harvey. The road will begin operations with twelve passenger cars and two motor cars. The cars will run every half hour during the day, and every ten minutes in the morning and evening during the rush trips.

Articles of incorporation of the Lockport, N Y, and Olcott Beach Electric Railroad company have been filed with the secretary of state. Its term of corporate existence is to be 500 years and the length of the road is to be about twelve miles. The route is to be as follows: From the city of Lockport, thence through the town of Lockport, and the town of Newfane, to the shore of Lake Ontario, at the village of Olcott. The capital stock is placed at $120,000. The road will be part of the system intended to connect Rochester and Lockport by an electric railway along the Ridge road.

An electric road built by the Decauville company a short time since on trial at Bourg, France, has proved such a success that the municipality of the town has granted the director of the electric lighting department there a concession of thirty years for the working of the line. The cars, which were run for the first time last year on trial in the Champs Elysées, at Paris, are lighted as well as propelled by electricity stored in accumulators. The track is of only $23\frac{1}{2}$ inches gauge, and curves of 16 yards radius are practicable. It is said that these cars have no difficulty in running up grades of 1 in 80.

One phase of the possibilities of the electric street railroad system was practically demonstrated recently by a young Rochester business man of a humorous turn of mind, says the Rochester, N. Y., *Herald*. One evening, in company with his sister, he boarded an east bound East Main street car near the Glen Haven terminus with the purpose of riding down town as soon as the course of the car should be reversed. When the end of the route was reached, the young man and his sister were the only passengers. The trolley rod was swung about, of course breaking the connection of the incandescent light within the car. In the instant of tunnel-like obscurity which ensued the humorous young man imprinted a sounding smack upon the back of his own hand. Then the lights flashed up again, just as the young lady exclaimed, "You horrid thing!" and bounced half-way along the length of the car. Her flushed face and generally discomposed manner, coupled with the foregoing circumstances, naturally disposed the motor man and the conductor to the belief that they had been the witnesses of an interesting love episode, and the series of grins and chuckles which they indulged in caused the young lady to alight hurriedly, that she might vent her wrath upon the sportive brother who had caused her discomfiture.

TELEGRAPH.

From Baltimore comes news that the transfer of the telegraph lines of the new Baltimore & Ohio Akron branch road to the Western Union, in accordance with the sixty-years' lease to the Western Union entered into by the Baltimore & Onio company in 1888, took place on July 6th. This agreement provides that the telegraph lines on every road or branch road acquired or constructed by the Balti-more [illegible] ma [illegible]

The sale is reported of the American Rapid Telegraph company [illegible] well.

The [illegible] to the [illegible] lines of the French Telegraph Cable company have been extended to [illegible] Martinique, [illegible] is expected that the line to Rio de Janeiro via Para will be completed by August 15th.

The second cable between France and Denmark, intended to duplicate that now existing between Oyne, near Calais, and the Island of Fance, in Denmark, will be laid during the latter part of this month between these points. This new cable will give more direct communication for French messages to St. Petersburg. It is the property of the Compagnie des Telegraphes du Nord.

During a recent storm Sergeant Farley, who had charge of the telegraph instruments at the Tremont police station, New York city, had an unpleasant experience. In the middle of the afternoon the man at police headquarters concluded to send out a general order. Sergeant Farley had got as far as "also you will strictly" in receiving the message when lightning struck the telegraph pole at One Hundred and Sixtieth street and Railroad avenue. The wire which was carrying the message to the sergeant was strung on that particular pole. Fifteen poles were tumbled into the railroad cut by the combined effect of the lightning and the wind, and the sergeant was thrown across the office and brought up with considerable force against the railing. He was little the worse for the shock.

In last week's issue it was stated that the Western Union Telegraph company had won a victory at Milwaukee by a report of the judiciary committee of the common council in favor of an amended ordinance granting the company the right to run its wires overhead in a cable instead of burying them. It appears that the council at a meeting held since passed a resolution requiring the company to bury its wires by August 15th. It is now believed that Mayor Somers will veto this resolution. Together with his veto the mayor will probably recommend that the Board of Public Works suspend the work of chopping down the company's poles until action is taken on the ordinance now pending allowing the wires to be placed in aerial cables. The ordinance requiring that the company place its wires underground has been in force more than two years, but extensions have been granted from time to time until now Mayor Somers thinks it about time the company should comply with the law as the telephone company has done.

MISCELLANEOUS.

E. E. Ries, L. S. Greenfielder, O. M Dennis and others have incorporated the Ries Electric Specialty company in Baltimore, Md., for the manufacture, sale and installation of electrical apparatus. The capital stock is $25,000

The Southern Electric company has been incorporated at Lynchburg, Va., with C. P. Poole, president, and C.W. Poole, vice-president, for the purpose of manufacturing electrical apparatus. The capital stock is to be not less than $5,000 nor more than $25,000.

Lightning struck the big captive balloon in Chicago on July 6th. The silken bag is said to have contained 150,000 cubic feet of gas, and the newspaper accounts state that flames 200 feet high rolled over an area of half a block. The balloon and its appurtenances were completely destroyed, and the loss is estimated at $50,000.

The United States Corporation Bureau of Chicago reports 313 new, completed corporations in the United States for the week ending June 26th, with a total capitalization of $80,937,150. Included in this number are thirty one mining and smelting companies with a capital of $22,175,000, and twenty-nine light, heat and power companies capitalized at $6,757,500.

The Empire Electrical company, now located at Brandywine, Pa., has bought a number of acres of ground in Cicero, near Chicago, and proposes to move. It is said to be the intention to form a practically new electrical supply company with a capital stock of $1,000,000. Several hundred men will, it is claimed, be employed, and work will be begun within sixty days.

On July 3d at St. Inigoes villa, St. Mary's County, Md., a peculiar and fatal accident occurred resulting from a lightning shock. St. Inigoes villa is a Catholic institution, and Father Boureaud thus tells the story: "On Friday night a tornado passed over St. Inigoes [illegible] drenching rain. The scholastics, who were asleep on the top floor, were awakened by the rain pouring in on them and made hasty preparations to move their cots to dry places. They were in all parts of the room when a blinding flash of lightning pervaded the apartment. After the shock seven of the young men were found lying on the floor. John B. Lamb of Boston, [illegible] of New York and James Waters of New York [illegible] killed, and Daniel Quinn of New York, [illegible] of Philadelphia, Mr. Raley of St. Mary's County, Md., and Mr. Neary were injured. A singular incident is that all the young men who were killed were in different parts of the room."

In the course of an [illegible] Machinery in Coal Mines [illegible] application of electricity to mining [illegible] eventually to revolutionize [illegible]

ments in this direction have been practically and exhaustively carried on by experts, and the possibilities of electric adaptation have been accurately and scientifically placed. In mining mechanics it is already a conclusion that electric power is advantageous in economy of cost and increase of production. Motor power can be transferred from one point to another, as occasion requires, with but a minimum of trouble and expense, and the transfer of the product made with the same reduction in time and cost. The electric coal cutter now runs at the rate of 500 revolutions per minute, and on an average, inclusive of stoppages, can make a clean cut of 20 to 30 square yards of coal per hour. Fifty-five yards have been bored to an average depth of 3 feet 8 inches in seventy-five minutes, making a difference in the relative cost of cutting coal of 35 cents per ton in favor of the electrical apparatus. These advantages being established, the most important point in the use of electricity in coal mines has been the open question as to whether a motor would be likely to cause an explosion. This has been practically settled by inclosing the cummutator in a protecting air-tight casing. In special cases, where fire damp might leak into these covers, a constant supply of carbon dioxide is introduced from a steel cylinder, preventing the ingress of any explosive mixture. Switches are also inclosed and sparking prevented by a resistance coil of self-induction. It is practically demonstrated that in electric pumping, coal cutting and drilling machines, the advantages of economy and efficiency are in favor of electricity, as compared with the older methods, and that it is but a question of time when electricity will be dominant as a motor force in our coal mines."

TRADE NEWS.

The merits of the Thomson-Houston Motor company's system of electric tramways are attractively set forth in a finely illustrated pamphlet recently issued by that company. A number of highly successful installations of this character are described.

The Union Electric Manufacturing company of Bridgeport is manufacturing an incandescent lamp socket that has been received favorably by the trade. It is simple and durable, and there are few parts. Since its introduction there has been a lively demand for it, and it has evidently commended itself to popular favor.

The Pelton Water Wheel company has opened an office in New York at 235 Central building, Liberty and West streets. It is prepared to manufacture at this point water wheels and motors, together with water pipe, shafting, pulleys and other machinery connected with the development of power by the Pelton system.

Whipple's Reports for July states that the Chicago Electric Manufacturing company has dissolved This statement is untrue. J. D. Claghorn, the manager of the company, on being seen by a WESTERN ELECTRICIAN representative, was very indignant that such a report should be put in circulation, claiming that the concern was never in such good shape as at present.

Queen & Co., Philadelphia, are just now making a specialty of tachometers for indicating the speed of engines, dynamos and motors. These instruments are quite essential to the economical operation of a plant. By means of a tachometer it is possible to tell at a glance the exact rate of speed at which an engine or dynamo is running. For portable work a special instrument is made which takes up but little space, and can easily be carried about. This tachometer is as accurate in its readings as the larger type mounted on a strong base and designed for permanent attachment in the engine or dynamo room.

The increase in the sales of Perkins lamps by the Knapp Electrical Works during the last month has been greater than any preceding month of the year. The orders for these lamps have been coming in in large numbers from consumers who have had the lamps on trial for some time. Mr. Knapp reports that the lamp business has so increased during the last year that the Perkins company will be obliged to enlarge its manufacturing facilities again. Mr. Knapp also reports large sales of Safety wire, which he is now handling Mr. Knapp has a large stock of wire of all sizes at his headquarters on Franklin street.

T[illegible] has recently taken some very large orders for electroliers and other electric light [illegible] in the Northwest. The company reports a large trade on these articles. The [illegible] demand for better [illegible] At a recent [illegible] the [illegible] The Central [illegible] and [illegible] the [illegible] new [illegible]

BUSINESS.

[illegible]

out a large line of cooking utensils, showing that aluminum is destined to go into very general use.

The West Side Car company of Boston is fast equipping the system with electricity, and as the work progresses the old cars are offered for sale. The company, it is said; operate more cars than any other line in the world, and when fully supplied with electric motors will have a plant that will command the admiration of the world.

Julius Andrea, Milwaukee, has discarded steam in his factory, and is installing a three horse power Eddy motor to run a part of the machinery. Later he will add a larger motor, taking the current direct from the Edison company's mains. Mr. Andrea is building up a very large business in Milwaukee, and by careful, painstaking work is deserving success.

The eighth edition of the revised catalogue of W. R. Ostrander & Co., 195 and 197 Fulton street, New York, has just been issued. It contains a complete list of their manufactures, comprising six systems, viz.: Speaking tubes, electric call-bells, electric burglar alarms, electric gas lighting, mechanical door bells, pneumatic call-bells, etc. The various appliances under each head are illustrated, and are arranged in a simple and systematic order.

The Pond Engineering company has recently received a large order for Armington & Sims engines from the Chicago Edison company for its central lighting station on Adams street. The engines are of 400 horse power each. The first engines in this plant were made by the Armington & Sims company, but since then tests of engines built by other firms were made. The Armington & Sims company was therefore greatly gratified on receiving the last order.

A new car, built by the Brownell Car company of St. Louis and known as the California Adjustable Car, patented by J. B. Blow, has just been put on the North Side cable line as a trailer. The car is a novelty, and in many ways would seem to have merit The seats are arranged to either face in or out along the side of the car. Windows are dropped down inside the back of the seats, so that when the seats are facing inward the windows can be put up, making a closed car for use in winter or in case of a storm. The car is handsome and solidly built, and has been put on the North Side line for exhibition purposes.

The Rockford Electric Works are placing the Mayo generator and their new "Iron Clad" motor on the market, and are meeting with well merited success. They have recently established a sales agency at Lincoln, Neb., and are desirous of placing agents in the field in other territory. Recently published testimonials from the *Chicago Tribune*, *Inter Ocean* and other Chicago establishments would indicate that the motors made by this company are giving satisfaction. A special feature will be made of isolated lighting, it being claimed that perfect regulation has been reached and that but little attention will be required after the plant has been installed. A large number of generators are under construction in the factory, and preparations are being made for an active fall season.

The Union Electric Works, 506 Springer building, are making the apparatus to be used by the American Electric Fence company, which is now being put on the market in Texas and Colorado. Preparations have already been made for the construction of a large amount of the fence. The parties owning the patent for California are advertising it in that territory as a protection against the rabbit pest, and it is likely to be put to general use so it is claimed for that purpose The Chicago company has devised a very fine converter, in the form of a large coil, and when power can be had, they are going to supply a small magneto generator to take the place of the battery and coil The Union Electric company has recently purchased several electrical inventions and is making a specialty of exploiting new devices.

ELECTRICAL PATENTS.

Issued July 7, 1891.

455,298. Electric Locomotive. Norman C. Bassett, Lynn, Mass.

In this locomotive the electric motor extends from axle to axle of the truck and is mounted thereon by spring bearings. Upon the armature shaft of the motor there are placed variable friction pinions which engage corresponding friction wheels fixed upon a countershaft, which shaft is geared to and swings about the axle as a center.

455,316. Annunciator. Manias Garl, Canton, Ohio

455,320. Telegraph Key. Robert W. Green, St. Thomas, Canada.

455 322. Trolley Pole Stand. James R. Griffiths, Allegheny, Pa.

455,339 Conductor for Electric Railways. Walter H. Knight, Cleveland, Ohio.

The last claim is:

"25. In an electric railway, the combination of an inclosing conduit, a supply conductor, a vitreous insulator having a spring-bearing, and a deadener therefor."

[illegible] Electric Railway. Walter H. Knight, New York, N. Y.

In this system a contact device is carried by the car, the outer extremity of said device being pressed against the line conductor, while the inner extremity [illegible] with the vehicle that it permits the accommodation of the device to the irregular paths followed by its ends respectively.

[illegible]

[illegible] and an [illegible] of a conduit a supply [illegible] propelled vehicle

and a contact device held against fore-and-aft movement by its connections with the vehicle and movable laterally about a horizontal axis."

455,341. Electric Railway. Walter H. Knight, New York, N. Y.

The yokes are provided with sockets with insulators seated therein and conductors attached thereto. The slot rails, extending through the pavement to form the upper part of the conduit, are suitably attached to said yokes.

455,342. Electric Railway. Walter H. Knight, New York, N. Y.

455,343. Electric Railway Plow. Walter H. Knight, New York, N. Y.

455,352. Electrical Watchman's Clock. Harvey S Park, Chicago, Ill.

455,366. Combined Fuse Block and Incandescent Lamp. Horace E. Swift, Boston, Mass.

455,398. Quadruplex Telegraphy. Charles D. Haskins, Brooklyn, N. Y.

In this system an extra helix is provided on the neutral relay magnets whose terminals are connected to the magnet terminals of an ordinary back contact relay.

455,410. Watchman's Time Detector. Abraham Newman, Brooklyn, N. Y.

455,420. Method of Electric Welding. Elihu Thomson, Swampscott, Mass.

In this method the metal is cooled just back of the weld and between the same and the places where the current bearing electrodes form contacts.

455,421. Securing Metal Bands on Wooden or Other Articles. Elihu Thomson, Swampscott, Mass.

455 440. Watchman's Time Recorder. John A. Lannert, Cleveland, Ohio.

455,446 Grave Annunciator. William H. White, Topeka, Kan.

455 447. Conduit for Electric Railways. William Bradley, Fort Wayne, Ind.

455,451. Diaphragm for Electrolytic Cells. Ernest A. Le Sueur, Ottawa, Canada.

455 454. Electric Railway. Edwin W. Rice, Jr., Lynn, Mass.

In this system two supply conductors attached to separate generators, and parallel with the road, are each at separate times made to propel the car by means of a suitable arrangement which brings the propelling motor in circuit with either of them at one time.

455,488. Friction Gearing for Dynamos. Frederick L. McGahan, Indianapolis, Ind.

455,510. Train Signaling Apparatus. Linwood F. Jordan, Somerville, Mass.

455,517. Multipolar Dynamo. Andrew L. Riker, New York, N. Y.

455 518. Carbon Brush and Holder Therefor. Andrew L. Riker, New York, N. Y.

455,520. Pulsating Current Reciprocating Electric Engine System. Charles J. Van Depoele, Lynn, Mass.

455,524. Electric Meter. James J. Wood, Brooklyn, N. Y.

455,532. Self-winding Electric Clock Fred L. Gregory, Niagara Falls.

455,545. Electrical Walking Toy. John B. Kibler, Minneapolis, Minn.

455,559. Lamp Socket and Switch and Circuit Closer Therefor. Henry P. Ball, Brooklyn, N. Y.

455,575. Electric Meter. Johan W. T. Olan, New York, N. Y.

455,576. Electric Arc Lamp. Johan W. T. Olan, New York, N. Y.

Claim one reads:

"The combination, with the carbons or electrodes of an arc lamp and inclosing globe therefor, of a tube extending from the base thereof and containing a column of liquid, said column supporting one of the lamp carbons, and means for separating the carbons to form an arc "

455,581. Electric Motor Car Truck. John F. Seiberling, Akron, O.

455,631. Apparatus for the Defecation of Saccharine Juices by Electricity in the Manufacture of Sugar. Elias Maigrot and Jose Sabates, Havana, Cuba

455 680. Electric Belt. Charles A. Bogardus, Syracuse, N. Y.

455 683 Transmission of Alternating Currents of Different Phase. Michael Von Dolivo Dobrowolsky, Berlin, Germany.

455,693. Galvanic Battery. Henry C. Sample, Ravenswood, assignor to Hugh W. Matthews, Chicago, Ill.

455 696. Switch board for Electric Fence Stations. David H. Wilson, Normal, Ill.

455,711. Electric Motor. Lemuel G. Goode, Jersey City, N. J.

455 722. Support for Telephones. William J. Myers, Allegheny, Pa.

455 726 Electric Motor or Generator. Walter F. Brown, St. Paul, Minn.

The last claim reads

"5. The combination, with the commutator of a reversible dynamo or motor, of [illegible] radial support on opposite sides thereof, arms secured at right angles with and adjustable along said supports, standards adapted to be secured upon either side of said arms and adjustable along the same, and brush holders and brushes carried by said standards."

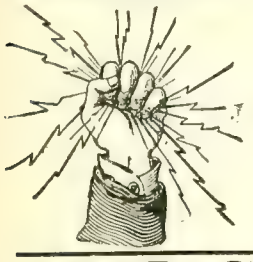
EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,



Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and is **guaranteed to be waterproof, and will not deteriorate, oxidize or crack,** and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

Fine Office Furniture and Folding Beds.

Brass and Wire Work. 215 Wabash Av.

A. H. Andrews & Co., Chicago.

BRASS FANS

FOR ELECTRIC MOTORS.

MANUFACTURED BY

THE TURNER BRASS WORKS,

4 LaSalle Ave., Chicago.

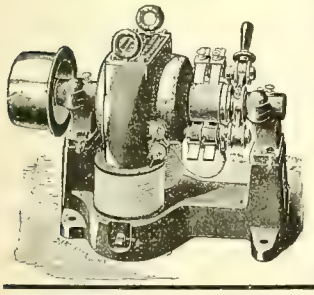
Write us for prices.

ROSE POLYTECHNIC INSTITUTE.

TERRE HAUTE, INDIANA. A SCHOOL OF ENGINEERING. Well endowed, well equipped departments of Civil, Mechanical and Electrical Engineering, Chemistry, Drawing. Extensive Shops and Laboratories. Expenses low. For catalogue address H. W. Eddy, Pres.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS

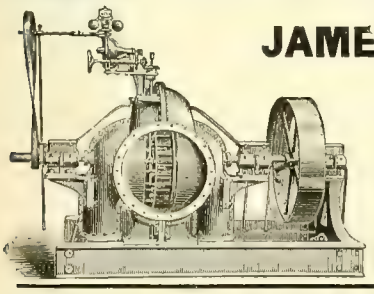
BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.



Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY

MICA.

I sell all kinds of Insulating Purposes, but I claim that my Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

To Manufacturers:

A young man with [illegible] is open for an engagement. Has had [illegible] For further information address

I. F. D., Care WESTERN ELECTRICIAN.

CHICAGO

The Electrical Construction Co.

43 and 45 Fremont St.

C. A. HARTER, Manager. Telephone, 1718.

Electric Billiard and Pool Table.

Patent Number 453,674.

The owner of this patent wishes to correspond with parties interested in electrical appliances with the view of putting the device in use.

Address, **S. L. A.,**

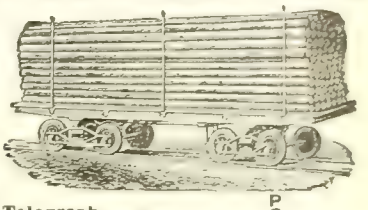
Care WESTERN ELECTRICIAN.

UNION ELECTRIC WORKS.

Electric Specialties manufactured on royalty or **purchased of inventors.** Repair work of all kinds given careful attention.

Room 506, Springer Building, Chicago.

ELECTRICAL WOOD.



Telegraph Telephone Electric Light CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N. Y.**

MEASURE YOUR INCANDESCENT LAMPS WITH

Queen's Portable Bunsen Photometer.

In every Central Station there is constant occasion to measure the candle power of Incandescent Lamps, and to meet these requirements we have designed our **Portable Bunsen Photometer.** It is **compact,** gives **accurate results,** is **simple in operation,** and the **price is low.** Dimensions, 37 inches long and 5½ inches square. Total weight, 13 pounds.

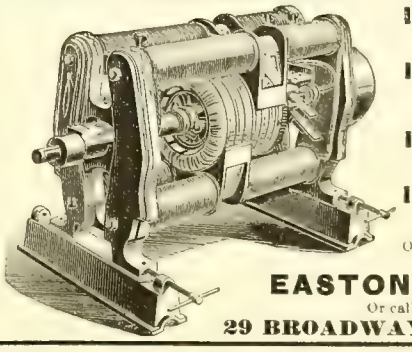
PRICE, $30.00.

Indispensable to the Economical Operation of Every Central Station.

CORRESPONDENCE SOLICITED.

Send for Illustrated Catalogue of Electrical Test Instruments No. 1-03.

QUEEN & CO., PHILADELPHIA.



IF YOU WANT
AN EXCELLENT DYNAMO, Arc or Incandescent;

IF YOU WANT
A UNIVERSAL ARC LAMP, adapted for use on any dynamo of any system;

IF YOU ARE
Looking for an ARC LAMP for use on Incandescent Circuits;

IF YOU NEED
MOTORS, GENERATORS, SEPARATORS, ETC.;

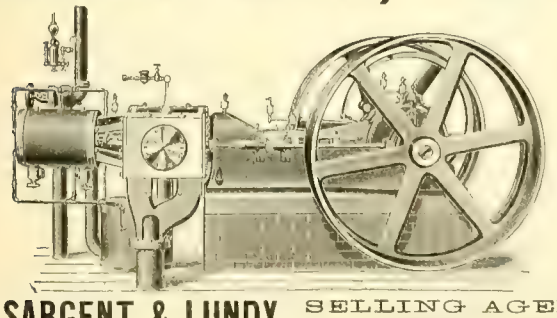
Or if you are seeking information in regard to Electrical Apparatus, write to the

EASTON ELECTRIC CO.,

Or call on them at their office,

29 BROADWAY, - NEW YORK CITY.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

	SIZE	H. P. OF EACH ENGINE.	DESTINATION
One	12½x12	80	Edison General Electric Co., Groton, N. Y.
Two	18½x17	200	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rio Janeiro, Brazil.
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 19x15	151	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	241	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Robins & Co., Chicago, Ill.
One	15 and 23x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Leeds, England.
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T. H. Int. Elec. Co., Helsingfors, Finland.
One	11 and 19x15	150	Fritz Wilen, Helsingfors, Finland.
One	18x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 25x17	400	Baltimore Electric Relining Co., Baltimore, Md.
One	14½ and 23x23	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, **339 Rookery Bldg., CHICAGO.**

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN St.
FITCHBURG, MASS, U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

WANTED.

A Specialty to Manufacture—electrical preferred, or will sell my Foundry and Machine Plant on easy terms. Address

C. C. PAIGE,

Eagle Iron Works. **Oshkosh. Wis.**

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 13, 1883. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

Binders FOR THE Western Electrician $1.00.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

FOR SALE. WEST END ST. RAILWAY COMPANY, 81 Milk St., Boston. This company having adopted the long car for traffic on its most populous lines, is now able to dispose of a portion of its box and open cars. Roads in want can be promptly supplied at advantageous prices. We invite correspondence, but believe an examination of our stock by a representative of parties in want would be to their advantage. HENRY F. WOODS,

JUNE 19, 1891. Purchasing Agent.

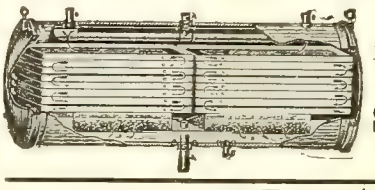
A Choice List of Summer Resorts.

In the Lake regions of Wisconsin, Northern Michigan, Minnesota, Iowa and the two Dakotas there are hundreds of charming localities pre-eminently fitted for summer homes. Among the following selected list are names familiar to many of our readers as the perfection of Northern summer resorts. Nearly all of the Wisconsin points of interest are within a short distance from Chicago or Milwaukee, and none of them are so far away from the "busy marts of civilization" that they cannot be reached in a few hours of travel, by the frequent trains, over the finest roads in the Northwest—the Chicago, Milwaukee & St. Paul Railway and Milwaukee & Northern Railroad:

Oconomowoc, Wis.	Clear Lake, Iowa.
Minoqua, Wis.	Lakes Okobeji, Iowa.
Wankesha, Wis	Spirit Lake, Iowa.
Palmyra, Wis.	Fronte-nac, Minn.
Tomahawk Lakes, Wis.	Lake Minnetonka, Minn.
Lakeside, Wis.	Ortonville, Minn.
Kilbourn City, Wis.	Prior Lake, Minn.
(Dells of the Wisconsin.)	White Bear Lake, Minn.
Beaver Dam, Wis.	Lake Madison,
Madison, Wis.	So. Dakota.
Delavan, Wis.	Big Stone Lake,
Sparta, Wis.	So. Dakota.
Pewaukee, Wis.	Elkhart Lake, Wis.
Wausaukee, Wis.	Ontonagon, Mich.
Marquette, Mich.	Mackinaw, Mich.

For detailed information apply to any coupon ticket agent, or send stamp for a free illustrated tourist folder, to Geo. H. Heafford, General Passenger Agent, Chicago, Ill.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

SLATE.

Six samples showing all finishes for $1.50.

T. J. MURPHY,

96 Columbus Ave., NEW YORK.

STAR GAUGE GLASS CUTTER.

A necessary tool in every engine room. Sent by mail on receipt of price.

No. 1. Cuts over 5 inches $1.50
" 2. " " 8 " 2.00

S. TAUSSIG, 45 River St., Chicago. WESTERN AGENT.

EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, Brooklyn, E. D., N. Y.

HARD PORCELAIN ELECTRICAL SUPPLIES,

— INCLUDING —

Switch Bases, Cut-Out Boxes, Cleats, Circuit Breakers, Bushings, Knobs and other Insulators.

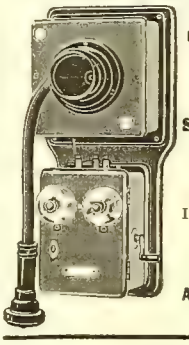
The body of our goods is made non-conductive. Our ware is the most dense and is consequently the most non-absorbent that can be produced, being the TRUE HARD PORCELAIN.

73-75 W. Jackson St.
RELIABLE

WE ARE FITTED WITH RELIABLE Machinery and Tools, And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.



THE STANDARD

TELEPHONE!

Non-Electric, and only one Adjustable to Atmospheric Changes.

SOLD OUTRIGHT with "PEERLESS INSULATORS."

For Private Short Lines, For Connecting Factory and Office, Residence and Store, Stable, etc., etc.

Plainest Speaking! Superior to Others! Highly Recommended!

Intending purchasers will do well to investigate it before buying elsewhere.

THE BOSTWICK & BURGESS MFG. CO.,

NORWALK, OHIO, U. S. A.

ACTIVE MEN AND BUSINESS HOUSES can secure valuable territory in which to take orders and put up lines.

ELECTRICAL BOOKS

OF ALL KINDS.

Send for Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building CHICAGO, ILL.

A NEW BOOK.

NOW READY.

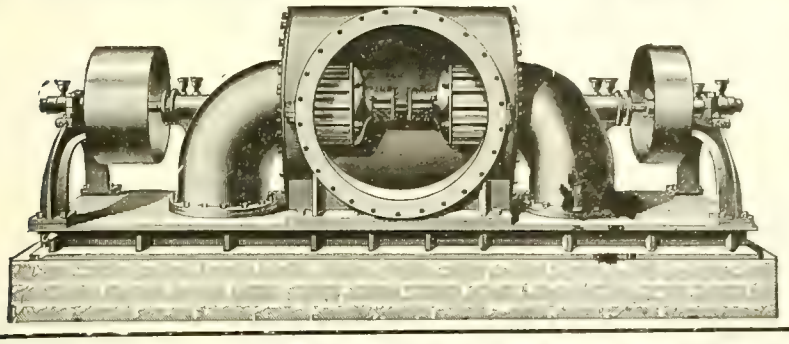
ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES [illegible] to the **CELEBRATED WATER WHEEL** [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** [illegible] diameter, being **double** the **Power** of most wheels of [illegible] number of the leading electric companies [illegible] ical use of water it is without an equal, producing the [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no [illegible] are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Casting [illegible] Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ALUMINUM

IN ALLOYS 75c. PER POUND.

Aluminum in alloys equal in purity to any on the market 75c. per pound for the contained Aluminum.

Cowles' Pure Aluminum in ingots is offered as low as that of any American concern; quality guaranteed.

THE COWLES

Electric Smelting & Aluminum Co.,

LOCKPORT, N. Y.

HARRISON CONVEYOR

FOR HANDLING

Grain, Coal, Tan Bark, Seeds, Etc.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One Hundred and Fifty Tons of Coal per hour Made of Wrought Iron and Steel. Send for Illus. Catalog. **BORDEN & SELLECK CO., 48 and 50 Lake St., Chicago, Ill.**

J. C. TEMPLE,

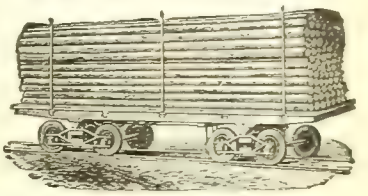
(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO.

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

THE SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

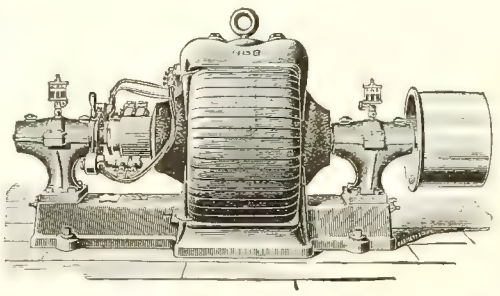
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS.

WIRES.

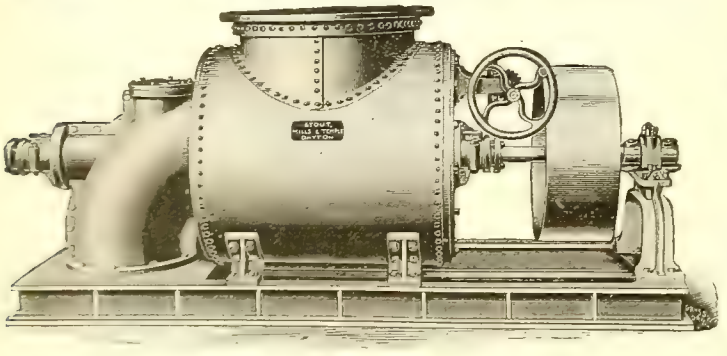
You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK.

G. H. MEEKER, Western Manager.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.

JOHN STEPHENSON CO.,

LIMITED,

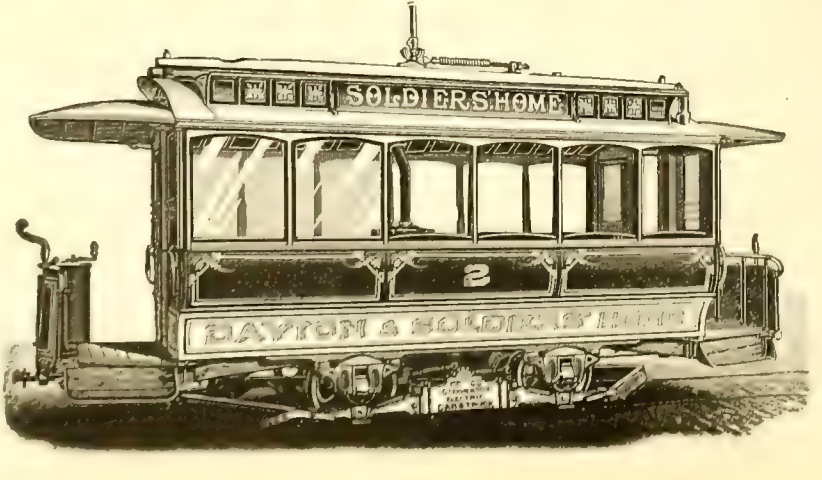
NEW YORK.

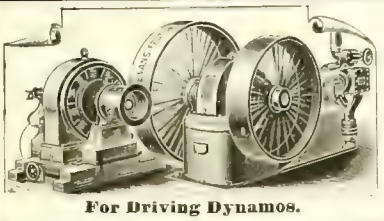
STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.





For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.

Evans' Cones. For Varying Speed.

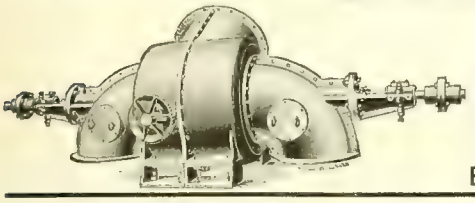
TURBINE WATER WHEELS,

Horizontal AND Vertical.

MANUFACTURED BY

RODNEY HUNT MACHINE COMPANY.

SPECIALTIES FOR ELECTRIC LIGHT AND POWER.



Double the power of most wheels. **High speed. Belting** directly to dynamo. **Efficiency,** .9050. Holyoke Testing Flume. **Easy working gate. Even speed** Excellent workmanship, great durability. **Moderate prices** and satisfaction in every respect guaranteed. 1,800 wheels sold in New England One party has 87 of these wheels in use; another 6,800 h. p.; another 7,200 h. p., etc., etc. Large number of wheels furnished for Electric Lighting All giving perfect satisfaction. Write for catalogue and estimates on proposed plants.

Boston Office, 70 Kilby St. Main Office and Works, ORANGE, MASS., U. S. A.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

A MODEL RAILWAY.

The Burlington Route, C., B. & Q. R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

TRIPOD BOILER

Three Points of Superiority Guaranteed: Safety, Economy, Low First Cost

Repeated tests prove that it is absolutely Non-Explosive and the most Durable ever made.

Strong testimonials from hundreds of users, in all parts of the country.

Sizes 10 to 1,000 H. P.

For full information address,

HAZELTON TRIPOD BOILER CO.

809 Monon Block., CHICAGO, ILL.

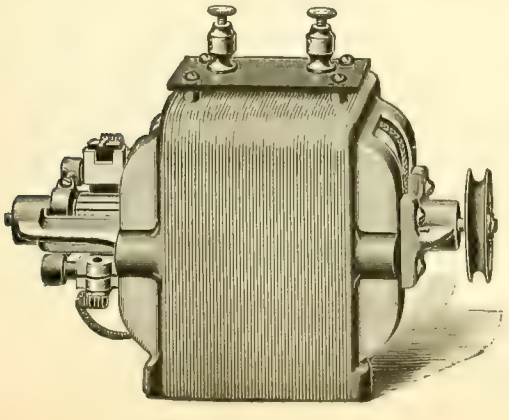
WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

OKONITE TRADE MARK

SOUTHERN ELECTRICAL SUPPLY CO.,

823 Locust St., ST. LOUIS, MO.,

Okonite Wires AND Cables.

AGENTS FOR THE CELEBRATED PACKARD LAMP.

Made to Fit any Socket.

We also have a full stock of Sockets made to fit any Lamp.

SEND US A TRIAL ORDER.

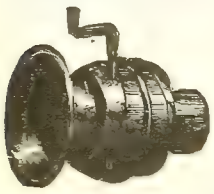
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

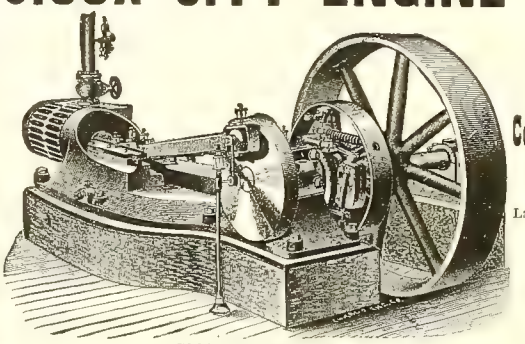
W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

SIOUX CITY ENGINE WORKS.



Giddings' Automatic.

Builders of High Grade

AUTOMATIC ENGINES

from 30 to 500 H. P.

OF BOTH THE

Corliss and Giddings' Types.

Boilers and complete Steam Plants erected. Send for circulars and estimates.

Largest Engine Works west of the Mississippi River at

SIOUX CITY, IOWA.

S. K. GREGG,

Manager Chicago Office,

48 S. Canal St.

C. S. LEWIS, Agent,

703 Market St., St. Louis, Mo.

THE WOODBURY ENGINE

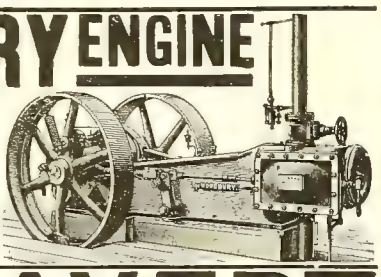
SELF-CONTAINED, AUTOMATIC

HIGH SPEED STEAM ENGINE

for Electric Lighting and Street Railway Service,

WITH BOILER PLANT COMPLETE

— Catalogue sent on application. —



STEARNS MFG. CO. ERIE, PA.

BRANCH OFFICES: Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.

WESTINGHOUSE ENGINES

USED BY THE FOLLOWING GOVERNMENTS.

UNITED STATES.

U. S. Torpedo Station, Newport, R. I., 43 H. P.
U. S. Army Department, San Antonio, Tex., 50 H. P.
U. S. Engineer Corps, St. Louis, Mo., 8 H. P.
U. S. Military Post, Fort Canby, Wash., 4 H. P.
U. S. Government Quartermaster Department, Vancouver, Wash., 62 H.P.
U. S. Government Quartermaster Department, New Orleans, La., 15 H. P.
U. S. Senate, Washington, D. C., 150 H. P.
U. S. House of Representatives, Washington, D. C., 75 H. P.
U. S. Government Ice Factory, San Antonio, Tex., 4 H. P.
U. S. Navy Yard, Norfolk, Va., 125 H. P.
U. S. Navy Yard, Brooklyn, N. Y., 125 H. P.
U. S. Government, Ellis Island, N. Y., 120 H. P.
U. S. Dispatch Boat "Lucerne," Norfolk, Va., 50 H. P.
Washington Monument, Washington, D. C., 25 H. P.
MEXICAN: State of Guerrero, 15 H. P.
JAPANESE: In Government Coal Mines, 150 H. P.
HOLLAND: Government Physical Laboratory of Leiden, 15 H. P.
RUSSIAN: Moscow Imperial Technical School, 10 H. P.
NEW SOUTH WALES: Government of New South Wales, 160 H. P.
TASMANIAN: Alexandria Battery, Hobart, 75 H. P.
ENGLISH: Number unknown. Details not reported. Over 30 engines.

Many others sold by agents, but not reported.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH. PENNA. U.S. OF A.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

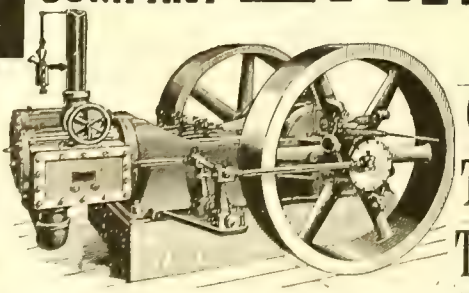
POND ENGINEERING COMPANY,

ST LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC, CUT-OFF

ENGINE.



Simple.

Cross Compound.

Triple Expansion.

Tandem Compound

THE BALL ENGINE CO. Ball Engine REGISTERED TRADE MARK ERIE, PA.

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER, 38 South Fourth St., Philadelphia, Pa.; COOLEY & VATER, 224 Washington Ave. So., Minneapolis, Minn.; W. B. PEARSON, Room 403 Home Insurance Bldg., Chicago, Ill.; BRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; CHAS. K. SHERMAN, New England Bldg., Kansas City, Mo.; NORTH-WESTERN SUPPLY CO., Tacoma, Wash.

STANLEY ELECTRIC MFG. CO.

TRANSFORMERS.

Compare these weights with weights of other transformers:

5 light,	48 lbs.
10 light,	65 lbs.
20 light,	85 lbs.
30 light,	101 lbs.
40 light,	130 lbs.
100 light,	300 lbs.

A. C. FAN MOTORS.

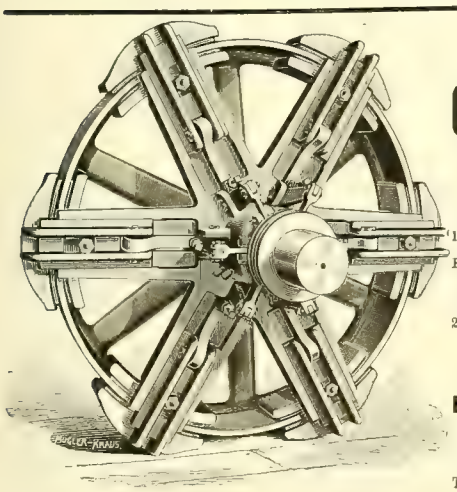
SMALL,
NOISELESS,
RELIABLE.

Less than 1½ Amperes required to drive it.

Price, $20.00.

PITTSFIELD, MASS.

Chicago Agents: THE ELECTRICAL SUPPLY CO., 102 Michigan Ave.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
118 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS
Designed, Erected and Furnished.

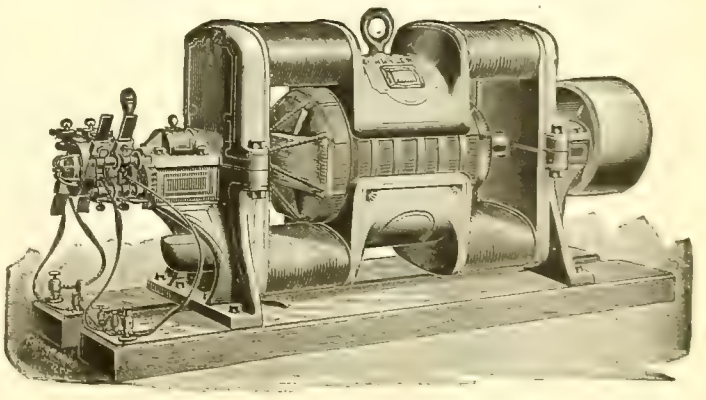
Send for new Catalogue Power Transmission Machinery.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:

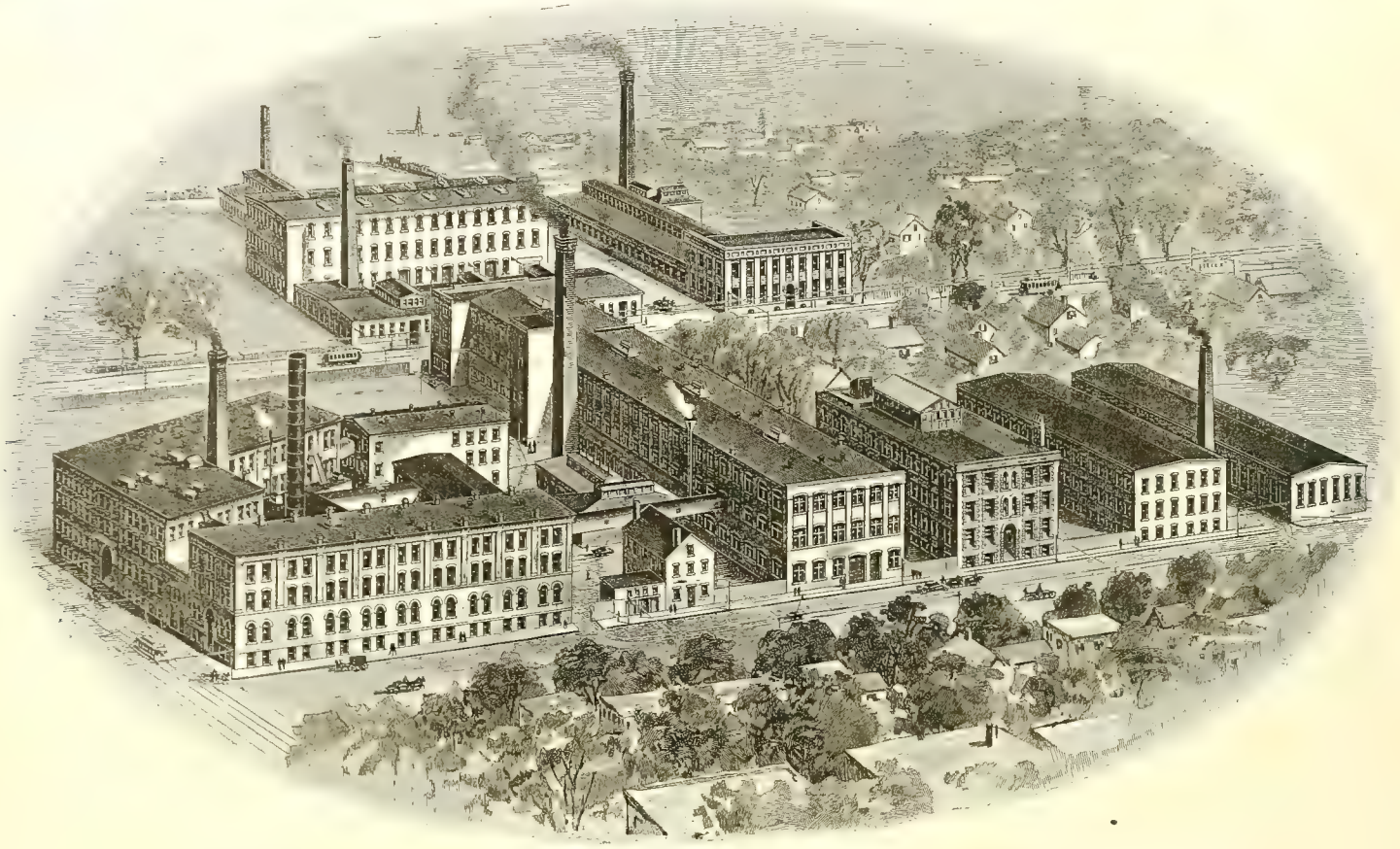


Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.

The KNAPP ELECTRICAL WORKS,

GENERAL AGENTS FOR

"SAFETY"

WIRES, CABLES AND CORDS

For Inside, Underground and Submarine Use.

"SAFETY" Fire-Proof House Wire. "ATLAS" Line Wire.

R. B. WATSON & CO., Agts., DETROIT, MICH.

J. W. MASON, Agt., 527 Delaware Street, KANSAS CITY, MO.

POST & CO., Agts., CINCINNATI, O.

THE PERKINS ELECTRIC LAMP CO.

LAMPS

TO FIT ANY SOCKET.
ANY CANDLE POWER.
ANY VOLTAGE.
LONGEST LIFE.
HIGH EFFICIENCY.

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

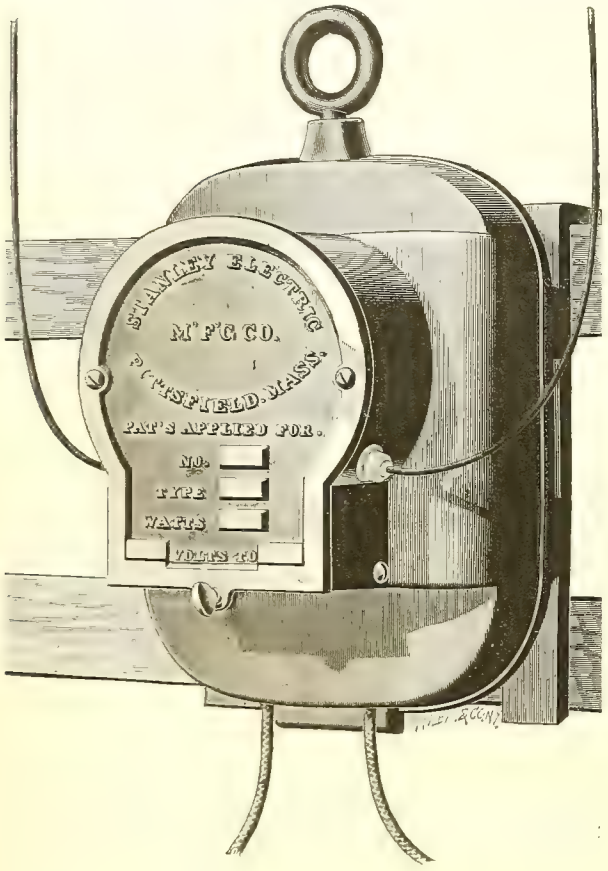
54 and 56 Franklin Street, CHICAGO.

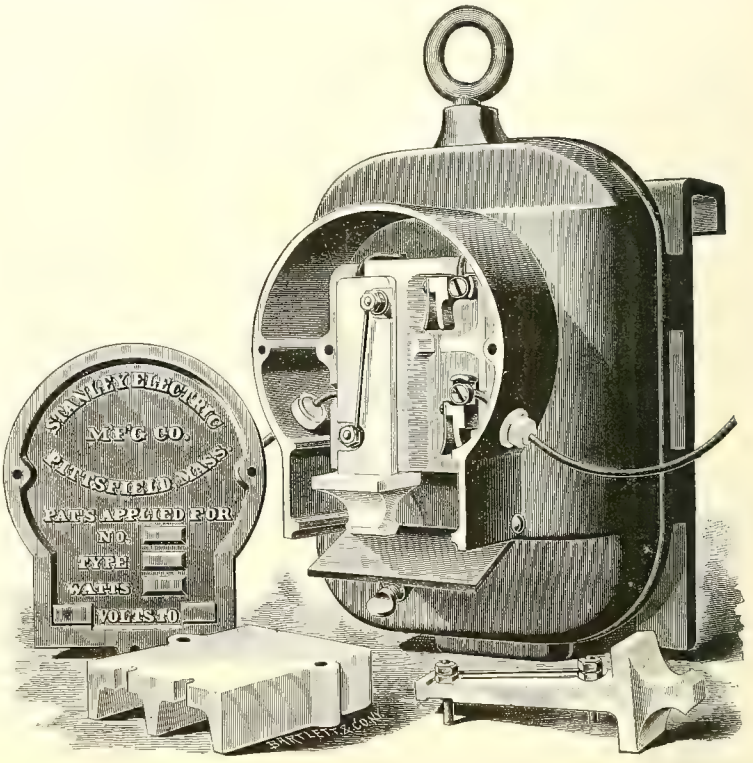
SEND FOR CATALOGUE.

THE ELECTRICAL SUPPLY CO.

171 RANDOLPH ST. CHICAGO.

102 and 104 MICHIGAN AVENUE.





We say that the "Stanley" is the most efficient Transformer made, but the best way for you to back our judgement is to try one. This we will be glad to have you do, and if they are not as we claim, it costs you nothing. We stand behind the returns.

Try a No. 8 capacity 40 16 c.p. lamps.

We have had several struck by lightning but none damaged the fuse did the rest.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive, and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush invention.

ARC LIGHTING APPARATUS,
ELECTRIC MOTORS AND GENERATORS,
ALTERNATING CURRENT APPARATUS.
INCANDESCENT LIGHTING MACHINES,
CARBONS FOR ARC LIGHTING,
ETC, ETC, ETC.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

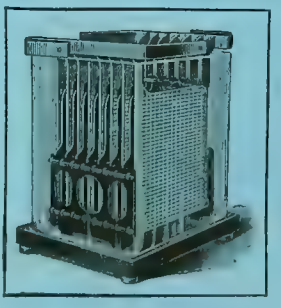
SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

FACTORIES AND GENERAL OFFICES, BALTIMORE, MD.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
Central Station and Isolated Lighting.
Portable Lighting or Power.
Portable Electric Lanterns.
Electric Power for Motors.
Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR COMPANY,

224 and 226 Chestnut Street, Philadelphia, Pa.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 and 226 Chestnut St.
NEW YORK:—TRUEX & VAIL, 44 Broadway. CHICAGO:—WM. HOOD, 239 La Salle St.
SAN FRANCISCO:—THE PACIFIC ELECTRICAL STORAGE CO., 118 and 120 Pine St.
BOSTON:—THE HOLTZER-CABOT ELECTRIC CO., 111 Arch St.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, JULY 25, 1891. No. 4

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building, - - CHICAGO.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN

EVERYTHING ELECTRICAL.

SEND FOR 256-PAGE CATALOGUE.

111 Arch Street, BOSTON, MASS.

SPECIAL AGENCIES: CLOWER & HARRIS, Dallas, Texas. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.

A full line of our manufacture can be found at our Agencies.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes
Telephonic transmission through Our Cable an easy
GAME.

An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices.
Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Nuttall Trolley. Patents Pending.

THE BEST!

$30.00

WRITE US.

Electric Railway Specialty COMPANY,
29 Broadway,
NEW YORK.

KELLOGG

COMBINATION STEEL CENTER AND SIDE

POLES.

ENGINEERING EQUIPMENT CO.,
SOLE AGENTS,
NEW YORK, 143 Liberty St.
BOSTON, 126 Pearl St.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.

F. CAZENOVE JONES, Manager of Factories.

The International OKONITE COMPANY, LIMITED.

13 Park Row, New York.

OKONITE TRADE MARK

INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP

AGENTS
J. W. PEALE, 1 BROADWAY, NEW YORK.
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.* Concealed Wiring in all Locations.
Aerial Use, Subterranean Use, Submarine Use.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

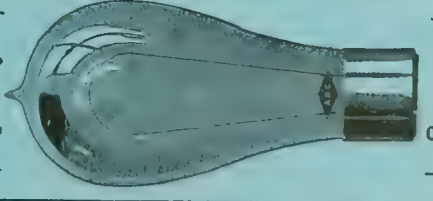
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,

20 CORTLANDT ST., NEW YORK.

GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."



WRITE US FOR PRICES OF ALL GOODS.

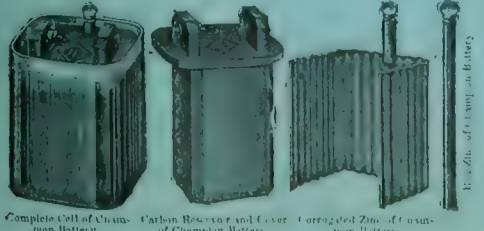
THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,

MANUFACTURERS, IMPORTERS AND DEALERS IN

THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.

THE TRADE WILL BE PROPERLY PROTECTED.



Complete Cell of Champion Battery. Carbon Resistor and Cover of Champion Battery. Corrugated Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,
11 ADAMS STREET, CHICAGO.
W. R. MASON, General Manager.

IS THE THOMSON-HOUSTON ELECTRIC CO.'S SYSTEM OF LIGHTING A SUCCESS?

Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, 1,653 Lamps.	None.	None.

Cut of Factory, 1886.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, 21,840 Lamps.	29 Companies, 11,275 Lamps.	None.

Read the Answer on Page xx.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....—
Abendroth & Root Mfg. Co.... xiii
Alexander, Barney & Chapin..... i
American Electrical Works..... xi.i
Andrews & Co., A. H.....xiv
Automatic Switch Co..... x
Baggot, E.....xiv
Bain Electric Mfg. Co..... vii
Ball Engine Co.....xviii
Barton & Brown..... xiv
Baxter Electric Motor Co.....xxiv
Beardsley, Chas. S., Receiver.. xix
Bernstein Electric Co.....iv
Blatz, L.....xiii
Borden & Selleck Co.....xv
Braun Illustrating Co.....xviii
Brownlee & Co..... xii
Brookfield, Wm..... xii
Brush Electric Co..... xvii
Butler Hard Rubber Co.....viii
C. B. & Q. R. R..... xvii
C. & C. Electric Motor Co. ... xvi
Card Electric Motor & Dynamo Co.....iv
Central Electric Co..... ... v
Chicago Electric Mfg. Co..... xiv
Chicago Insulated Wire Co.... xvii
Cleverly Electrical Works... ...iv
Colburn & Co., I. W. xiv
Coolidge, Fuel & Supply Co.... viii
Cowles Electric Smelting and AluminumCo.....xv
Crocker-Wheeler Electric Motor Co..... .xiii
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co. xvii
Eastern Electric Cable Co.....xiii
Easton Electric Co.....xiii
Edison General Electric Co.,—Motor Dept..... .vi
Edison General Electric Co, Wire Department..... vii
Electric Construction & Sup. Co. viii
Electric Merchandise Co.....i
Electric Secret Service Co..... iv
Electric Railway Specialty Co.....i
Electrician Pub. Co..... .vii
Electrical Construction Co., The. xiii
Electrical Engineering Co.....xiii
Electrical Supply Co., The....xxii
Elektron Mfg. Co..... xvi
Empire China Works..... .xiv
Engineering Equipment Co.....i
Evans Friction Cone Co..... xvii
For Sale.....xiii, xiv
Fort Wayne Electric Co..... xxiv
Freeman, Coleman & Co.....—
Globe Carbon Co.... xv
Great Western Electric Supply Co..... x
Greeley & Co., The E. S.....i
Hazelton Tripod Boiler Co.....xviii
Heisler Electric Light Co.....xvii
Hill Clutch Works.....—
Hine Elimnator Co..... xii
Holmes, C. H.....xiii
Holmes, Booth & Haydens..... iv
Holtzer-Cabot Electric Co.....i
Hood, Wm..... x
Hunt Machine Co.,Rodney.....—
India Rubber & Gutta Percha Insulating Co.....—
Interior Conduit & Insulation Co.. xii
International Okonite Co.....i
Kartavert Mfg. Co..... xii
Knapp Electrical Works..... xxi
Law Telephone Co..... xiii
Leffel & Co., Jas.....xiii
Loud, H. M. & Sons Lumber Co xiv
McLaughlin, James xiv
Mason, James H.....xiii
Mason, J. W..... iv
Milliken Bros.....iv
Minneapolis Street Railway Co..xxiii
Monitor Electric Co x
Munsell & Co., Eugene.....xiii
Murphy, T. J.....xiv
National Carbon Co.....iv
National Electric Mfg. Co.....ix
N. Y. Belting & Packing Co..... xii
New York Insulated Wire Co.. xvi
New York & Ohio Co..... i
Northwestern Electrical Specialty Co..... xiv
Ohio State University..... xiii
Ostrander & Co., W. R.....xviii
Paiste, H. T..... xii
Page Belting Co.....—
Partrick & Carter Co..... x
Payne & Co., Geo. W.....—
Pearson & Co., W. B.....xviii
Phoenix Glass Co.....—
Pond Engineering Co.....xviii
Powell Co., The Wm..... xiv
Queen & Co..... xiii
Rockford Electric Mfg. Co.... —
Roeblings' Sons Co., Jno. A....—
Sargent & Lundy..... i
Sawyer-Man Electric Co.....xi
Schieren & Co. Chas. A..... xii
Schoonmaker, A. O..... xii
Schuyler E'ectric Co..... xxiv
Short E'ectric Railway Co..... xii
Shultz Belting Co..... xiv
Sioux City Engine Works..... —
Southern Electrical Supply Co.xviii
Standard Underground Cable Co....i
Standard Paint Co.....xii
Stanley Electric Mfg. Co.....—
Star Iron Tower Co..... viii
Stearns Mfg. Co.....xviii
Stephenson Co., Jno.....xvi
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co xv
Taussig, S.....xiv
Temple, J. C..... xv
Thomson-Houston Electric Co. Lighting Department ..... ii, xx
Turner Brass Works..... xiii
Union Elec. Mfg. Co., The..... vii
Union Electric Works.....xiii
Union Hardware Co.....xii
United States Electric Lighting Co.....—
Van Nuis C. S.....—
Vulcanized Fibre Co..... xv
Wanted ..... xii, xiii
Wenstrom Consolidated Dynamo & Motor Co., The x
West End Street Railway Co.. xiv
Western Electric Co.....viii
Westinghouse Electric and Mfg. Co.....xi
Westinghouse Machine Co.... xviii
Weston Electrical Instrument Co.....—
Williams Engine Works.....xviii
Woodbridge & Turner Engineering Co xv
Worthington, Henry R.....—

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Southern Electrical Supply Co.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Beardsley, Chas. S.
Central Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co, Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Southern Electrical Supply Co.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.
West End Street Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
BainElectric Mfg. Co.
Chicago Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Engineering Equipment Co.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.
Williame Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Beardsley, Chas. S.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Monitor Electric Co.
Southern Electrical Supply Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Beardsley, Chas. S.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Southern Electrical Supply Co.
Union Electric Manufacturing Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Colburn & Co., I. W.
Easton Electric Co.
Electrical Engineering Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.
Union Electric Works.

Electric Railways.
Edison General Electric Co.
Sargent & Lundy
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrolliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Sioux City Engine Works.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Beardsley, Chas. S.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Easton Electric Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
Northwestern Electric Specialty Co
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Southern Electrical Supply Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phoenix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Beardsley, Chas. S.
Brookfield, Wm.
Butler Hard Rubber Co.
Central Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Mason, J. W.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Southern Electrical Supply Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Monitor Electric Co.
New York and Ohio Co.
Sawyer-Man Electric Co.
Southern Electrical Supply Co.
Sunbeam Incandescent Lamp Co.
Wenstrom Consolidated Dynamo & Motor Co

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co, The Wm

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica
Manufacturing Co.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Electric Construction & Supply Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co.
Elektron Manufacturing Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Son- Lumber Co.
Southern Electrical Supply Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Beardsley, Chas. S.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
West End Street Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Universities.
Ohio State University.

Wire, Bare.
American Electrical Works.
Beardsley, Chas. S.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

Cleverly 1018 CHESTNUT ST. PHILA

Electric Specialties.

—WE MAKE—

Electric Supplies Under Contract.

J. W. MASON,

DEALER IN

GENERAL ELECTRICAL SUPPLIES,

INCANDESCENT LAMPS, SHADES AND SHADE HOLDERS.

527 Delaware St., KANSAS CITY, MO.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY **MILLIKEN BROS.**

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

THOMAS STURGIS, President. **WM. C. LANE, Secretary and Treasurer.** **C. P. MACKIE, General Manager.** **S. S. BOGART, General Agent.**

ELECTRIC SECRET SERVICE CO.,

45 BROADWAY, NEW YORK.

Owning the patents of Mosher, Gill, Hatch, Foote, Kintner and Moore for

INDIVIDUAL TELEGRAPH CALL AND CUT-OUT APPARATUS.

OTHER PATENTS PENDING.

The only practical and reliable system of electric selection invented.

Use either ***Morse Key*** or ***Automatic Transmitter.***

From every station selected an ***Automat'c Answer back*** is received.

Going ringer cut off by operator.

Any other line can be selected without disturbing the others and either called up or cut out. No interference with regular telegraph service. No resistance added to main line. Easily applied. Economical. Convenient. Reliable.

Applicable to arc lights, singly or in groups; fire alarm service; police telegraph; electric motor circuits; railroad signals, etc.

The public is warned against infringing companies and devices.

For terms and other particulars, address as above.

FAN MOTOR,

—MANUFACTURED BY—

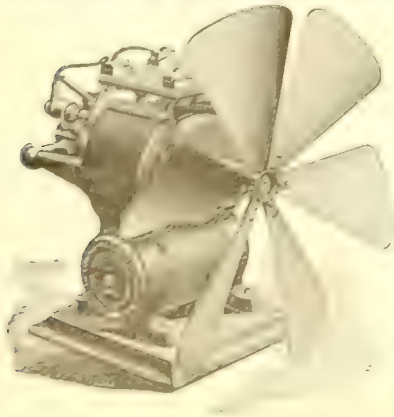
The Card Electric Motor and Dynamo Co.,

Cincinnati, Ohio,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits, from 1-6 to 50 H. P.

Correspondence Solicited.



AGENTS

BOSTON—The Eastern Electrical Supply & Construction Co., 45 Oliver St.

CHICAGO—The Thos. L. Johnson Co., 312 Dearborn St.

MILWAUKEE—Henry Hammen, 631 Third St.

WASHINGTON, D. C.—J. Geo. Gardner, 1405 H St.

ATLANTA—Southern Electrical Engineering Co., 24 Peachtree St.

MONTGOMERY, ALA.—E. P. Murphy

DETROIT, MICH.—The Michigan Electric Co., 253 Griswold St.

MINNEAPOLIS, MINN.—A. M. Lennon, No. 45 Lumber Exchange Building.

BERNSTEIN ELECTRIC CO.

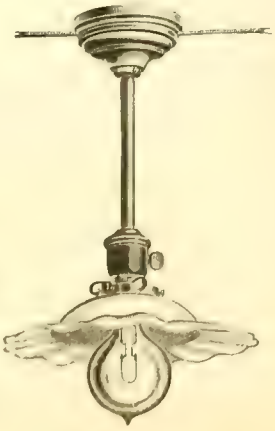
INCANDESCENT LAMPS

—FOR—

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

Our St. Louis Branch:
Southern Electrical Supply Co.,
OKONITE
TRADE MARK.
823 Locust St.,
ST. LOUIS, MO.

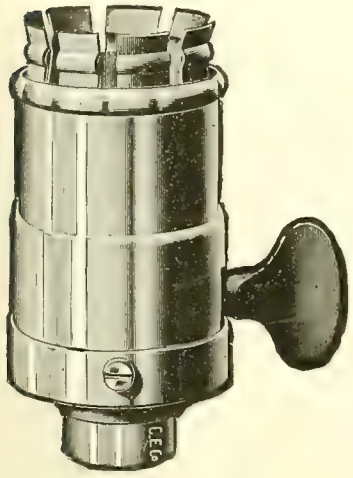
SOCKETS.

BEST IN THE WORLD.

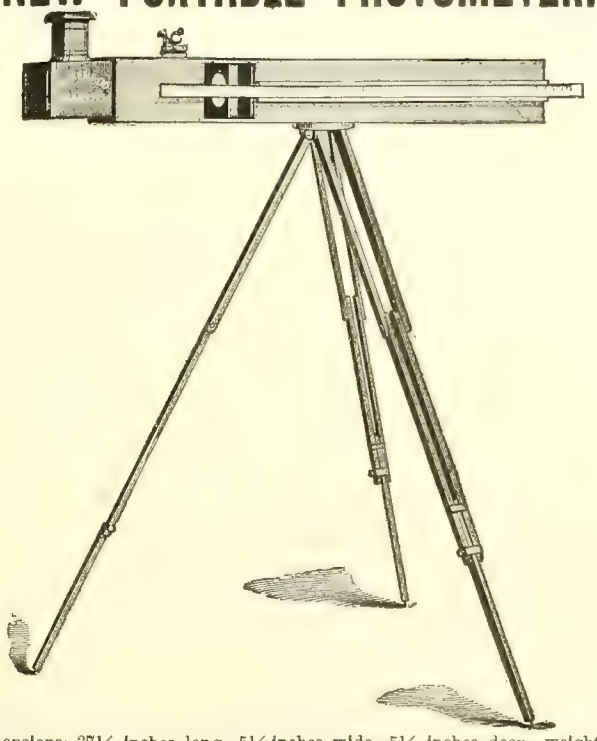
BRYANT'S INCOMBUSTIBLE SOCKETS.

Our Kansas City Branch:
Gate City Electric Company,
OKONITE
TRADE MARK.
522 Delaware St.,
KANSAS CITY, MO.

The insulating parts of these Sockets are made of porcelain, and they contain nothing that will burn. They are handsomely finished, and are unquestionably the best Sockets now on the market. Made especially for Thomson-Houston, Sawyer-Man and Edison Lamps.



NEW PORTABLE PHOTOMETER.



Dimensions: 37½ inches long, 5½ inches wide, 5½ inches deep; weight, 13 pounds. Complete of finely polished Cherry, with Lantern, Measuring Bar and Tripod. Just the thing to determine whether your lamps are burning up to candle power or not, and indispensable in determining the wattage of lamps.

General Western Agents for

OKONITE

—AND—

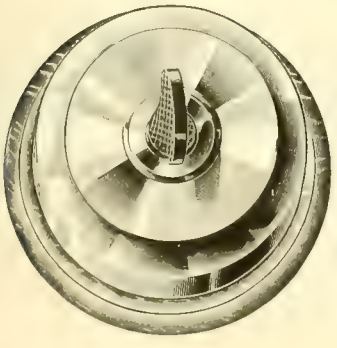
IMPROVED

CANDEE WIRES.

HEADQUARTERS

FOR ALL

ELECTRICAL SUPPLIES.



PAISTE SWITCHES.

We can quote low on a large stock of Paiste Switches.
Get our prices before ordering elsewhere.

Our Omaha Branch:
Western Electrical Supply Co.,
OKONITE
TRADE MARK.
418 S. 15th St.,
OMAHA, NEB.

CENTRAL ELECTRIC COMPANY,

116 & 118 Franklin Street,

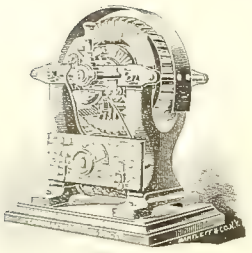
CHICAGO.

Connected by Private Wire with Postal Telegraph-Cable Company's System.

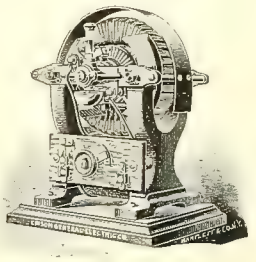
Our Denver Branch:
Electric Power Transmission Co.,
OKONITE
TRADE MARK.
1722 Lawrence St.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.



NEW



ELECTRIC MOTORS.

MINIMUM OF ATTENTION AND REPAIR.

Highest Efficiency,
Slow Speed,
No Sparking.

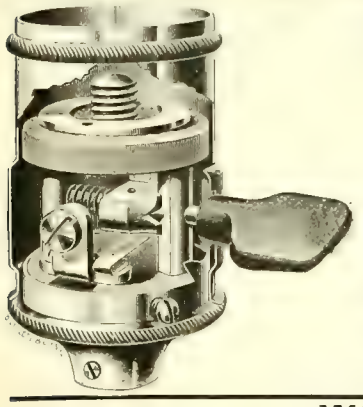
H. P.	LIST PRICES.	PRICES TO USERS, 45 PER CENT. OFF LIST.
1-12	$ 40	$22.00
1-6	60	33.00
1-3	100	55.00
1-2	125	78.75

Independent Coils,
Improved Lubrication,
Mechanically Perfect.

SEND FOR DESCRIPTIVE CIRCULAR TO NEAREST DISTRICT OFFICE.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.



SOCKETS, SWITCHES, CUT-OUTS.

The Union Electric Mfg. Co.,

BRIDGEPORT, CONN., U. S. A.

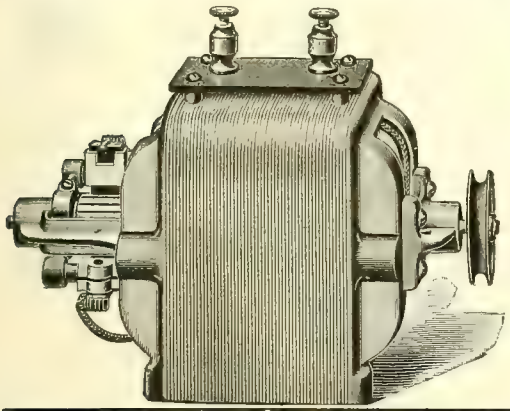
WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

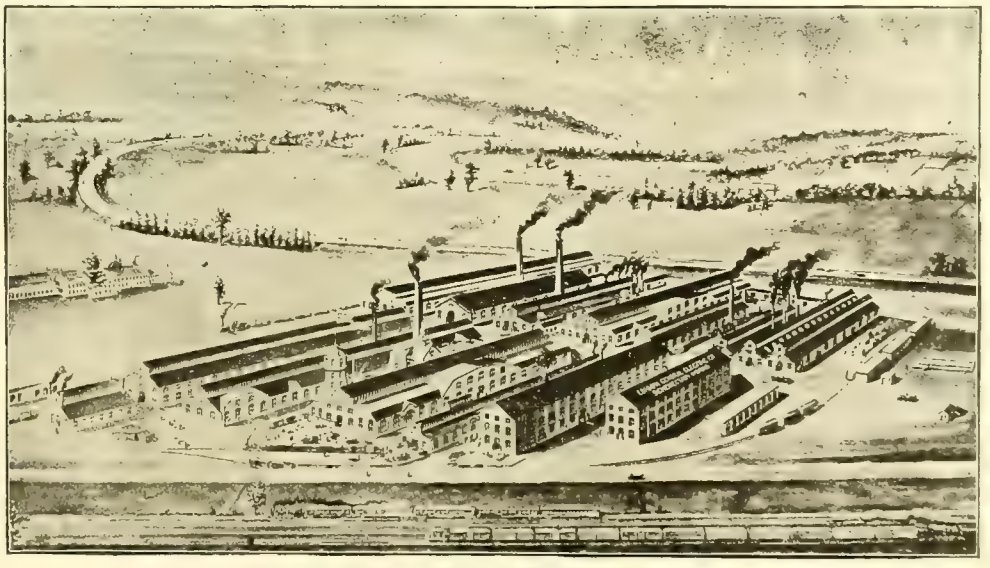
SEND FOR CATALOGUE.

SIEMENS CABLES.

Submarine,

Telegraph,

Underground,



Telephone,

Interior,

Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Wire Department, Edison General Electric Company,

EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

BEST MAST ARM IN USE.

More Lamps Trimmed. No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRON TOWER CO., FORT WAYNE, IND.

SEND FOR New American Electrical Directory, just published; very complete lists. Invaluable for its information of Lighting and Railway Plants.

COOLIDGE FUEL & SUPPLY CO.,
CEDAR AND OCTAGONAL PINE POLES.

Railroad Cross Ties and Piling.

Cross Arms, Pins and Brackets, Manufactured by J. R. CLARK CO.,
MINNEAPOLIS, MINN.

To Electric Railway Companies:

We shall be pleased to make you quotations on Washburn & Moen's hard drawn copper trolley wire, and our own make of Weatherproof insulation feeder wires. Our Weatherproof wire is superior to any other wire of like character in the market.

WESTERN ELECTRIC COMPANY, CHICAGO. NEW YORK.

"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

WE GUARANTEE OUR LAMPS ELECTRICALLY AND MECHANICALLY.

In corresponding please give full particulars and state voltage.

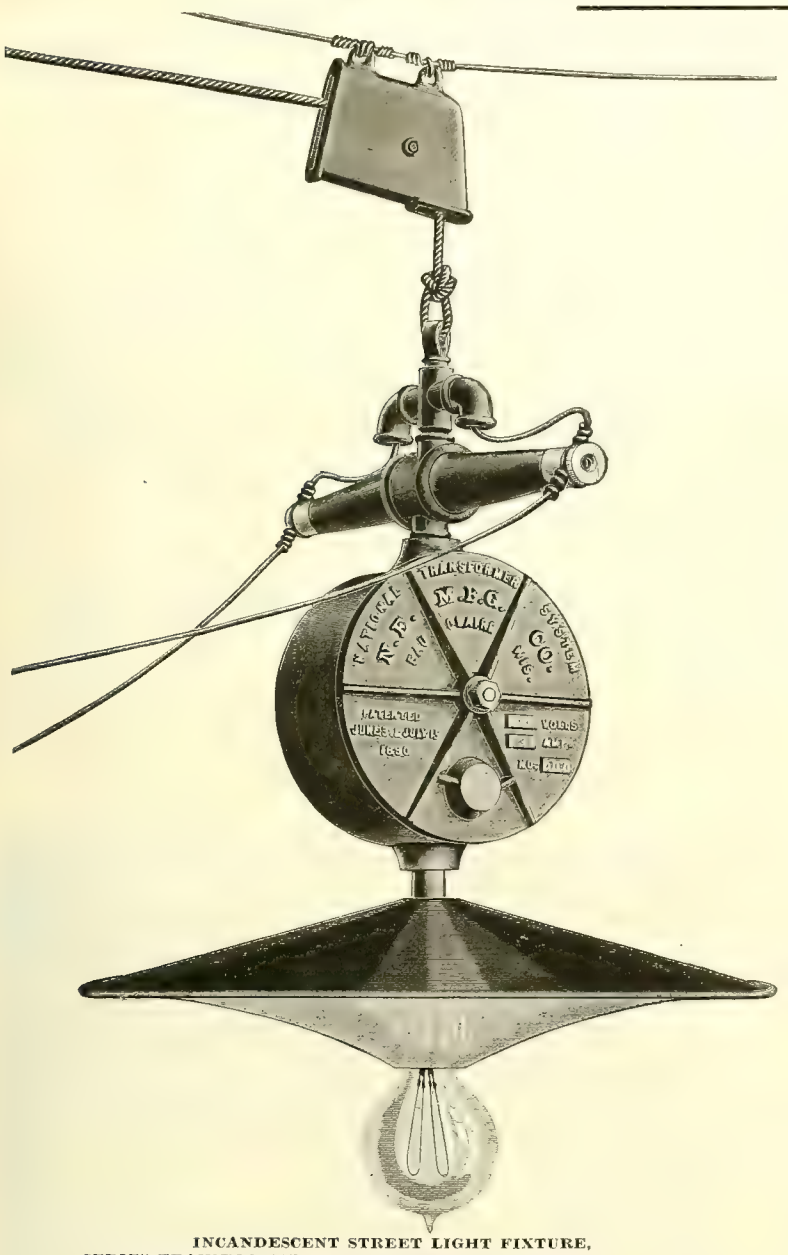
ELECTRIC CONSTRUCTION AND SUPPLY COMPANY,

Phenix Bldg., CHICAGO, ILL. · 18 Cortlandt St., NEW YORK CITY.

ESTABLISHED 1881.

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



INCANDESCENT STREET LIGHT FIXTURE,
SERIES TRANSFORMER, REFLECTOR CANOPY AND 32 C. P. LAMP.

WHY

USE ARC LAMPS

WHEN THE

NATIONAL

SERIES TRANSFORMER

ENABLES YOU TO DO

STREET LIGHTING

ECONOMICALLY
EFFICIENTLY
SATISFACTORILY ???

Send for Circulars and Prices.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

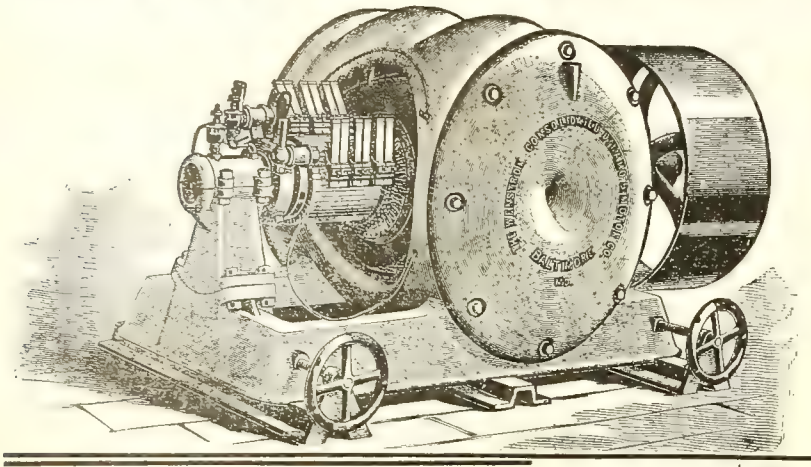
AGENTS:

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	**ST. PAUL, MINN.,**	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	**DETROIT, MICH.,**	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	**DENVER, COLO.,**	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	**WINNIPEG, MAN.,**	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	**SAN FRANCISCO, CAL.,**	National Electric Development Co.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords, in fact, every kind of Wire known to the Electrical Trade.

REMOVAL

August 1, 1891, We will Remove from 190 Fifth Ave. to

201, 203, 205 and 207 S. CANAL STREET,

Where we have secured larger and more commodious quarters.

GREAT WESTERN ELECTRIC SUPPLY CO.,

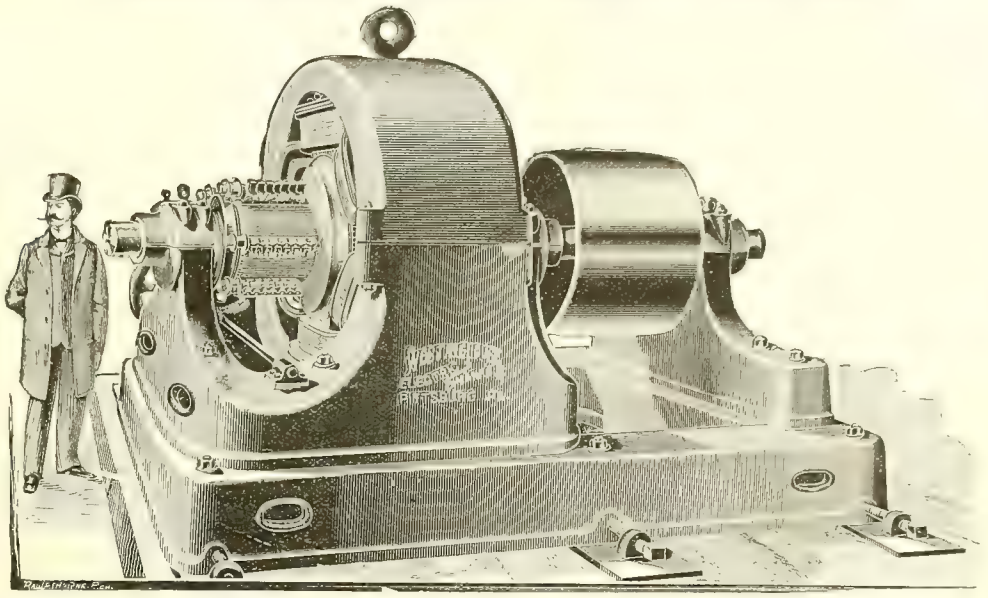
CHICAGO, U. S. A.

WESTINGHOUSE
MULTIPOLAR STREET RAILWAY GENERATORS.

COMPOUND-WOUND. SELF-EXCITING.

Perfect Self-Regulation.

High Electrical Efficiency.



Slow Armature Speed.

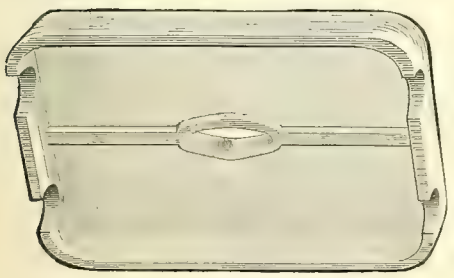
No External Magnetism.

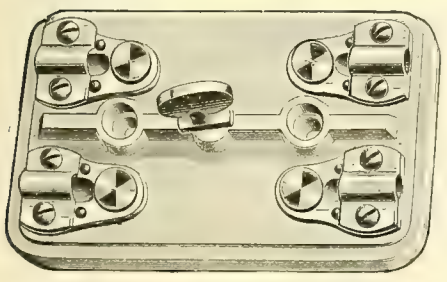
Self-Oiling Bearings.

Descriptive Catalogues of Generators, Single-Reduction and Gearless Motors, and Power Station Appliances furnished upon application. Correspondence on all subjects connected with Electric Railways is solicited.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,
RAILWAY DEPARTMENT,

PULLMAN BUILDING, CHICAGO. PITTSBURGH, PA. 120 BROADWAY, NEW YORK.

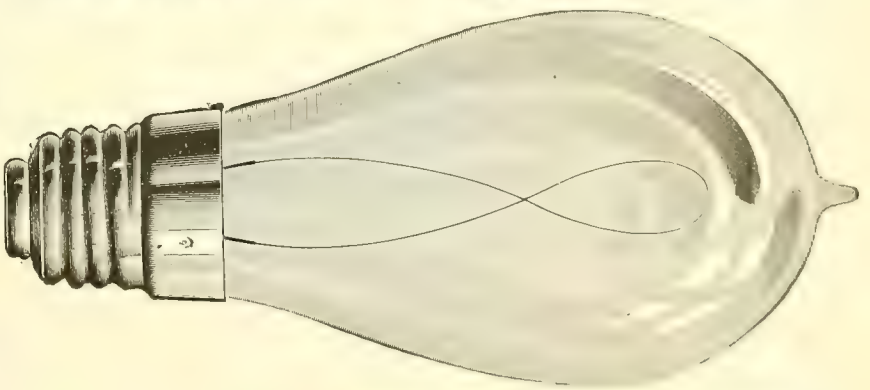




CUT-OUTS,
Single Light, Main and Branch,
OF SUPERIOR PORCELAIN,
With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS. 510-534 W. 23d Street, NEW YORK. 217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

MICA. For all Electric Insulating Purposes East In. ha Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

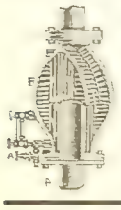
158 William St., NEW YORK.

WANTED.

A Specialty to Manufacture—Electrical preferred, or will sell my Foundry and Machine Plant on easy terms. Address

C. C. PAIGE,

Eagle Iron Works. **Oshkosh, Wis.**



KNOW WHAT YOU'RE GETTING!

HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

A test of six of the best known "Separators" has recently been made at Cornell University. **Hine's Eliminator stands at the head.** The full report with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street. NEW YORK.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

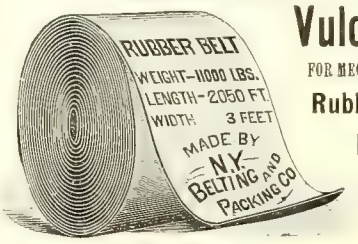
Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

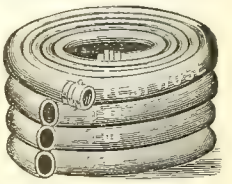
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 161 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 3d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 1624 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

THE ONLY GEARLESS MOTOR.

THE SHORT ELECTRIC RAILWAY CO., CLEVELAND, O.

THE NEW CATALOGUE

—OF THE—

UNDERGROUND CONDUIT SYSTEM

OF THE **Interior Conduit & Insulation Company**

IS NOW READY.

Copies mailed upon application to

INTERIOR CONDUIT & INSULATION COMPANY.

EDWARD H. JOHNSON, President.

WORKS, 527 to 531 W. 34th St. and 526 to 528 W. 35th St. GENERAL OFFICES, 42 & 44 BROAD ST., NEW YORK.

H. M. UNDERWOOD, Gen. Western Agent, Rookery Building, Chicago. B. FRANK JOHNSON, Gen. Agt. for Pa., Provident Bldg., Philadelphia, Pa.

THOS. DAY & CO., Gen. Agents for California, San Francisco, Cal.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

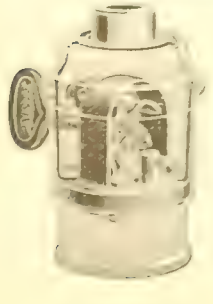
Subscribe for the Western Electrician.

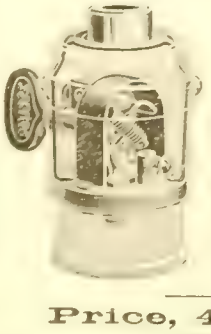
H. T. PAISTE,

Paiste Electrical Specialties.

241 THE ROOKERY, CHICAGO, ILL.

1201 MARKET ST., PHILADELPHIA, PA





PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

P AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, JULY 25, 1891. No. 4

Electricity in a Chicago Rolling Mill.

In these days of heavy currents and high voltages one's attention is drawn oftener to matters pertaining to electric power and lighting equipments than to the multitudinous small devices through which electricity becomes a most useful agent in the workshop or factory. The assertion may be ventured that a tour of the many manufactories in and about Chicago would reveal a number of ingenious applications of electrical apparatus, worked up by the amateur, perhaps, but doing good work nevertheless, and on this account deserving of more than a passing notice.

The tendency among manufacturers is to employ about their plants men of technical education, and these, coming oftentimes directly from schools at which the electrical engineering course receives the closest attention, are not long in finding a way of introducing improved and thoroughly scientific methods.

As an instance of what is being accomplished by a few of those who call themselves "amateurs," there may be mentioned two simple yet very useful applications of electricity now in service in the rail mill of the south works of the Illinois Steel company at South Chicago. The devices referred to are an electrical recording rail counter and an ingenious printing telegraph. The working of the two sets of apparatus will be understood by a reference to the illustrations.

From Figs. 1, 2, 3 and 4 there may be obtained a very clear idea of the construction and operation of the electric rail counter. By means of this mechanism and a few cells of battery a tally of the number of rails rolled is kept in the office of the superintendent.

Fig. 1 shows the location in the mill of the water-tight and heat-proof contact maker, or key, through which an electrical impulse is sent into the office to operate the register or counter proper. This last mentioned device, Fig. 2, consists merely of an electromagnet arranged, as shown, to operate a lever escapement connected with a train of gears so proportioned and numbered as to constitute a counter. The contact maker, shown in position in Fig. 1, is simplicity itself, and after a glimpse at the cuts, Figs. 3 and 4, showing the details, the reader will doubtless imagine that the construction was a comparatively easy task. For the benefit of the uninitiated, though, it must be stated that the position of the apparatus at the rail is such that it is subjected to about as hard usage as one could well imagine. Splashed with water and in the closest proximity to the red-hot rails, and thus alternately cooled and heated, it is not to be wondered that the present design of the waterproof casing inclosing the one moving part was arrived at only after much experience and several disappointments. As will be seen from Figs. 3 and 4, the contact lever proper is mounted on a short, stout spindle within a casing of 4-inch pipe. This upright spindle is keyed into and forms a part of another lever below and on the outside, which projects in front of the rail. The lever at the rail is kept in position by a spring as indicated. As the rails come along from the saws one after another, this lever is pushed outward and thus makes one contact for every rail. The simple arrangement by which a good rubbing contact is secured is so clearly illustrated that no further explanation is required.

The printing telegraph system illustrated by Figs. 5, 6, 7, 8 and 9, is, as a matter of course, more complicated than the counter. Its object is to print on a tape, at the finishing end of the mill, where the stamping machine is located, the heat numbers of the ingots, the ingot numbers, and the number of rails in each ingot, so that the proper heat and ingot numbers may be stamped upon every rail that leaves the mill. In addition to these numbers, the "pit" and "hole" numbers, i. e., the furnace numbers, are also dispatched.

The system in its entirety consists of a receiver, Fig 5, a transmitter, Fig. 6, three connecting wires and eight cells of gravity battery.

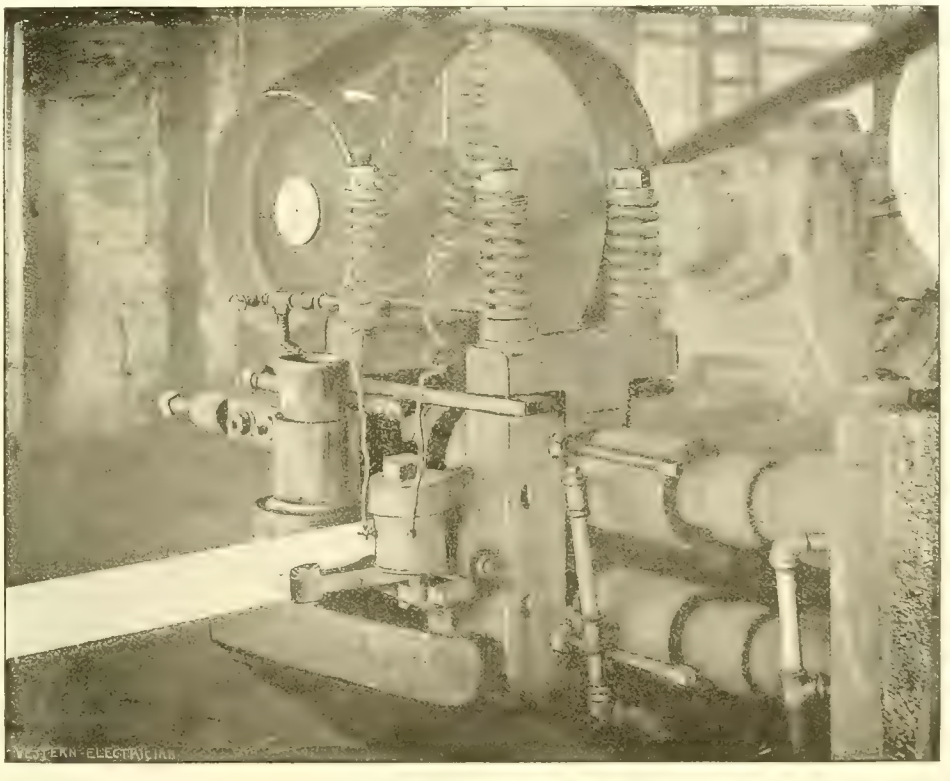


FIG. 1. ELECTRICITY IN A CHICAGO ROLLING MILL.

The receiver on which the tape is printed is located at the finishing end of the mill not a great distance from the point at which the contact lever of the rail counter is placed. This machine is in charge of a boy who records on a blackboard for the use of the stamper the numbers and letters as they are printed on the tape. The transmitter is operated by a man at the "pits," or reheating furnaces, at the further end of the mill, about 350 feet from the stamping machine.

To understand the details of this printing telegraph system it will be necessary to refer to the lettered parts in the diagrams and also to remember that two circuits are employed. It will be understood from Fig. 1 that while there are two circuits only three wires are needed, common return wire being used. From Fig. 7, in which is shown the transmitter with the dial face removed and also three sectional views, it will be seen that the transmitter consists essentially of a commutator ring *C* and a contact ring *B*, between which there may be revolved a contact lever *L*. The contact lever is shown more clearly to the left in the cut. This last named part can be turned around in only one direction, any back motion being prevented by a rachet wheel *K*. The part *D* of the contact maker bears against the inner face of the commutator ring *C* and as this arm *A* is directly connected with the battery (see diagram of circuits, Fig. 9), a revolution of the crank over the segments sends impulse after impulse of current to the receiver at the other end of the mill. These impulses act on magnet *M*, Fig. 8, and serve, by means of the lever escapement *E*, to produce a synchronous movement of the type wheel *T*.

To make the impressions upon the tape after the type wheel has been set by the impulses due to the movement of the little contact block *D* over the segmental face of *C*, the push button *P* in the transmitter, Fig. 7, is brought into play. When the crank has been moved around to a number or a set of letters on the dial, the button *P* is pushed in so as to make contact with ring *B*. As block *D* is at this moment in such a position that it is insulated by one of the segments of ebonite which are dovetailed into ring *C*, the contact between the crank and the other ring *B* serves to send current into magnet *N* of the receiver. Magnet *N*, lifting lever *L*, presses the tape up against the type and thus prints the symbol corresponding to the one on the dial to which the crank had been turned.

The upward movement of lever *L* serves also, by means of the escapement *F*, to move along the type into a position to receive another impression. The brass feed rollers *H* are actuated by the clock spring *S*. This spring is wound every 24 hours and feeds out from 200 to 250 feet of tape. *I* is the ink roller. The tape is wound up on the spool *W* by the slipping belt *V*. It may be mentioned, too, that there is a "dog" to prevent backward motion, which would throw the type wheel out of synchronism relative to the crank *A*.

The rail counter was devised by H. S. [illegible] of the south works of the Illinois Steel company, and the printing telegraph was made after designs prepared by C. A. Trube, also of the south works. For the photographs of the apparatus the WESTERN ELECTRICIAN is indebted to W. Clarke Cain, assistant superintendent of the rail mill.

An Electric Road for Chicago's West Side Suburbs.

It is reported that the Harrison Street and Des Plaines River Electric railroad company, which was recently incorporated at Springfield, will begin actual construction as soon as possible.

It is the intention of the company to start the road as near Western avenue, Chicago, as possible and run it west on a line near and parallel with Harrison street to the Des Plaines River, a distance of six or seven miles. The road will be just south of Harrison street, and will pass near Waltheim and Cicero [illegible]. It is the ultimate intention to obtain a right of way into the city if possible. The nearest competitor to the north of the proposed road is the Wisconsin Central main line, which has no suburban trade, while to the south there is an open field, with many new subdivisions springing up, and hundreds of houses building. That part of the West Side through which it is proposed to run the road is without adequate transportation facilities.

The Telephone in '93.

By Herbert Laws Webb.

A good many journals, both electrical and political, have a fondness for airing their opinions on the present status of the telephone industry, and its prospective status two years hence, when the Bell patent shall have expired. According to some of these journals the public is charged an excessive price for telephone service at present, and in '93, when the "grinding monopoly" is at end, the same useful commodity will cost next to nothing at all. If we are to believe these journals, in two years' time telephones will be

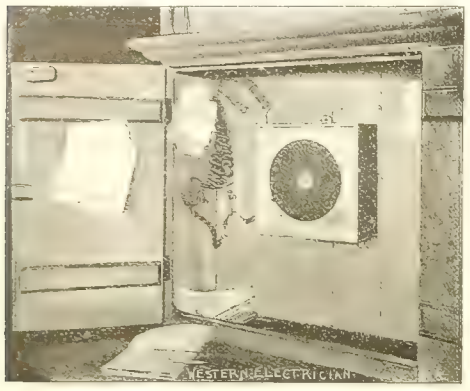
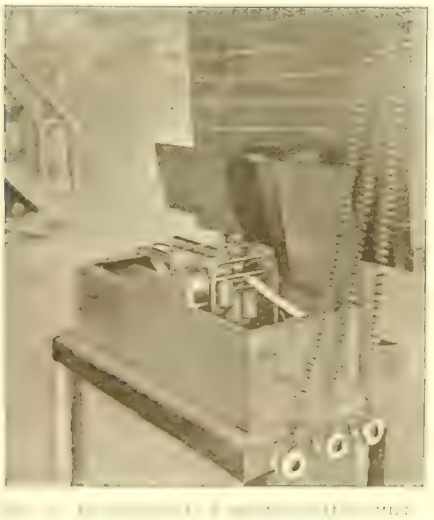


FIG. 1. ELECTRICITY IN A CHICAGO ROLLING MILL.

so cheap that, as we read is the case in Honolulu, every street soda water vendor will be connected with the exchange, and thirsty patrons will order their drinks from free "pay-stations" a block or two off.

To those who indulge in these fanciful theories it has become an article of faith that the entire telephone business is bound to stand and fall by the receiver patent. Given the expiration of that patent the field is free from competition, and the existing telephone companies must either lower their rates to starvation point or go to the wall. Some years ago, when the industry was young, weak and undeveloped, that might have been the case, but to day matters are on a very different footing. If the Bell patent had been broken down by any of the strenuous attacks made on it, then indeed some such situation might have come about as is prophesied by many for '93. In that case the numerous devices that go to make up a complete telephone system would have been distributed among many different companies instead of falling into the hands of one, and competing systems could have gone ahead and fought with each other and cut prices, or amalgamated and made "combines" in the same way that they have in the electric lighting industry.

Referring to the old telephone patent suits reminds me that the public, duly enlightened by the political press, entertained remarkable notions as to the possible result of the litigation, to an even more curious extent than those which



acquired practically all that there was in the telephone business, because at that time the industry was completely in its infancy, and there was very little but the telephone itself and some very crude and inefficient switching apparatus. In 1893 there will be given to the public the Bell telephone receiver, and the right to transmit speech by means of undulatory currents of electricity. In the words of a famous poet, "only that and nothing more."

Now the question arises, what will the public do with the receiver and the undulatory currents when it gets them? According to the newspapers it won't be happy until it does get them, but when the long wished for acquisition takes place the discovery will come that it is not worth nearly so much as it seemed to be from afar off. In this case truly distance lends enchantment to the view.

The motto of most newspapers should certainly be "writ large" at the top of the editorial page. "Where ignorance is bliss, 'tis folly to be wise." The newspapers, when they discourse about the telephone, believe, or pretend to believe, that the receiver patent having expired, the telephone business will be open to all comers, and that telephone service will be furnished for half or less than half the rates that are charged at present. If they would look a little farther into the question, they would find that the telephone receiver is one of the smallest items in the complicated collection of apparatus and machinery, large and small, which go to make up a telephone system. Do the newspapers or does the public imagine that all these countless devices, instruments, circuits and systems will be thrown in gratis with the receiver in 1893? To believe so would be to reveal a state of mind simple and confiding to the last degree; yet this belief is implied in the supposition that we are to have free telephony in '93.

When the American Bell Telephone company bit upon the ingenious and highly successful policy of leasing in-

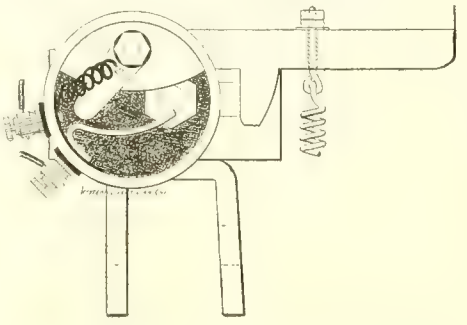


FIG. 3. ELECTRICITY IN A CHICAGO ROLLING MILL.

stead of selling the instruments for which it holds patents, that policy found a natural sequence in the acquisition of the patents for every other form of instrument and apparatus connected with telephony. Transmitters, switch-boards, bells, spring jacks, repeating coils, annunciator drops, ringing-keys, listening-keys, testing circuits and myriads of other devices and circuits are patented, and the patents are held by the Bell and its licensees. In any case the inventions would have been made and patents would have been taken out, and the patentee would have been paid for his ingenuity and trouble, so that to the public it makes but little difference whether the patents are owned by the American Bell Telephone company or by individuals, but to the mythical companies who are going to inaugurate competing systems in '93 it will make a very considerable difference.

Of course these patents form as it were a very strong inner wall of defense, which will prove a formidable obstacle to those intending to compete with the existing telephone companies, but there are outer works of a nature and strength which it will be very difficult to overcome. The chief of these is the strongly established position in which all the telephone companies in the large cities of the country are entrenched. Every day it is becoming more difficult to run wires from point to point. Overhead they are prohibited by the municipalities; underground the municipality steps in again, and says the streets shall be disturbed no more. There is a limit to the number of house holders, who for love or money (it is very seldom except for the latter) will permit fixtures to be placed on their roofs, or wires to be strung over them. There are a few other difficulties which he who runs wires in cities has to contend with, but these are the principal ones, and when attempts are made to add a few thousand wires to those already existing in all our large cities their importance will be duly appreciated.

Another difficulty in the way of active competition will be the dearth of real telephone engineering talent. To [illegible] equipped with all modern [illegible] switching apparatus, and [illegible] with all the complications, they intro-

duce—requires a very high order of electrical engineering ability, only acquired as the result of years of experience gained step by step with the growth of the industry itself. Even as the industry stands to-day there are comparatively few men who have this ability or this experience, and a modern telephone exchange cannot be designed, equipped and maintained by men new to the art. Such men would have all the old problems to conquer and solve over again in addition to the new ones which come up almost daily, and on the solution of which a concentration of effort, investigation and experiment is directed in a manner unparalleled in the electrical industries, excepting, perhaps, at

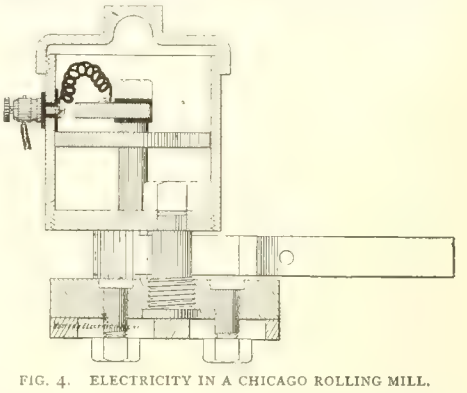


FIG. 4. ELECTRICITY IN A CHICAGO ROLLING MILL.

Llewellyn Park. At present the telephone companies all over the country profit by the knowledge thus systematically acquired, and their subscribers benefit by the results thereof, but the new comers would enjoy no such advantages. Many mistakes would be made, and in telephone work mistakes cost money in a dozen different ways. Here again the outlook for competition is rather a poor one.

The equipment of a large telephone exchange involves the expenditure of a considerable amount of capital, but its maintenance, including that of subscribers' instruments and lines, is a work that is not only expensive, but requires the most careful organization and supervision, both from a technical and executive point of view. A large staff must be employed for this work, and its members must receive systematic training and instruction from their superior officers in order that the work may be efficiently carried out. Records must be kept in order to trace the responsibility for any failure at any of a dozen different points in a subscriber's line, and in these records the daily history of the entire plant has to be entered from slips and memoranda. The intricacies of such work as this—which is absolutely necessary in order to maintain at its utmost efficiency a piece of machinery whose complexity is paralleled nowhere outside the human body—are not learned in a day, nor carried out smoothly, except by a large and well organized

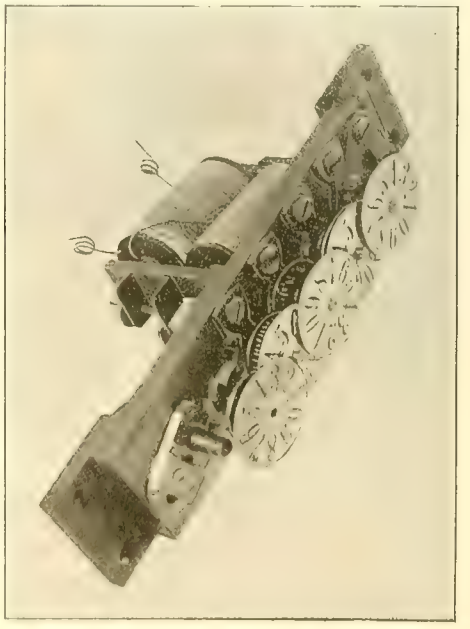


FIG. 2. ELECTRICITY IN A CHICAGO ROLLING MILL.

staff. In short, a modern telephone exchange is a very expensive concern to run.

It is questionable whether there will be any general reduction of telephone rates when the Bell patent expires. Large telephone plants become more expensive to equip and maintain every day, and the saving to the companies by the abolition of royalties on the receivers will be more than offset by the heavy fixed charges entailed by the

maintenance of extensive systems of underground cables. Cheaper classes of service may be introduced to meet any demand for lower rates. But to assume that in '93 good telephone service will be a very much cheaper commodity than it is at present is to argue without knowledge of the subject. Of late years the expense of installing large telephone exchanges has increased, owing to the very general introduction of underground work. Underground cables are far more costly than overhead wires, as regards equipment, and experience has yet to show that they are not more costly to maintain. They are certainly far less efficient as regards the service, and they introduce many new engineering problems in the equipment of the exchanges themselves. It would be no small undertaking to found a corporation to carry on telephone service in a large city; it would be an undertaking requiring a very large capital, and it is doubtful whether the capital would be forthcoming in view of the slender chances of securing an adequate return for it.

No unprejudiced observer who is at all acquainted with the inner workings of a telephone system can deny that the chances are slender indeed. There will probably be competition in the private line business and in small systems for large buildings or for connecting up a few houses close together; in fact, where small exchanges can be established competition will no doubt spring up. No individual and no collection of individuals is likely to start rival telephone exchanges in large cities either for the fun of the thing or for glory. Unless it were believed that there existed a good chance of making money in such a way capital is not likely to be attracted to the undertaking. The odds against there being any prospect of making money in opposition to the very completely laid out systems now existing in all the large cities of the country are so overwhelming that it is very improbable that any such competition will spring up.

One more obstacle may be mentioned, and that is the long distance service. The Long Distance Telephone company has interlaced the eastern states with a network of superbly built lines, which represent a vast outlay of capital. A system which should efficiently compete with these lines would be practically out of the question for several reasons, the difficulty of obtaining way-leaves for one; in any case it could only be built up in the course of several years and by the employment of capital running well into seven figures. The Long Distance company gives a splendid service and provides a means of rapid communication which has become absolutely indispensable to a large percentage of the subscribers to the local exchanges in most of the large towns. How long would it take for new companies to duplicate these conditions, and how much cheaper could they do the work than it is done at present?

It would seem, after all, if the present situation is soberly and intelligently considered, that the telephone situation in '93 will not materially differ from that which exists to-day. The obstacles in the way of extensive competition are numerous and formidable enough to convince any one who takes the trouble to examine them closely that extensive competition is practically impossible. The companies will go on steadily introducing improvements, which they are constantly doing—the political press, which affects to believe that all improvements are suppressed, to the contrary—and extending their systems. Telephone subscribers will learn in time that telephone service costs a good deal to furnish, and if in '93 they find that they are getting more secure and reliable communication, with improved facilities in every direction, there will be few inclined to grumble or cry out for the cataclysm in telephone affairs that in some quarters seems to be expected and hoped for.

Proposed Harvey Electric Road.

Articles of incorporation were recently issued to the Harvey Transit company of Chicago to construct a railroad in Harvey, Ill. presumably to be operated by electric power. Mr. Stanwood, one of the incorporators, informed a representative of the WESTERN ELECTRICIAN that the road would be constructed in sections of two and one-half miles. Work has not yet been begun on the road, nor has the exact route been decided upon. It is the intention to construct about seven and a half miles of road.

Electricity at the World's Fair.

It now appears altogether likely that there will be a temporary electric plant on the World's Fair grounds to supply light and power during the work of construction. At first, as has been heretofore noted in this paper, it was thought that it would be more economical to secure current from some one of the South Side central stations, and several companies were invited to put in bids with that end in view. Now, however, as the magnitude of the work in hand becomes more apparent, it has been thought best by the authorities of the electrical and construction departments to put in a temporary plant as soon as possible. This conclusion was hastened by the decision to employ electricity to furnish power for building operations. Several of the contractors have expressed their willingness to employ electric power if they can obtain it as cheaply as steam, and it is thought that this condition can be complied with. At first the power will be chiefly employed in operating saw-mills to manipulate the large quantities of lumber required for the huge wooden buildings that are now, or will shortly be, in process of construction. Another consideration that has led to this decision is the distance separating Jackson Park from the nearest central station. Probably two or three miles of heavy copper wire would be required, if the work were done by contract, which would, of course, greatly increase the expense.

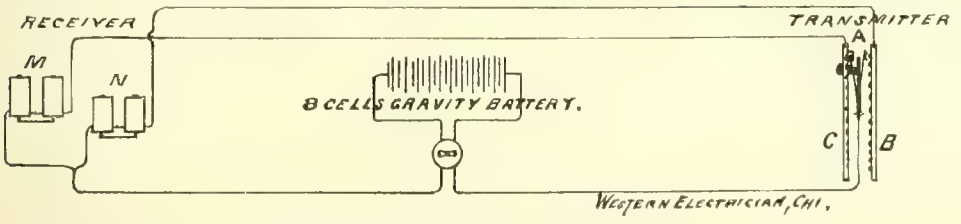


FIG. 9. ELECTRICITY IN A CHICAGO ROLLING MILL

The location of the temporary power house has not yet been definitely determined, nor have the specifications been completed. Arrangements will probably be made for an installation capable of supplying 250 arc lights, 1,000 incandescents and at least 300 or 400 horse power for motor service. But of course only a portion of this will be used at first.

In pursuance of his plan of personally conferring with all the leading electricians of the country, Chief Barrett paid a flying trip to Fort Wayne and Indianapolis, Ind., last week. He was accorded a cordial reception, and came back well satisfied with the results of his journey. He reports that everybody he met appeared to take the greatest interest in the electrical features of the exposition, and reporters importuned him for interviews at every turn. This department, whose happy faculty of gaining the friendship of [illegible] it is not the intention to use steam power in any building but the Mechanical Hall. The applications for space are phenomenal. We have now 140, and these embrace everything in electrical science, from a singing doll to a locomotive. The Ind[illegible]

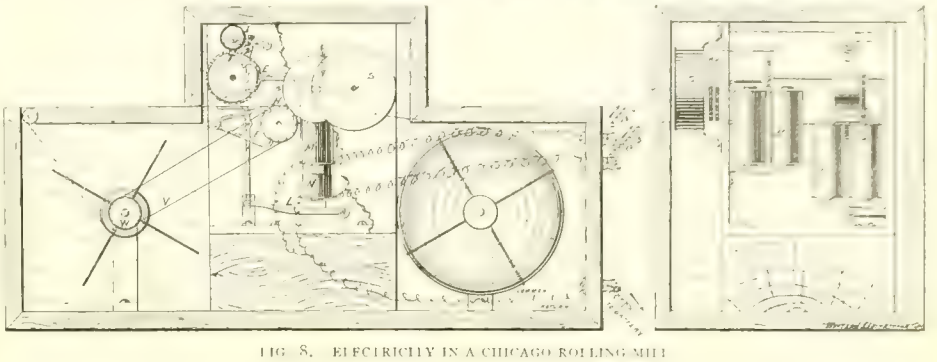


FIG. 8. ELECTRICITY IN A CHICAGO ROLLING MILL

to have mixed things somewhat, for he wrote: "Already 100 000 square feet of space have been asked for, and more than 41,000 feet of steam and electric current." Chief Barrett will soon make another eastern trip, starting about August 8th or 9th. He will attend the firemen's convention at Springfield, Mass., and also pursue his missionary labors among eastern electrical companies.

Before long Secretary Hornsby will issue diagrams of the main and gallery floors of the electricity building, showing the proposed location of the aisles and the arrangement of the space. These will be sent to the applicants for space, with the request that they indicate the location they would prefer. It will be impossible, of course, to comply with the desires of exhibitors in this respect in all cases, but it is thought that the replies will be of much service in apportioning the space available. Wherever practicable, the wishes of exhibitors as to location will be complied with.

A tool house has already been erected on the site of the electricity building, and the work of putting in the foundations will be begun at once. A spur from the Illinois Central railroad runs alongside the site of the building, greatly facilitating the shipment of material.

The Sperry Electric Mining Machine company of Chicago has applied for 1,250 square feet of space in the mining building.

One of the unique features of the fair, if the proposition of the Pittsburg Reduction company is accepted, will be a complete 125 horse power plant for the production of aluminum, all the processes for the reduction of the much-talked-about metal by electricity being performed on the spot. For this purpose a current of [illegible] amperes at 50 to 60 volts will be necessary. The Reduction company will gladly accept the current from the big power house, or it will set up two dynamos of its own if power is furnished to run them. This exhibit, although partly electrical in character, will [illegible] mining department, being [illegible] or in a small building of [illegible]

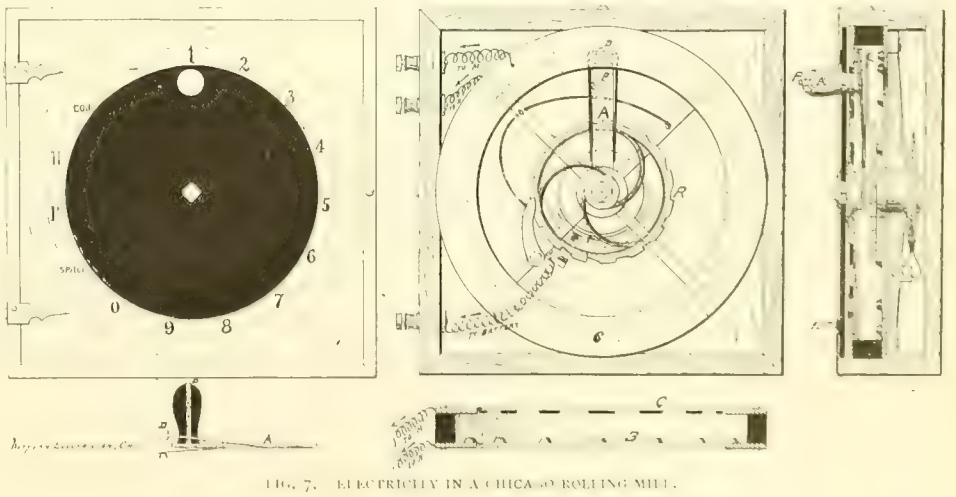
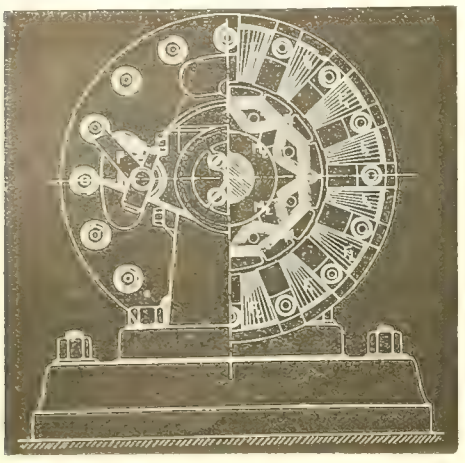


FIG. 7. ELECTRICITY IN A CHICAGO ROLLING MILL.

The Hubin-Leblanc Alternating Current Motor.

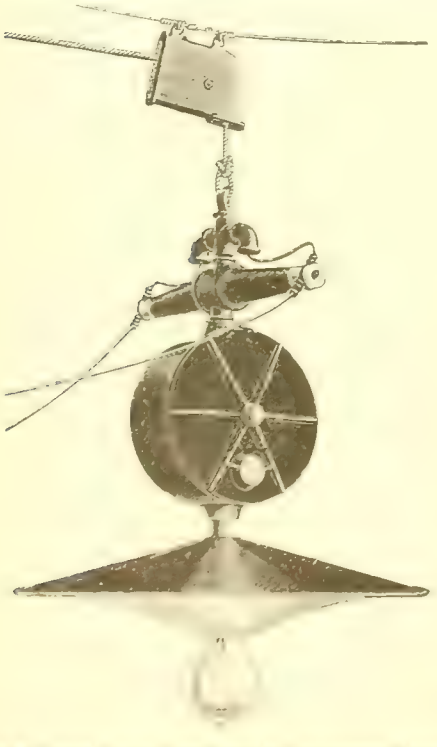
In the accompanying illustrations is shown the new Hubin-Leblanc alternating current motor, built by the Societe L'Eclairage Electricite. This motor is claimed to possess several advantages.

The cuts represent a 15,000 watt machine, the main features of which are a double ring of electric magnets. The outside part of the ring is immovable and constitutes the field, while the inside ring is mounted on a rotating



THE HUBIN-LEBLANC ALTERNATING CURRENT MOTOR.

shaft and forms the armature. The core of the outside ring or field is built of a large number of sheet-iron disks, insulated from each other and bolted together in the usual way. These disks are furnished with 16 double notches, in such a way as to form sixteen grooves both on the outside and inside of the cylinder. Room is thus made for two sections of windings, F_1 and F_2, each of which has 8 spools, filling the entire space of the notches. The outside part of the armature has a laminated core, securely fastened to the shaft and also furnished with 16 notches in which the armature wire is placed. The construction is similar to that of the outside ring, there being two sections, each composed of 8 spools joined together in series. One side of these two sections is joined together with the



The speed of the motor is 1,100 revolutions per minute, but by increasing the speed to 1,800 revolutions per minute, which can be done without danger to the windings, the efficiency increases to 88 per cent. The length of the iron core in the outside ring or field is 1.31 feet; the inside diameter is 0.98 foot. The size of the wire is equal to No. 13 B. & S. gauge and the number of windings per spool is 42. The resistance of the windings on the outside ring is 7.8 ohms when all the spools are joined in series and 1.97 ohm when joined in multiple series. The resistance of the armature is 0.18 ohm.

The motor has been subjected to a series of trying experiments and has stood the test successfully, according to the *Elektrotechnischer Anzeiger*, from which the cuts are reproduced.

The National Series Transformer System for Street Lighting.

Of the many problems met with in electric lighting by means of the alternating current, probably none taxes the ingenuity of the electrical engineer so much as the illumination of streets or other large areas by means of transformers. As a rule, the lights are several hundred feet apart, and to run a secondary circuit from a transformer centrally located would, of course, be highly uneconomical and comparatively expensive. Various arrangements to overcome this difficulty have been proposed and put into practice. Taking a 1,000 volt current as a standard, 40 25 volt or 20 50 volt lamps may be connected in series, but this arrangement would necessitate some sort of an automatic device for keeping the circuit closed, should one or more lamps in the series become disabled. It would also be necessary to provide means of guarding against the increase in voltage at the remaining lamps.

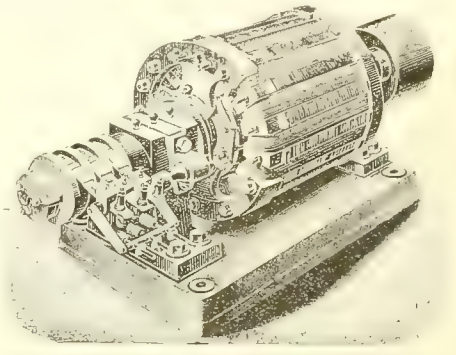
To overcome many difficulties and to provide a system of lighting which will be at once simple, reliable and efficient, the National Electric Manufacturing company of Eau Claire, Wis., has just put upon the market a special series transformer illustrated in the accompanying cut. These transformers do not materially differ from the company's standard transformers except in the ratio of winding between the primary and secondary coils, which is one to two, as against one to twenty in the regular transformers. The primary coils are wound for 100 volts and the secondaries for 50 volts, with a suitable allowance for loss in the circuit. Thus ten of these transformers can be connected in series on a 1,000 volt circuit, absorbing 100 volts each in their primary coils, with a difference of potential of 50 volts at the secondary terminals. The secondary coils are wound with wire large enough to carry up to three amperes of current without heating, and consequently a change of lamps to those of other candle powers can be easily accomplished.

The proportion between primary and secondary coils and the core of the transformers is such that, should the lamp become extinguished, the transformer becomes a [illegible] but other similar devices only lowers the electromotive force of the circuit sufficiently to make up for the [illegible] lamp, and it is claimed so nearly perfect [illegible] that from one to eight [illegible] of ten, without appreciably increasing the candle power of the remaining lamps.

[illegible] are placed in an iron weather [illegible] with a light cross arm and depending [illegible] carrying the reflector canopy, [illegible] and lamp socket. The secondary wires are entirely inclosed, while the primary terminals are carried through a T shaped pipe to the cross arm, the whole arrangement being preferably suspended at street intersections similar to arc lights. The transformers can, however, be provided with a gas pipe bracket for attachment to lamp posts direct.

Hercules Electric Motor.

The accompanying cut illustrates a new motor which is placed on the market by the Zucker & Levett Chemical company of New York. As can be seen, the motor is of the inverted horseshoe type, in which the whole of the mag-



THE HUBIN-LEBLANC ALTERNATING CURRENT MOTOR.

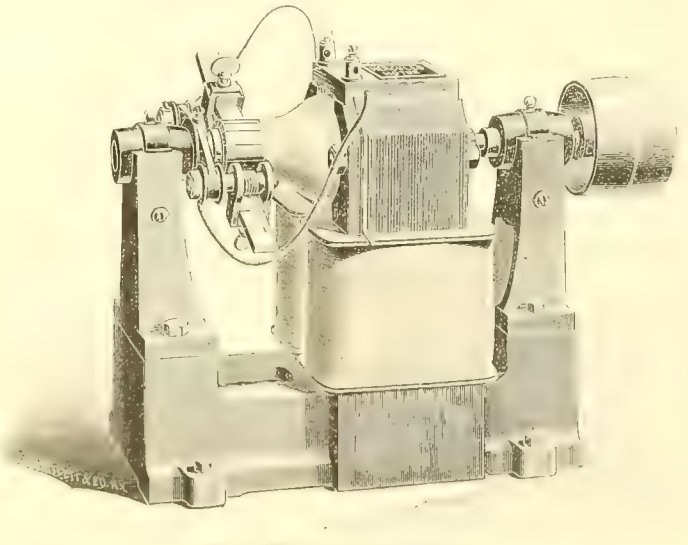
netic circuit is stamped out of one sheet of Swedish iron, the number of sheets being bolted together to form the magnet frame.

The plates are thoroughly insulated to prevent the generation of Foucault currents and consequent heating. The field coils are separately wound on brass spools and the distance between the magnet cores is slightly larger than twice the depth of one coil, thus allowing the coil to be slipped over the core.

The plates of the armature, which is of the modified Siemens type, have teeth forming longitudinal channels on its periphery, in which the coils are wound. These teeth, beside reducing the magnetic resistance to a minimum, entirely prevent the coils from flying out, due to the centrifugal force, and consequent burning out of the armature.

The magnet frame is bolted to an iron base, having iron standards and self-oiling bearings even in the smallest size of machines.

The automatic motors are mostly shunt wound with an armature of extremely low resistance. The fan motors are series wound and run a six blade 12-inch propeller fan at



THE HERCULES ELECTRIC MOTOR.

1,600 revolutions per minute, taking one ampere at 120 volts.

The mechanical details of these machines have been very carefully worked out, and all parts are adjustable. Quite a number of the Hercules fan outfits are in daily use. These machines will be manufactured in all sizes from one-eighth horse power up for both light and power

Chicago City Lighting Plant.

While Prof. Barrett was in Fort Wayne last week he purchased two 60 light Wood arc dynamos for use in the northwestern station of the city lighting plant of Chicago. Four systems—the Thomson Houston, Brush, Western Electric and Fort Wayne—are now represented in the several street lighting stations of the city

Richardson's Electrical Impression Indicator for Printing Presses.

Attention has been called to an electric indicating device invented by G. B. Richardson and applied to the press of the David C. Cook Publishing company of Elgin, Ill.

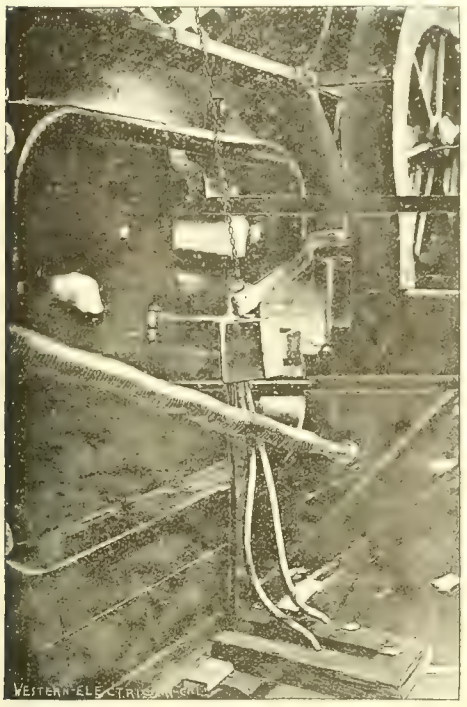


FIG 1. RICHARDSON'S ELECTRICAL IMPRESSION INDICATOR FOR PRINTING PRESSES.

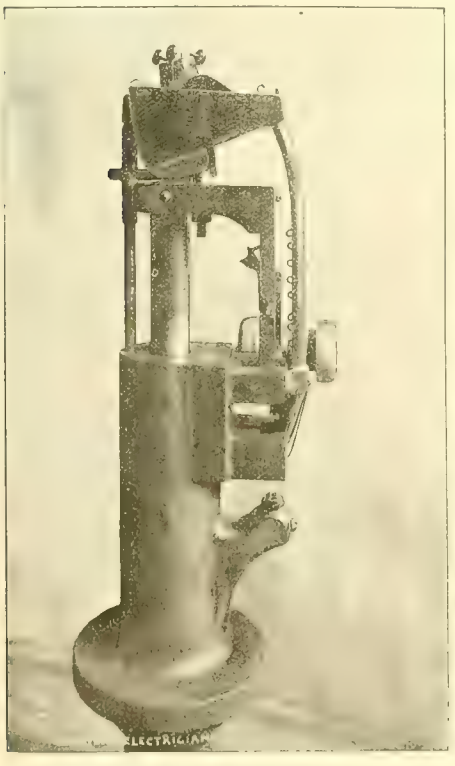
The device has attracted more than usual attention owing, no doubt, to its simplicity. It is illustrated in the accompanying views and will be readily understood. The whole arrangement is simplicity itself. A push button at the press, operated by a lever, Fig. 1, so connected to a moving part of the press that one contact is made for every impression; a row of lamps in a case in the office, Fig. 2, and each lamp connected by a separate circuit to a button on a press; the whole drawing current from the 110 volt Edison house-lighting circuit—this is the outfit through which each press indicates at the desk of the manager its every impression.

Magnetic Button Fastener.

An ingenious application of an ordinary horseshoe magnet in a mechanical appliance is shown in the illustration. The machine, which is the invention of Clyde and Clarence Coleman of Chicago, is designed for the purpose of affording a rapid means for attaching buttons to shoes. The difficulty was to devise some simple plan of feeding the buttons from the hopper on top of the machine down the tube leading to the stamping mechanism. This is effected by the magnet, which, playing up and down in the hopper through a slot in the bottom, attracts several of the loose buttons at each upward movement. In the picture the magnet is shown at its highest point, with buttons clinging to it. On the downward stroke the buttons are rubbed off into a little trough adjusted to fit the magnet closely. This trough is so grooved that the buttons, naturally attached to the magnet by the iron wire forming the eyes, fall into the chute in the proper position, as shown in the illustration.

FIG. 2. RICHARDSON'S ELECTRICAL IMPRESSION INDICATOR FOR PRINTING PRESSES.

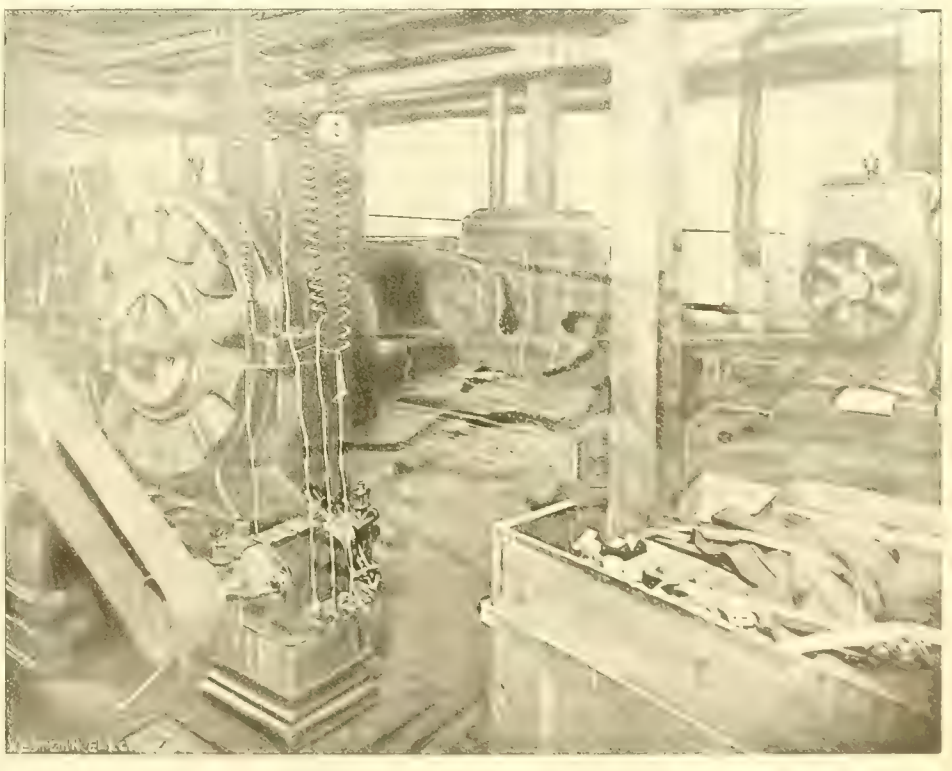
At the bottom of the chute the wire fastening is fed through the eyes of the buttons from a coil at the right hand of the operator. The wire is cut off at the proper length and stamped through the leather, which is, of course, held in position by the person operating the machine. The wire is formed into a staple and clinched on the under side, and the shoe is then adjusted for another button. The machine is operated by treadle, and all movements necessary for fastening one button are made by one downward tread.



MAGNETIC BUTTON FASTENER.

Lighting Plant at the Allen Flats, Chicago.

Chicago is blessed with many fine apartment buildings, or "flats," as they are more generally called, although, of course, this style of residence has not such an enforced popularity as in pent-up New York, for instance. As a type of this class the new Allen flat building on Oakwood boulevard, near Cottage Grove avenue, may be taken as a fair representative. It is typical in its handsome and imposing exterior, in its comfortable, almost luxurious, fittings, and in the character of its tenants. Here are pleasantly fitted suites forming either the homes of contented and happy families or the comfortable bachelor quarters of single gentlemen. Among the latter are many professional men; and not a few journalists, attached either to the daily or technical press, find in flats such as the Allen a congenial



LIGHTING PLANT AT THE ALLEN FLATS, CHICAGO.

the neighborhood of Cottage Grove avenue in the district bounded on the north and south by 35th and 39th streets. The arc lamps are used largely for lighting stores. The wiring is overhead, except at the street crossings, where the city ordinances require the conductors to be buried. In running the lines, the wires are carried across the streets in wrought iron pipes driven through from cellar to cellar.

The electrical apparatus in the station consists of two arc light and one incandescent machine. The incandescent dynamo is a 650 light separately excited Slattery alternating current machine. The arc lighting equipment consits of two 60 light Wood dynamos. These machines are driven by a 100 horse power New York safety engine. The two arc machines are belted in tandem to one side of the engine and the alternator is driven directly from the other fly wheel. The building is wired for 800 lamps, which are supplied through converters. The transformers are mostly twenty-five lighters, and they supply fifty volt lamps.

Electric Road at Bloomington, Ill.

There is a limit to human endurance, and it appears that this limit was reached by the members of the city council of Bloomington when at their last meeting a resolution was unanimously adopted declaring forfeited the franchise of the Bloomington and Normal Street Railway company. The members seem thoroughly tired of the present street car service, which has been execrable for many months. It is understood that [illegible] several capitalists are ready to [illegible] and efficient electric road.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - Editor and Publisher.
J. E. O'HARA, - } Associate Editors.
F. L. PERRY, -
W. E. KEILY, -
J. L. BAKER, - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN —*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application

CONTENTS OF THIS NUMBER.

PAGE.

Electricity in a Chicago Rolling Mill. Illustrated ... 43, 44, 45
Electric Road for Chicago's West Side Suburbs ... 43
The [illegible]. By Herbert Laws Webb ... 44, 4[illegible]
[illegible] Electric Road ... 45
Electricity at the World's Fair ... 45
The [illegible] Alternating Current Motor. Illustrated ... 46
The National Series Transformer System for Street Lighting. Illustrated ... 46
[illegible] Motor. Illustrated ... 46
[illegible] Lighting Plant ... 46
[illegible] Impression Indicator for Printing Presses. Illustrated ... 47
[illegible]. Illustrated ... 47
[illegible] Flats. Illustrated ... 47
[illegible] at [illegible] ... 47
[illegible] ... 48
[illegible]. Illustrated ... [illegible]
[illegible] Current Motors [illegible] Alternating Current [illegible] ... [illegible]
[illegible] Battery Wires. Illustrated ... [illegible]
[illegible] ... [illegible]
[illegible] ... [illegible]
[illegible]. Illustrated ... [illegible]
[illegible] ... 50
The Montreal Convention ... 50
[illegible] ... 50
[illegible] Frankfort ... [illegible]
[illegible] Chicago and Milwaukee ... [illegible]
[illegible] ... [illegible]
[illegible] ... [illegible]
[illegible] ... [illegible]
[illegible] ... 51, 52, [illegible]

DEPARTMENTS.

[illegible]

[illegible]

[illegible] telegraphing apparatus at the south works of the Illinois [illegible]

electrical appliance to the plant of the rolling mill with which they are connected—one of the largest in the country, by the way. They are fairly entitled to commendation.

"WHEN electricity moves and heats our railway trains," remarks the *New York World*, "there will be no more roasting of people, as happened in the tunnel last February, and on the Erie road this July." Indeed! But electricity would never do for the suburban trains proposed by the Rapid Transit commission, would it? The New York papers are strangely inconsistent in their advocacy of electric traction in the abstract, and their opposition to it in the concrete.

NOT long ago a leading New York daily took up the question of electrical construction in country towns, holding that "the chief sufferers from bad electrical construction, as it is called, are outlying towns and villages, and a ride through the country adjacent to New York reveals a deplorable state of affairs." Undoubtedly this criticism may hold good in a few instances, but, as is usually the case when a wholesale attack of this kind is made by a writer who has only a superficial knowledge of the subject in hand, the general inference sought to be drawn is all wrong. Of course no intelligent person will claim that all electrical construction is what it should be. Perfection has not been attained by the electrical manufacturing and supply companies any more than by the men in any other line of trade. Still it is undoubtedly true that from the very nature of electrical construction work the constant tendency, both in villages and cities, is toward a higher order of excellence. The poles, arms, brackets and wires put up for electrical work are where all may criticise and attack. Nothing is easier, for instance, than for the croakers to assert, as in the article in question, that "villages and rural places are threatened by the careless or ignorant arrangement of wires charged with the deadly fluid," or that "ignorant village officers make contracts with wily experimenters, and some day the public will pay a fearful price for its temerity." The truth is that no first-class company can afford to put up poor work of this kind. Let it once be noised abroad that any supply company followed the strange gods of unsafe construction and its business would disappear like dew before the sun. No village, however small, need have other than the safest of overhead work within its limits unless it deliberately chooses otherwise.

MAYOR GRANT of New York has received a check in his crusade against the electric companies of the metropolis. The mayor has been informed that in certain cases at least he must observe the law. In the first crusade against electric lighting companies in which the pole chopping brigade destroyed the property of electric companies wherever they found it, the suggestion was made that the mayor and his followers were exceeding their authority, but at that time the mayor, taking advantage of the public panic due largely to the sensational articles in the daily papers, refused to consider anything but his own interests. Poles were chopped, and miles of wire cut in streets unprovided with conduits. As a result many sections of the city were left without means of lighting other than gas. Recently the mayor decided to renew these tactics, but this time the corporation counsel informed his honor that there were some things he couldn't do, and this was one of them. But this was not all. The mayor and his associates in the Board of Electrical Control received another bit of intelligence from the corporation counsel. The subway company has been greatly delayed in its work by the "board," which, at the mayor's instance, passed a resolution in June asking the corporation counsel to proceed against the company for the forfeiture of its charter because certain work had not been finished by June 1st. The mayor had offered a resolution intended to make June 1st the limit of time, but as recorded in the minutes, the resolution did not so provide specifically. The corporation counsel gave his opinion that proceedings for forfeiture could not be begun. The company has therefore been "instructed" to proceed with the work. The troubles of the electric companies of New York may be traced directly to this political "board," which is constantly interfering in matters of which it knows absolutely nothing.

THAT there is a strong prejudice against the "telephone monopoly," so called, is evident from the opposition that the old company has experienced for years and the enthusiasm with which "new telephones" are welcomed. The history of the telephone includes many bitter controversies, and some of these (it would seem) have not yet been concluded. [illegible] measure at least, for the anxiety with which the opponents of the old company await the expiration of the patent on the Bell telephone receiver in 1893, fully expecting that with the expiration of this patent the old company will cease to occupy a prominent position in the telephone world. That such is not the case is clearly pointed out elsewhere in an able article by Herbert Laws Webb, in this issue. Mr. Webb carefully reviews the field and shows that the Bell interests are to-day in a wel fortified position. During the years that have elapsed since Prof. Bell's claims were established the system has been developed, valuable improvements have been introduced, and as all of these are covered by patents and as each is as valuable and necessary in securing good service as the Bell receiver the old companies are in far better position to maintain a struggle than ever before. In large cities, Mr. Webb shows, the old companies are secure. New comers must necessarily give as good service at least as the old company, and an equal number of subscribers will be necessary to give equal value to the patrons. Can a new comer offer these inducements?

It is easily shown that a telephone system is not established in a day, but is rather the result of years of development. Then, too, a vast expenditure of money will be required and capitalists will be loth to invest where there is little hope for return. It will be readily seen, therefore, that the outlook for competitors of the old company, so far as large exchanges at least are concerned, is anything but hopeful. Those who persist in the belief that with the expiration of the receiver patent the field will be opened and all will stand on an equal footing, are doomed to a rude awakening in '93.

THE decision of Judge Wallace in the Edison lamp case, announced in the last issue of the WESTERN ELECTRICIAN, was the most notable victory in patent litigation that has thus far been achieved in electrical circles. The victory is not yet complete, as there is a probability that the case will be carried to the appellate court. It is now six years since this action was instituted, and had it not been for the passage of the law last winter providing for the review of patent cases by the new United States circuit court of appeals it is quite probable the final adjustment of the matter would have been prolonged until the expiration of the patent. Aside from the commercial advantages the decision will insure the Edison company, it is a source of no little gratification to those who have identified themselves with the Edison interests to have this protracted controversy favorably decided. There has been an honest difference of opinion entertained by experts equally learned, and these conflicting views did not escape Judge Wallace, who commented on the fact in his opinion. Describing Edison's accomplishment the court continues: "By doing these things he made a lamp which was practically operative and successful, the embryo of the best lamps now in commercial use, and but for which the subdivision of the electric light by incandescence would still be nothing but the *ignis fatuus*, which it was proclaimed to be in 1879 by some of the learned experts who are now witnesses to belittle his achievement, and show that it did not rise to the dignity of an invention."

Again Judge Wallace says: "It is of little import what Mr. Edison, or his patent solicitor, may have thought about the meaning of the claim during the pendency of the application for a subsequent patent, or that Mr. Edison may have supposed a resistance as high as one hundred ohms in the burner would be required for use with the means of distribution which he expected to employ with his system of lighting. There are many adjudicated cases in which it appears that the inventor builded better than he knew; where a patent has been sustained for an invention, the full significance of which was not appreciated by the inventor when it was made. In the case of the Bell Telephone patent there was great room for doubt whether the speaking telephone had been thought of by Mr. Bell when he filed his application for a patent, but the court said: 'It describes apparatus which was an articulating telephone, whether Bell knew it or not.'"

The commercial aspect of the case is equally interesting in the eyes of Mr. Edison's followers. The decision means that every manufacturer of incandescent lamps in this country will be compelled to pay tribute to the Edison company. But the prospect does not seem to have any terror for the large supply companies. In fact they seem relieved at the termination of the suit, as the interviews published elsewhere indicate. The Edison company can regulate the market and prevent numerous cutting of prices by the small fry that has caused so much trouble in the lamp business.

It is of course impossible to estimate the value of this decision to the Edison company, but it is safe to say that it is amply repaid for the worry and expense attending the litigation.

Medical Lighting Apparatus.

Additions are daily being made to the already large number of electro-medical appliances. The accompanying illustrations show a new device for throwing light into the cavities of the human body. The little apparatus consists essentially of a lamp provided with a sheath made to fit the finger. It has a spring contact so arranged as to open and close the circuit as the finger is bent or

MEDICAL LIGHTING APPARATUS.

straightened. This attachment is the invention of P. Oudin and H. O. Kratz-Boussac of Paris.

Evanston's Electric Railway.

A company has been formed to build an electric railway at Evanston, Chicago's most attractive suburb. The corporation will be known as the Chicago & Evanston Electric Railway company, and the capital stock is $500,000. The incorporators are John L. Cochran, DeLancey H. Louderback, Frank S. Gorton and Alexander Clark.

One of the projectors of the enterprise is authority for the statement that the Edison interests would support the project. It is proposed to at once apply for a franchise to construct a double track electric road with the overhead system. It will extend through the villages of Evanston, South Evanston and Rogers Park, and connect with the Lincoln avenue cable. A portion of the route will be through Evanston avenue north from Lawrence avenue to the city limits, thence west on Homan street to Clark street and north on that thoroughfare through the township of Evanston.

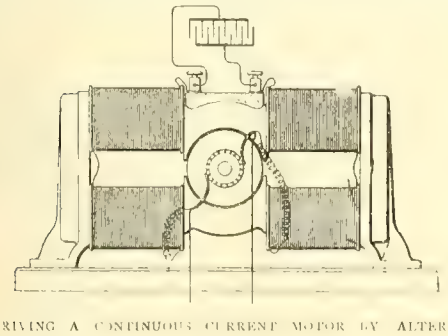
If a satisfactory arrangement cannot be made to transfer passengers from the southern terminal of the electric road to the central portion of the city, the line will be extended further south. The line will be thirteen miles in length and will afford 17,000 people an opportunity to visit the city without inconvenience.

Driving a Continuous Current Motor by Alternating Current.

A method through which it is proposed to render practicable and efficient the operation by an alternating current of an electric motor of ordinary type is illustrated in the accompanying diagram. The arrangement, which was devised by W. Stanley, Jr., of Pittsfield, Mass., and J. F. Kelly of New York, is claimed to be such that the motor may have the full capability of starting and regulation common to the corresponding forms of continuous current motors.

The particular form of motor to which the method applies is one having a commutator, and a field circuit in shunt to its armature circuit.

The invention is based on the well-known property possessed by a condenser of neutralizing or counteracting the



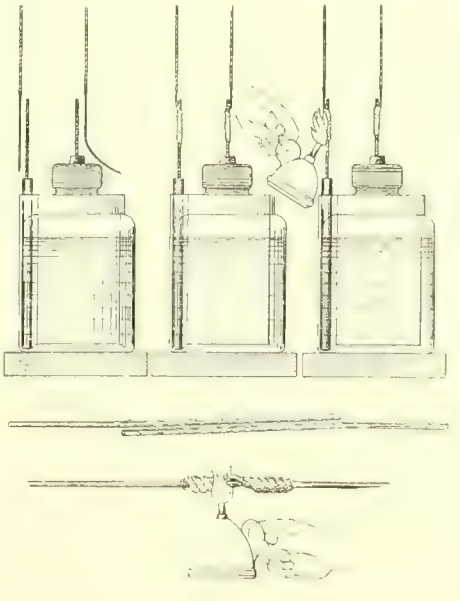
DRIVING A CONTINUOUS CURRENT MOTOR BY ALTERNATING CURRENT.

effects of the self-induction of a circuit with which it may be connected. The arrangement consists in the combination, with a motor of the kind illustrated, of a condenser included in the field circuit, or, in other words, in that circuit having the higher self-induction.

According to the inventors, if a motor of the kind described be operated by an alternating current, a loss is occasioned by the high self induction of the field circuit, which retards the phase of the current-imparting magnetism to the field magnets. As a consequence the maximum magnetic effects of the armature and field are not coincident, a condition which impairs the efficiency of the motor. In order to counteract this, and to bring the maximum magnetic conditions of the two elements, armature and field, more nearly into coincidence, there is introduced into the field circuit a condenser, which has the effect of bringing the phase nearer to that of the impressed electromotive force of the generator. The efficiency and economy of this disposition will, of course, depend upon the electromotive force, rate of change of the current, and other well understood conditions. In practice the cores of the field magnets should be laminated. A glance at the cut will enable the reader to understand the connections.

Method of Making Reliable Joints in Battery Wires.

In telephone work particularly it has been found that the mode of making battery connections by means of binding screws is unreliable. After but a short period of use, owing to the creeping action of the salts, corrosion takes place at the contacts, and the resistance of the circuit is largely increased. From the fact that as a rule a telephone battery is included in a short office circuit, any undue resistance is more serious than it would be were the connections of greater resistance. It becomes, therefore, a matter of vital importance to keep the resistance of the battery circuit at its lowest possible point, and on this account the method of forming joints on the wires which is



METHOD OF MAKING RELIABLE JOINTS IN BATTERY WIRES.

illustrated herewith will be of interest to the practical reader.

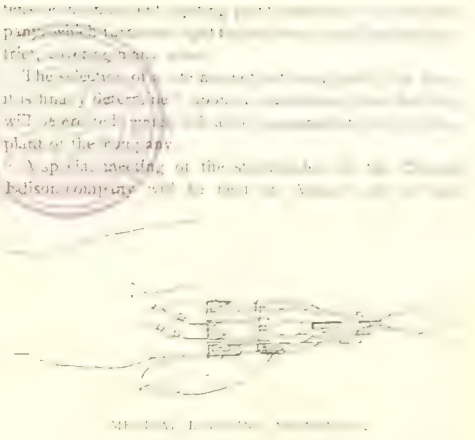
To make a battery connection there are provided terminal wires, each having one of its ends moulded into the plates as indicated. The other ends are coated by dipping with easily fusible alloy. To make a connection with other wires—say those of a Blake transmitter—it is only necessary to wind the wires from the transmitter round the battery wires as shown in the cut, and then direct upon the splice a moderate amount of heat—that of a small lamp being sufficient. Perfect battery connections, it is claimed, may thus be formed with great facility.

H. V. Hayes of Cambridge, Mass., and A. S. Hibbard of Morristown, N. J., are joint inventors of this device.

Chicago Edison Company.

As has already been stated in the WESTERN ELECTRICIAN, the Chicago Edison company has under consideration several propositions involving a change of location for its offices. The latest proposition, and one, which appears to be received with considerable favor by the directors, is the removal of the Adams street central station to a point near the river. This would enable the company to materially change the plant so as to effect a great saving in the cost of operation. The present headquarters of the company on Adams street are in the center of the business district of the city, but the contemplated change of site would not prove a disadvantage. The officers of the company say the plans have not yet progressed far enough to warrant a definite announcement of their arrangements.

The ground which the company's building now occupies has a frontage of 45 feet, and is leased for a period of 99 years at a rental of $8,000 a year, the lease having 95 years yet to run. The building is three stories high and was erected three or four years ago, the design providing for a high office structure which has never been completed. The company's offices are located here and also the ex-



action regarding the proposed increase of capital stock from $750,000 to $1,000,000.

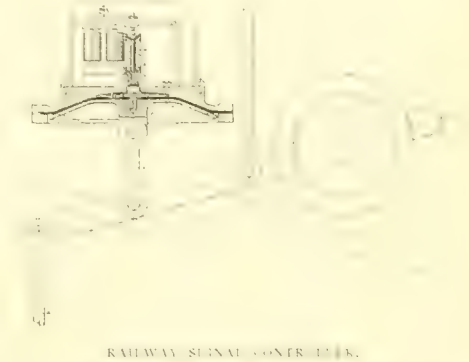
Firemen Aided by Electricity.

Electric cars were put to a new use in Oak Park, Ill., near Chicago, a short time ago. An alarm of fire had been sounded, and the village hose cart came bounding and plunging down the street just as a Cicero and Proviso electric car passed the corner. But the roads were bad, and the firemen were making slow work of it, while the red glare of the burning building half a mile or so away warned them that no time was to be lost. The conductor of the car took in the situation at a glance. "Hook on your old cart behind the car," he shouted. The firemen gladly availed themselves of the invitation, and the apparatus was whirled along to the scene of the fire in a twinkling, thus demonstrating another of the manifest advantages of electric traction.

Railway Signal Controller.

There are many electrical devices for operating railway signals, but the accompanying illustration shows one in which the idea has been worked out in a new way. By means of this device the signal may be operated from a tower some distance away, or it may be used where it is necessary for each train to put the signal to danger on passing an electric contact.

In the illustration *e* is the usual balance lever, weighted so as to put the signal to danger in case of a rupture of the connections; *n* is the connection which extends to the adjacent tower, and *s* is the rod which is in direct connection with the signal. The cut shows the weight lifted and the signal at all clear. The balance lever is centered on a link *d*, which is fastened to the diaphragm *r* by the buffet *t*. When the valve *b* is closed by means of the electro magnet pushing down the valve stem *a* the diaphragm is held in the position shown by the atmospheric pressure, and consequently the signal may be operated at will by the man operating the mechanical connection. But should the man operating the circuit in connection with the magnet open that circuit, then the spring *c* is released and raises the valve stem about one-sixteenth of an inch. The



RAILWAY SIGNAL CONTROLLER.

air is then allowed free access to the diaphragm chamber and the diaphragm falls to the dotted position [illegible] and the signal is thus put to danger. In the same manner the man operating the electric circuit may prevent the lowering of the signal at any time. The magnet is shown as working on a normally closed circuit, but in certain cases it may be desirable to work with a normally open circuit. Instead of the diaphragm a piston or valve might be used, but there is less danger of leak with a diaphragm. The device is the invention of A. H. Johnson of Orange, N. J. The cut was taken from the [illegible]

Reorganization of Westinghouse Interests.

At the adjourned meeting of the Westinghouse Electric & Manufacturing company at Pittsburg, July 15th, the plan of reorganization as outlined by Mr. Westinghouse's statement on April 7th was formally adopted, and a new board of directors was elected. The meeting was attended by a large number of stockholders. George Westinghouse, Jr., the president of the company, after calling the meeting to order, made the following statement: "I have pleasure in stating that the plan of reorganization has met with the approval of the holders of over 95 per cent. of the stock of the company. The reorganization committee has closely examined the books, and looked into the affairs of the company generally, and it has announced that it is satisfied with the condition of affairs and is willing to become a part of the board, and is ready to carry out the plans of reorganization upon the lines agreed. Brayton Ives, chairman of the committee, is here to-day to vote the stock deposited with the Mercantile Trust company."

Resolutions necessary to perfect the reorganization were then presented. The main points in the resolutions were: In the plan of reorganization, as announced on April 7th, $4,000,000 of cumulative preferred stock to bear 7 per cent. interest is created, $3,000,000 of which has been taken at par by the reorganization committee. This it is proposed to utilize in arranging for the floating debt of the company and providing for additional working capital. The assenting stockholders, who gave up the required 40 per cent. of their holdings of the original common stock, aggregating $2,500,000, for value, which had been turned over to the Mercantile Trust company of New York for the use of the company, are to receive a 7 per cent. preference on the 60 per cent. of their original stock retained, over the small amount of non assenting stockholders now withheld from the reorganization committee.

There were 141,402 shares of stock voted, which includes the stock voted by Brayton Ives, chairman of the reorganization committee. The following board of directors was elected: August Belmont, Henry B. Hyde, Marcellus Hartley, George W. Hebard and Brayton Ives, all of New York; Charles Francis Adams and Charles Fairchild, both of Boston; George Westinghouse, Jr., A. M. Byers and Lemuel Bannister, all of Pittsburg.

The meeting was then adjourned until July 29th in order to make necessary arrangements for the adoption of the plan of reorganization. The result of the meeting was favorably commented on in financial circles, and the newly elected board of directors is highly regarded for the financial standing and business sagacity of its members. The men at the head of the concern are all of national reputations, thorough business men and able financiers, and with the large amount of capital now at their disposal there is no doubt that the company will once more become an important factor in electrical matters.

The Montreal Convention.

The citizens' committee of Montreal is pushing forward the completion of the plans for the entertainment of the National Electric Light association with the vigor for which the people of that city are noted. The corporation of the city has just voted the appropriation of a large sum of money to be placed at the disposal of the citizens' [illegible]

The use of quite a number of yachts has been tendered by private gentlemen of Montreal especially for the pleasure of the ladies attending.

President C. R. Huntley of the association announces [illegible] introduced this year, as suggested by the executive committee, which will add to the inter- [illegible] information on the details [illegible] the operation of central station [illegible] will be placed at headquarters in Montreal for the reception of written [illegible] will be [illegible]

Enterprise Appreciated.

[illegible] prosperity, and an improvement in the appearance of the [illegible]

International Congress of Electricians at Frankfort.

There will be an International Congress of Electricians during the electrical exposition at Frankfort-on-the-Main. This congress will extend from September 7 until September 12, 1891. A large number of well-known electricians and scientists of all nationalities have signed the circular just published by the Electrotechnical Society of Frankfort-on-the-Main. The list includes the names of Prof. W. E. Ayrton, London; C. F. Brush, Cleveland, O.; Prof. H. S. Carhart, Ann Arbor, Mich.; Prof. A. E. Dolbear, College Hill, Mass.; Thos. A. Edison, Orange, N. J.; W. H. Preece, London; Sir William Thomson, Glasgow.

The following papers will be read:

Carhart, Ann Arbor: Application of Dynamo-electric Machines Instead of Galvanic Cells in Telegraphy, and Current Regulators for Dynamic Electric Machines.

Dolbear, College Hill: Electrical Terminology.

Von Dolivo-Dobrowolsky, Berlin: Electric Transmission of Power with Alternating Currents.

Epstein, Frankfort: Applicability of Electro-magnetic Measuring Instruments (Containing Iron) for Alternating Currents.

Feussner, Charlottenburg: Material and Construction of Measuring Instruments.

Frœlich, Berlin: 1. Curves of Vibration and Electric Acoustic Experiments. 2. Generation and Application of Ozone.

Holborn, Charlottenburg: On the Magnetic Properties of Various Iron Alloys.

Hummel, Nurnberg: Direct Determination of the Work of Magnetization and of Currents in Iron Rings.

Kahle, Charlottenburg: The Admissible Errors of Standardized Measuring Instruments in Relation to Heating, etc.

Kareis, Vienna: 1. Prevention of Cross talk in Telephone Wires. 2. Prevention of Disturbances in Telephony by Currents of Great Strength. 3. Improvements in the Conductivity of Telegraph Conductors.

Kohlrausch, Hanover: What is the Best Course of Education for Electricians?

Lœwenherz, Charlottenburg: Adoption of Standard Screws in Electrotechnics and Mechanics.

May, Frankfort-on-the-Main: Instructions Concerning Electric Conductors from the Standpoint of the Fire Insurance Companies.

Meissner, Gœttingen: Application of Lippman's Capillar-Electro Meters for Cable Telegraphy.

Mueller, Hagen: Connecting Accumulators for Various Purposes.

Peukert, Braunsschweig: On the Question of Electric Meters.

Rothen, Berne: Important Questions Relating to Telephony.

In addition to this list the following named gentlemen have promised to read papers, reserving the right to name the subject later: Alioth, Basel; Arnold, Riga; DuBois, Berlin; Ferraris, Turin; Gœrges, Charlottenburg; Grawinkel, Berlin; Quincke, Heidelberg, and Slaby, Charlottenburg.

A general invitation has been extended to electricians and persons interested in electrical matters to attend this congress. Applications for tickets are to be directed to the "Vorstand der Electrotechnischen Gesellschaft zu Frankfurt a. M."

A ticket will cost 16 marks (about $4.00). Tickets for ladies, 10 marks. These tickets contain eight coupons, which give the right to visit the electrical exposition and the garden of palms and the zoological garden from September 7th to the 13th. Special cards are required for the dinner and the gala performance in the opera house, the ball and the excursion to Wiesbaden.

The programme of this congress is a very elaborate one, both from a scientific view and relating to amusement, and the committee hopes to have a large number of foreign visitors.

Proposed Electric Road between Chicago and Milwaukee.

The promoters of the rapid transit line between Chicago and Milwaukee described in the last issue of the WESTERN ELECTRICIAN not only propose to make the run between Chicago and Milwaukee in one hour, but to reduce the fare for the single trip, which is now $2 53, to the very [illegible] of $1. They declare that they will run trains every half hour. The object in making the road an elevated one is to [illegible] crossings, and permit the very best time possible. It is claimed that there will be less danger of accident than on ordinary steam railroads, notwithstanding the great speed at which the electric trains on the elevated road will be run. It will be almost impossible, [illegible] for the cars to get off the track. There will be two sets of wheels, one smaller than the other and hung below the rail, and the latter will bear upon the under side of the rail, but will not touch it so long as the cars remain perfectly upright, but if the car be tilted to one side or the other, the smaller wheels will clutch the rail, and, it is claimed, prevent any derailment. The promoters held an informal conference last week and seemed to be in a very confident frame of mind. They state that a considerable portion of the capital stock has already been subscribed.

The Book Table.

UNIVERSAL WIRING COMPUTER. By Carl Hering, 44 pp., 4x7 inches, with tables. Published by the W. J. Johnston company, limited, New York. Price $1.

The author states in the preface that this book is intended to facilitate the computing of the size and quantity of wire used for wiring. It is not a treatise on wiring, but assumes a knowledge of wiring on the part of the reader. It is intended for a book of reference and not for a book of instruction. In this latter respect it therefore differs considerably from other treatises extant, and especially from the "Incandescent Wiring Hand-book," which initiates the incandescent wireman in the rudiments of wiring.

The charts and wiring tables of the "Computer" will be found very convenient for a special and limited class of work. The wiring tables on pages 29, 40, 41, 42, 43 and 44 are in form and contents almost identical with wiring tables gotten up about six years ago by the engineering department of the Chicago office of the United States Electric Lighting company. They were always considered to be very useful tables.

THE ARITHMETIC OF ELECTRICITY. By T. O'C. Sloane, Ph. D., illustrated, 134 pp., 3x5 inches. Published by Norman W. Henley & Co., New York. Price $1.

This is a very useful book to students and really an extension of Day's Electric Light Arithmetic.

The book is made up on the general plan of the "Incandescent Wiring Hand-book," even the "rules" being printed in heavy type, followed by examples. The rules for incandescent wiring are almost identical with those of the "Incandescent Wiring Hand-book."

Henry Villard's Plans.

Since Henry Villard's return to this country recently his movements have been watched closely by capitalists who are interested in rival corporations. Mr. Villard has been interviewed by a New York reporter on the outlook for his American enterprises. Questioned about the North American company, Mr. Villard called attention to the fact that the company occupied two fields, one of which was the promotion of electric light and power enterprises. "The substitution of electric light for other illuminants, and of electric for steam power in manufacturing and transportation, that is now progressing all over the civilized world, and nowhere more rapidly than in this country, offers the greatest opportunities for the lucrative employment of large capital," said Mr. Villard. "In Milwaukee this company has acquired all the street railway and electric light properties previously contracted for, and is now engaged in substituting the trolley system of electric traction in place of animals as a motive power for the railways, and in completing the electric light plants and central power station under favorable contracts with the Edison General Electric company.

"In Cincinnati this company has obtained valuable franchises for the introduction of the incandescent light and the use of electricity as a motive power, and for all kinds of industrial and domestic purposes, and the work of construction is well under way, some miles of underground conduits having already been laid and the construction of the electric lighting and power plant being well in hand. It is expected that within the next few months the Cincinnati company will be in full operation. In these electrical enterprises the company has the co operation of the German banks and bankers whom I have represented in this country since 1886."

Crystal Palace Electrical Exhibition.

The exhibits for the Crystal Palace electrical exhibition will be received at Crystal Palace, London, from October 12 to November 2, 1891, and every exhibit must be in position by November 6th. The honorary council of advice includes such men as Sir Frederick Abel, Professors Ayrton, Kennedy and Unwin, Mr. Preece and Sir David Salomons. The exhibition will remain open for some months. No rent will be charged for space, and it is said that even now sufficient applications have been made to insure the success of the undertaking, and that if English exhibitors are at all backward in applying for the remaining space it will be allotted to foreign exhibitors. A limited amount of power can be supplied, for which exhibitors will be charged according to the amount they consume. All installations of electric light are to be carried out strictly in accordance with the rules laid down by the fire offices committee. Medals and certificates are to be awarded.

Incandescent Lamp Litigation.

The decision of Judge Wallace in the case of the Edison Electric Light company against the United States Electric Lighting company was announced in the last issue of the WESTERN ELECTRICIAN.

Considerable interest was of course manifested is this decision, involving as it does, the control of the entire incandescent lamp business. It is probable, however, that an appeal will be taken, although as yet notice of appeal has not been served. Eugene H. Lewis, of Eaton & Lewis, attorneys for the Edison company in the recent hearing, was in Chicago last Monday. To a representative of the WESTERN ELECTRICIAN he said that while there had been no notice of appeal as yet, the Edison company anticipated further litigation. "However," he added, "Congress could not have enacted a law more fortunate for us than that passed at the last session establishing a court of appeals at New York. According to that act any patent decision rendered after July 1st must be appealed to this court. It so happened that the decision in the Edison case was the first patent case decided after July 1st, so that if the case is appealed it will be heard in the new court early in October instead of waiting its turn for three or four years in the Supreme Court. Thus, if the case is appealed, we will get an early decision, and one whose benefits will not be modified by delay."

G. O. Fairbanks, Chicago representative of the Westinghouse Electric & Manufacturing company, said that he knew absolutely nothing about the case or decision beyond the facts given in the papers. "This decision will affect other companies as well as ours," he said. "It will stop the manufacture of many lamps; the case will probably be appealed."

F. S. Gorton of the Chicago Edison company said: "I have always pinned my faith, and incidentally my spare cash, to the Edison company, knowing that this decision would eventually be rendered." Concerning the companies opposed to the Edison interests, he added: "These companies have been playing a game of bluff and saying that this thing didn't amount to anything They have gone ahead manufacturing new lamps regardless of patents and points of law. Now the court has decided against these pirates, and they must stand the consequences."

"Will the case be appealed?"

Mr. Gorton scowled darkly at the windows of the Westinghouse company, whose offices are across the street in the Rookery building, and expressed the opinion that it would be appealed, but to no purpose.

B E. Sunny of the Thomson-Houston Electric company said that the decision was one that they had been expecting and helping to bring about as far as possible. "This decision will do away with poor lamps," he said, "and will put an end to the manufacture of lamps by those who don't know how to manufacture them."

F. S. Terry, manager of the Electrical Supply company, Chicago, when questioned about the recent decision in the lamp case replied:

"I have not given especial attention to the matter, but we have been and still are selling incandescent lamps."

"But what effect do you think this decision will have upon the trade?" he was asked.

"I have not considered the matter very fully, but if the Edison company pursue the policy which I understand is contemplated, it ought to be to the advantage of all large concerns engaged in making or selling incandescent lamps. The 'wild-cat companies' and 'curb-stone dealers' have succeeded in reducing prices to a point at which no profit can be made by the manufacturer or dealer, and if the Edison company will put prices up, and then make all the manufacturers preserve a uniform scale, and pay it (the Edison company) a reasonable royalty, the result will be profitable to all, and certainly bring an immense return to the Edison company."

"But what about the litigation which is likely to follow?"

"If the Edison company pursue this policy, there will be no litigation, as all the manufacturers and dealers will, in my opinion, gladly acquiese, and find, besides, that they are benefited after they are well over the smart of having to pay some damages. If, however, the Edison company should attempt to stop manufacturers and dealers from making and selling lamps, I think a desperate, expensive and long drawn out fight would follow, certainly lasting until the patent expires, which I understand will be in about two years. You can see, of course, that any attempt on the part of the Edison company to close the lamp manufacturers would necessarily result in a combination of lamp and machinery manufacturers, as well as dealers, against the Edison company. The Edison policy of raising prices, keeping them uniform, and levying a royalty from other manufacturers, meets my approval, and in view of the court's decision, I think that substantially all of the people interested in this branch of the business will cheerfully support the Edison company in that policy."

"But suppose the Edison company should succeed in stopping the manufacture of other lamps, notwithstanding the fight which you think would be made, what course would you take then?"

"I do not believe the Edison company will attempt such a thing, as it seems clear to me that such action could not possibly be the most profitable course for them to pursue, nor do I think they could close up the manufacturers during the life of the patent, even if they wished to do so. Such an attempt on their part would, in my opinion, stimulate invention and result in the development of a new lamp, entirely independent of the Edison patent. Indeed, I actually know of a person who, anticipating such a conclusion of the Edison suit, has been working for a year in the direction I mention, and has succeeded in producing a lamp, which proves to be entirely satisfactory and which does not use an exhausted globe. This lamp, I am assured, has passed successfully through every experiment, and I have every reason to believe it to be a thoroughly practical and successful article, and one that besides can be easily introduced should occasion arise."

Several of the managers of the local supply companies which were affected by the decision, declined to say anything for publication.

The opinion accompanying the decision is appended:

Two claims of letters patent, No. 223,898, granted Thos. A. Edison, January 27, 1880, for an improvement in electric lamps, are in controversy in this suit. These are claims 1 and 2. It is not asserted for plaintiff that the defendant infringes the other claims of the patent, consequently they will require no attention further than to see whether their terms may assist in defining the meaning of the claims in litigation.

The plaintiff contends that these claims are for fundamental inventions of great merit, and are entitled to a construction by which every incandescent lamp for electric lighting, consisting essentially of a filamentary carbon burner, hermetically sealed in a glass vacuum chamber, is within their terms. The defendant contends that unless the claims are limited to narrow inventions, not employed by the defendant, they are invalid for want of patentable novelty. The questions of the validity and scope of the patent have been adjusted in the courts of England and Germany with a diversity of opinion by the judges who have considered them. The specification is a perplexing one. The difficulty lies in its shadowy demarkation of the line between the essential and non-essential features of the invention described. It catalogues a number of discoveries which Mr. Edison had made; it sets forth some of the essential features of the lamp, and then it leaves to be found by inference from generalities what the elements are of the combinations included in the extremely elastic terms of the two important claims.

Nevertheless, when a sufficient knowledge of the prior state of the art to which it relates has been acquired, the new departures from the old devices which it describes, and which, presumably, the inventor proposed to incorporate into the claims of his patent, are reasonably apparent. The specification states that the object of the invention is "to produce electric lamps giving light by incandescence, which lamps shall have a high resistance so as to allow of practical subdivision of the electric current into numerous small units and their conversion into luminous centers." By practical subdivision is meant a distribution and division of the current and its conversion into lights comparable with those of ordinary gas jets, on a scale and under conditions of convenience and economy adequate to a system of illumination for domestic purposes in villages and cities analogous to that of gas. Prior to 1879 there was no method known by which this could be done practicably. The problem involved the perfection of devices for the proper distribution and regulation of the current as well as those for translating it into the light. No reference to the pre-existing devices for generating electricity, conducting it to the translating devices, or regulating its pressure and quantity, is necessary except to state that the principles governing the relation of the resistance of translating devices to the character of the circuit in which they are arranged, whether in series or in multiple arc, were well known to electricians, and had been applied in various forms of electrical apparatus. They were two well-known devices for converting the current into light—the arc lamp and the incandescent lamp. In the former the current is forced to leap an air gap separating two conductors, usually of carbon, and in overcoming the resistance of the air space heats the adjacent surfaces of the conductors and produces a light of great intensity. In the latter light is produced by the incandescence of an electrical conductor, a conducting strip of burner, placed in a continuous circuit through which the current passes and which develops heat by its resistance to the flow. The arc lamp was suitable for use in streets, open spaces and large halls but its light was too concentrated and powerful for the illumination of dwellings or of rooms of small dimensions. It was the generally accepted opinion of electricians that the hope of progress in the subdivision of the electric light was to be found in modifying the features of the arc lamp. The reason for this conclusion need not be mentioned; it suffices to say that Mr. Lane-Fox in England and Mr. Edison in this country seem to have been the only notable dissidents, and each of them had expressed the conclusion that subdivision might be accomplished by the incandescent lamp when provided with a conductor of high resistance and small radiating surface arranged in system of multiple arc. Lane-Fox had set forth the advantages of such a lamp in three patents granted to him in England, two in October, 1878, and one in March, 1879, and in a letter to the

[illegible] than for a single one, and the amount of current can be [illegible] resistance in the conductor permits the use of a weaker current, [illegible] energy is [illegible] small incandescent mass will radiate a moderate light, like the domestic lamp Electricians knew how to make conductors of high resistance [illegible] small radiating surface. They knew that with the materials of the same specific resistance the total resistance of the conductor could be varied by varying its length and cross section. They knew what materials were preferable and what processes of treatment to make conductors of high or low resistance.

If they had only known how to construct a lamp in which the conductor would have adequate mechanical strength and durability for practical commercial use, while having the small radiating surface and high resistance desirable, there would have been nothing wanting and electric lighting by incandescence would soon have been an accomplished fact. Although Lane-Fox and Edison had contributed to the state of the art the recognition of the principle that the conductor must have high resistance and small radiating surface, and each of them had embodied the principle in lamps for which they had severally obtained patents, neither of them had invented a lamp which satisfactorily embodied all the conditions of success, because a burner of the necessary material, form and complementary adjuncts was yet to be devised. As to material, experiments had been tried with platinum, iridium and alloys of these metals, and with carbon of various kinds. It was known that platinum, being a poor conductor, could be readily brought to incandescence by the electric current, but to do so it was necessary to raise a temperature very near the fusing point, and a minute increase would melt it. On the other hand, carbon was known to possess at an equal temperature much greater power of radiation than platinum, but the difficulty was that it would combine with oxygen at high temperature and rapidly disintegrate. It could only be used, therefore, in a vacuum, which is practically unattainable. From the earliest lamp (disregarding the Geisler tube, because it has no burner in the true sense) patented in England by King in 1849, to the latest examples, like those of Lane-Fox or Edison's platinum lamp, patented in 1878 9, the history of the art shows a variety of experimeuts to perfect a lamp in which a carbon burner or a platinum burner would have sufficiently long life for practical requirements. The result of these experiments may be succinctly shown by quoting two well-known electricians. Mr. Schwendler, in an article published in 1879 in the *Telegraphic Journal*, said: "Unless we shall be fortunate enough to discover a conductor of electricity with a much higher melting point than platinum, and the specific weight and specific heat of which conductor is also much lower than for platinum, and which at the same time does not combine at high temperatures with oxygen, we can scarcely expect that the principle of incandescence will be made use of for practical illumination." Mr. Sawyer, in a patent to Sawyer & Man, granted in June, 1878, said: "At the present day it is not new to produce a light by causing the electric current to heat a carbon conductor to incandescence in a vacuum, or in nitrogen, or in other gas; but no lamp has yet been devised which would be practically operative, and for these reasons: First, the methods which have been adopted for charging the lamp with the artificial atmosphere, such as a displacement of mercury, water or air by the gas, or the combustion of phosporus in the lamp are imperfect. A perfect vacuum is unattainable. Some oxygen or other element or compound remains in the lamp, and slow consumption or disintegration takes place, for the remaining gas or vapor other than hydrogen or nitrogen attacks the carbon, which, in turn, is decomposed, with a result of depositing some carbon upon the globe and setting free the oxygen to attack fresh carbon. Second, it has been found practically impossible under the varying degrees of heat and pressure to maintain perfect joints, and the result is that expansion of the artificial atmosphere by the heat from the luminous conductor expels a portion of the same, and the contraction of the atmosphere upon cooling causes a portion of the external air to penetrate the globe, thus supplying oxygen which at the least lighting feeds upon the carbon. Third, the unequal expansion of the carbon and its holders has resulted in fractures of the former, so that, however perfect the atmosphere in the globe, the lamp has never been permanent."

The most advanced type of carbon burner lamps in 1875 were the lamps of Lodyguine or of Konn, and until the spring of 1879 lamps like those of the Sawyer [illegible] Man patent or the patents of Mr. Farmer. It was thought to be the merit of Lodyguine's lamp that it obviated the difficulty of the short life of the burner by using two burners, rods of diminished section at the luminous focus, on a glass receiver, hermetically sealed and filled with nitrogen, electrically arranged so that the current would be passed to the second carbon when the first had been consumed. Konn provided his lamp with five carbon burners in the form of rods or pencils, and devices for bringing them successively into circuit. In the lamp of Sawyer & Man the carbon burner was a rod [illegible] globe charged with nitrogen gas, and the globe and its stopper both of glass were held [illegible]

In the lamp of the patents granted to Mr. Farmer, in March, 1879, the burner was a carbon [illegible] filled with hydrogen or other analogous gas, and the globe was closed by a rubber stopper [illegible] the one described in Mr. Edison's [illegible]

patents of 1878, had any attempt been made to make the vacuum chamber wholly of glass with the parts sealed together by fusion, or to seal the conducting wires leading to the burner through the glass by fusion of the glass. The impracticability of maintaining a carbon burner under such conditions that it would be sufficiently durable has apparently so impressed those who were studying lighting by incandescence that as late as in the early part of 1879 both Lane-Fox and Edison were trying to perfect a burner of other material. Edison's burner in his French patent of May 28, 1879, was of platinum wire coiled upon a bobbin composed of an infusible oxide, and Lane Fox's burner in his patent of May 14, 1879, was of platinum-iridium alloy, or of spiral strips of metal surrounding a tube of glass, fire-clay, steatite or lime, with the surface of the metal strips covered with asbestos, or some vitreous material.

This cursory view of the prior state of the art is sufficient for an intelligent reading of the specification. The specification describes the general nature of the invention as follows:

"The invention consists in a light-giving body of carbon wire or sheets coiled or arranged in such a manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation can take place.

"The invention further consist in placing such burner of great resistance in a nearly perfect vacuum to prevent oxidization and injury to the conductor by the atmosphere. The current is conducted into the vacuum bulb through platina wires sealed into the glass.

"The invention further consists in the method of manufacturing carbon conductors of high resistance, so as to be suitable for giving light by incandescence, and in the manner of securing perfect contact between the metallic conductors or leading wires and carbon conductors."

The specification then recites that previously light by incandescence had been obtained from rods of carbon of one to four ohms resistance placed in closed vessels in which the atmospheric air had been replaced by gases that did not combine chemically with the carbon; that the vessels holding the burner had been composed of glass cemented to a metal base; that the connection between the leading wires and the carbon had been obtained by clamping the carbon to the metal; that the leading wires had always been large, so that their resistance should be many times less than the burner, and generally the attempts of previous persons had been to reduce the resistance of a carbon rod. It then points out the disadvantages of such a lamp, stating that it could not be worked in great numbers in multiple arc without the employment of main conductors of enormous dimensions; that, owing to the low resistance, the leading wires have to be of large dimensions and good conductors, and a glass globe cannot be kept tight at the place where the wires pass in and are cemented, and consequently the carbon is consumed because there must be almost a perfect vacuum to render it stable, especially when it is small in mass and high in electrical resistance; and that the use of gas in the receiver at the atmospheric pressure serves to destroy the carbon by attrition.

The specification then states in substance that the patentee proposes a new departure; that he has discovered that even a cotton thread properly carbonized and placed in a sealed glass bulb exhausted to one millionth of an atmosphere offers from 100 to 500 ohms resistance to the passage of the current, and that it is absolutely stable at very high temperatures; that if the thread be coiled as a spiral and carbonized, or if a fibrous vegetable which will leave a carbon resistance after heating in a closed chamber be so coiled, as much as 2,000 ohms' resistance may be obtained without presenting a radiating surface greater than three-sixteenths of an inch; that if such fibrous material be rubbed with a plastic compound of lampblack and tar its resistance may be made high or low, according to the amount of lampblack placed upon it; that carbon filaments may be made by a combination of tar and lampblack, the latter being previously ignited in a closed crucible for several hours, and afterward moistened and kneaded until it assumes the consistency of thick putty; that small pieces of this material may be rolled out in the form of wire as small as seven one-thousandths of an inch in diameter and over a foot in length, and the same may be coated with a non conducting, non-carbonizing substance and wound on a bobbin, or as a spiral, and the tar carbonized in a closed chamber by subjecting it to high heat, the spiral after carbonization retaining its form; that he has carbonized and [illegible] papers, coiled in various ways, also lampblack, plumbago and carbon in [illegible] kneaded so that the [illegible] of various lengths and diameters; that each wire should be uniform in size [illegible] fragile and cannot be [illegible] force to [illegible] that if platinum [illegible] tar material [illegible] there is [illegible] tween the carbon and platinum, and nearly perfect contact [illegible]

appearance of the light, which on a plain wire is prejudicial, as it shows the least unsteadiness of the current by the flickering of the light, and if the current is steady the defect does not show."

The specification then gives directions for carbonizing the carbon thread in a manner to prevent its distortion, for blowing a glass bulb over it after it is formed, for exhausting the glass bulb, and for hermetically sealing the bulb when a high vacuum has been reached.

The claims are as follows:

"1. An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires as set forth.

"2. The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted, for the purpose set forth.

"3. A carbon filament or strip coiled and connected to electric conductors so that only a portion of the surface of such carbon conductors shall be exposed for radiating light, as set forth.

"4. The method herein described of securing the platina contact-wires to the carbon filament, and carbonizing of the whole in a closed chamber, substantially as set forth."

The specification is addressed to those who were skilled in the art to which it relates; who appreciated the advantages of arranging incandescent lamps in a system of multiple arc, and of providing the lamp with a burner of high resistance with small radiating surface; who knew how high resistance, both specific and total, is imparted to a conductor; who knew that the rods, pencils, or other forms of carbon burners previously used had not been designed to embody the principle of high resistance; who knew how desirable it was to maintain the burner in a perfect vacuum, or in gases that would exclude the oxygen; who knew what had been attempted and had proved impracticable in that behalf; who knew that such materials as are mentioned in the specification (even the tar-putty compound seems to have been used in one process) would compose a carbon of high resistance when subjected to a proper process of carbonization; and who knew how to practice proper processes for the carbonization of such materials.

Read by those having this knowledge, the radically new discovery disclosed by the specification is that a carbon filament as attenuated before carbonization as a linen or cotton thread, or a wire seven one-thousandths of an inch in diameter and still more attenuated after carbonization, can be made which will have extremely high resistance and be absolutely stable when maintained in a practically perfect vacuum. It informs them of everything necessary to utilize this discovery and incorporate it in a practical lamp. It describes, with the assistance of the recital in the second claim, as the vacuum in which the burner is to be maintained a bulb made wholly of glass, exhausted of air, sealed at all points by the fusion of the glass, and in which platinum leading wires are sealed by the fusion of the glass. It describes the materials of which the burner is to be made, and instructs them that the materials are to be shaped into their ultimate form before carbonization. It describes the use of platinum for leading wires, and a method of securing the leading wires and filaments, intended to dispense with clamping, which consists in moulding tar-putty about the joints and carbonizing the whole in a closed chamber. Besides stating that the resistance of the burner will be greatly increased and the radiating surface still be kept within moderate limits by coiling it in the form of a spiral, the specification states that by increasing the lengths of the filament coiled the exterior only will be the principal radiating surface, and greater steadiness of illumination will be promoted.

The first claim must be read with several limitations. The filament is to be made of carbon of high resistance; that is, as the experts agree, of high specific resistance. The filament is to be made as described, that is, the materials are to be of some of the kinds described, and are to be shaped in filamentary form and then carbonized. The filament is to be secured to metallic wires according to the method of the patent, because the claim implies the elements of a globe and metallic conductor arranged in circuit with the burner, otherwise the combination would not be operative, and it would have been needless to specify the securing of the metallic wires to the filament unless it was intended to insert into the claim the specific method of doing so emphasized in the specification.

The defendant does not infringe this claim, if for no other reason, because the leading wires in its lamps are not secured to the filament according to the method of the patent, that is, by cement carbonized in situ, by clamps such as the specification condemns.

The second claim is broad enough in its phraseology to secure the real invention described in the specification, and can be read consistently with its language so as to impart into it every essential limitation.

It was a remarkable discovery that an attenuated thread of carbon would possess all the long-sought qualities of a practical burner when maintained in a perfect vacuum. The extreme fragility of such a structure was calculated to discourage experimentation with it, and it does not detract in the least from the originality of the conception that previous patents had suggested that thin plates, or pencils, or small bridges could be used. The futility of hoping to maintain a burner in vacuo with any permanency had discouraged prior inventors, but Mr. Edison is entitled to the credit of obviating the mechanical difficulties which disheartened them, but what he did in this respect was a matter of only secondary merit, and was no longer new in the art because he had already disclosed it in his French and English patents. What he actually accomplished was to unite the characteristics of high resistance, small radiating surface, the durability in a carbon conductor by making it in a form of extreme tenuity out of any such [illegible] production, carbon [illegible] and previously arranged [illegible] made wholly of [illegible] the

leading wires entered, by the fusion of the glass. He was the first to make a carbon of materials and by a process which was especially designed to impart high specific resistance to it; the first to make a carbon in the special form for the special purpose of imparting to it high total resistance; and the first to combine such a burner with the necessary adjuncts of lamp construction to prevent its disintegration, and give it sufficiently long life. By doing those things he made a lamp which was practically operative and successful, the embryo of the best lamps now in commercial use, and but for which the subdivision of the electric light by incandescence would still be nothing but the ignis fatuus which it was proclaimed to be in 1879 by some of the learned experts who are now witnesses to belittle his achievement and show that it did not rise to the dignity of an invention.

The coiled form of the burner is only an alternative feature and is not a constituent of the second claim. It is the subject of the third claim. Nor is the bent form or any form other than the filamentary. It may be that in the haste which has always seemed to characterize Mr. Edison's effort to patent every improvement, real or imaginary, which he has made or hoped to make, he had not stopped to reflect when he framed his application for the patent that the filamentary burner would do its work just as well uncoiled as coiled, provided the same length and cross section were used. It is true that it is said in the general statement of the nature of the invention that the burner is so "coiled or arranged" as to offer high resistance and present a small radiating surface; but this description is satisfied by any arrangement, whether by coiling a considerable length in a small globe or using the same length uncoiled in a large globe, by which sufficient total resistance is obtained from a filament of small diameter. It certainly would not involve invention to omit the coiling and elongate the globe; hence, it is manifest that the invention described is the same thing essentially, whether the coiled form is used or not. The language is satisfied if the burner is filamentary and so arranged as to offer great resistance and slight radiation, without importing into it anything which is not of the essence of the invention. No precise limitation upon the maximum diameter of the filament can be defined from the specification or is required as an element of the claim. The specification mentions by way of illustration the threads of linen or cotton which become more attenuated after carbonization and the carbon wire which after carbonization would be from four to five one-thousandths of an inch in diameter, while the smallest rods of carbon previously known were about a millimetre in diameter, thus having a cross section fifty times as great as the carbon wires. It is to be implied from the suggestions in the specification that it is to have sufficiently high total resistance for efficient use when the lamps are arranged in multiple arc, and to be used with leading wires of fine platinum. The claim is not limited to a carbon filament made of non-fibrous material. The conductors of the claim are the platinum wires mentioned in the specification. The receiver is the vacuum described in the specification. The peculiar method of securing the conductors to the filament, made a constituent of the first claim, is not imported into the second claim. A more exact interpretation of the meaning of the claim than has thus been indicated is not necessary in the present case, because each of the three lamps representing the kinds used by the defendant embodies the invention of the claim as thus interpreted.

It is of little import what Mr. Edison or his patent solicitor may have thought about the meaning of the claim during the pendency of the application for a subsequent patent, or that Mr. Edison may have supposed a resistance as high as 100 ohms in the burner would be required for use with the means of distribution which he expected to employ with his system of lighting. There are many adjudicated cases in which it appears that the inventor builded better than he knew; where a patent has been sustained for an invention the full significance of which was not appreciated by the inventor when it was made. In the case of the Bell telephone patent there was great room for doubt whether the speaking telephone had been thought of by Mr. Bell when he filed his application for a patent, but the court said: "It describes apparatus which was an articulating telephone, whether Bell knew it or not." 88 Blatch., 532.

The nearest approach in the prior art to the invention of the second claim is undoubtedly the lamp of Edison's French and English patents with a platinum burner. It seems almost preposterous to argue that the substitution of the carbon filament for the platinum burner of that lamp was an obvious thing to electricians. It would have been probable if there had been such a thing as a filamentary carbon in the prior art. But the nearest approximations to it were the ribbon-shaped carbon burner of low resistance of Mr. Farmer (which was not a part of the prior art, but an isolated example known only to a select few) and the low resistance carbon rod burners of the patent of Sawyer & Man.

Undoubtedly the improvements that have been made in the art, such, for instance, as the method of electrical carbonization of the filament, since Mr. Edison's invention, have been of great value, and the perfected commercial lamp of to day is far superior to the one which could be made by applying to the description of the patent all the knowledge and skill then possessed by those to whom it was more particularly addressed. But as was said by Bowen, L. J., in the court of appeals in England, "The evidence shows that lamps made solely on the patent will and do succeed, although subsequent improvements have been engrafted on the original design." It is impossible to resist the conclusion that the invention of the slender thread or carbon as a substitute for the burners previously used opened the path to the practical subdivision of the electric light.

The questions which have seemed the most meritorious of those argued at the bar have now been considered. Others, to which no reference has been made, have not been overlooked, and may be dismissed without discus-

sion, and with the single remark that nothing which has been presented by the voluminous proofs and the exceedingly able and elaborate arguments of counsel seems to supply any valid reason for refusing to decree for the plaintiff. The usual decree for an injunction and accounting is accordingly ordered.

CORRESPONDENCE.

New York Notes.

NEW YORK, July 18.—That Judge Wallace would render a decision favorable to the Edison interests in the incandescent lamp litigation was pretty confidently looked forward to by the knowing ones in electrical circles. These knowing ones predicted that if the suit were thus decided Edison stock would go bounding up sky high. In this, however, they were wrong, as Edison stock, no doubt to the disappointment of many who were holding it for a rise, did nothing of the sort. On the day that the decision was given out the price ran up about seven per cent., but no higher, and since then there has been a slight falling off. At present the stock is only quoted at three or four points above par, and no further increase in price seems probable for the present.

The question of the actual present benefit to be derived by the Edison General Electric company from the decision affirming its monopoly depends chiefly on the character of its own treasury assets. Its most valuable rights to the introduction of the incandescent lamp are leased to minor companies; the Edison Electric Illuminating company, for instance, controlling the business in this city. These concessions have a long term to run, and would yield nothing to the parent company in the territory surrendered, but for the fact that the stock in the smaller companies was, to a considerable extent, taken up by the Edison General company in part exchange for the conceded rights. The Illuminating company, having the right to use the incandescent lamp on Manhattan Island, will be a great gainer by the decision. There has been considerable opposition built up by the alternating current people, in both the upper and lower parts of the city, and the competing companies will now have to pay the Illuminating company a royalty on the incandescent lamps they use. According to an official statement just issued the net earnings of the Edison Illuminating company during the six months ending July 1st were $152,000, against $99,000 for the corresponding period of last year, an increase of over 53 per cent. This is a striking proof of the general opinion existing among electrical men in New York that the business of the Illuminating company is governed by a thoroughly sound and progressive policy.

General interest in the electrocutions has died out very quickly, and it would have been even shorter lived, because, after all, the topic is a disagreeable one, had it not been for the prolonged howl of our "brainy, breezy, newsy" newspapers at being excluded from the death chamber. One of the coroners of this city achieved a little notoriety by threatening to hold an inquest on the body of Smiler. He announced his resolution to have the body exhumed for the purpose of making another autopsy, but desisted, on being curtly informed by the attorney-general that he had no authority whatever to make the investigation contemplated. The state physicians, congratulate Warden Brown, "on the completeness in all their details of the preliminary arrangements, on the uniform good order and decorum which prevailed during the trying ordeal, and on the resulting demonstration of the rapidity and painlessness of this method of inflicting the death penalty"—'congratulations" which, to say the least of it, are scarcely in good taste, any more than the use of the word is. The physicians also state that "the experience of to-day has proved to our satisfaction that this method is superior to any other yet devised." And that is the last that I shall write you about electrocution, I hope, for a long time to come.

Great interest is manifested here in the preparations for the approaching week's cruise and drill of the state naval militia, to which a number of electrical men belong. The squadron of evolution, numbering seven vessels in all, headed by the flagship Chicago, is now anchored in the Hudson river. Next week the squadron will proceed to the eastern end of Long Island Sound, where the naval militia will embark and be treated to a week's hard work in the shape of drills of all sorts. The volunteers will be taught by the regular ships' companies the handling of the large and small guns and the general work of clearing a ship for action. Target practice with the big guns and a night torpedo attack form part of the programme, and an invasion of Fisher's Island, the scene of operations, will wind up the manœuvers.

If the systems of rapid transit which New Yorkers hope some day to see at work in this unhappy, congested island prove to be no more rapid than the tedious deliberations of the Rapid Transit commission itself, the inhabitants of this city are doomed to grievous disappointment. The motto of the commission may be "slow and sure," but it would seem to be "slow and uncertain." A meeting was announced for yesterday, when it was supposed that the route for the east side would be made public, and that also a description of the plan of construction of the Broadway route would be given out. Nothing of the sort took place. An executive session only was held, and no decision was arrived at. Next week, say the commissioners, they will probably decide on both questions. They have met with much difficulty above the Harlem river, where the law prohibits the building of a surface road, and they are not yet settled in their opinion as to whether the line should be underground, elevated or depressed. At present the public is depressed, owing to the dilatoriness of the commission in handling the important business for which they were preparing themselves for so long before actually entering on their duties.

The victory of the trolley in Brooklyn in face of most determined and bigoted opposition is naturally received with mixed emotions by the inhabitants, official and unofficial, of that benighted city. The State Board of Railroad Commissioners came out flat footed in favor of the trolley, to the credit of their common sense, be it said. They hold that it does not increase the danger of fire; that it does not impair the appearance of the streets; that the danger of running over pedestrians and collision with vehicles is inconsiderable, and that the trolley system has decided advantages over horses. To all of which opinions electrical men will doubtless say, "Amen." Some of the Brooklyn city fathers do not agree with the railroad commissioners, and as it is left for them to decide at what speed the cars shall be run, and to approve the poles used for supporting the wires, they hope to make trouble for Mr. Richardson yet. That gentleman has had extended experience in dealing with local statesmen, and no doubt he will induce them to allow the cars to run at a reasonable rate of speed, and also to approve of the poles which he already has submitted for their inspection.

The learned president of the Board of Electrical Control last month caused that august body to pass a resolution declaring the bond of the Consolidated company forfeit because certain subways were not finished on time. He also threatened to confiscate the subways, which have cost a trifle of five millions and a half of dollars Mayor Grant's colossal piece of bluff has been ignominiously scattered to the four winds by the corporation counsel, who has notified the mayor that the board had no authority to pass any such resolution or take any such action, consequently the resolution is inoperative, and the board, through its president, has once more made a spectacle of itself. The board has ordered that all poles and wires in the district bounded by Third and Eighth avenues and Eighth and Fifty-ninth streets, should be removed within ninety days, but the corporation counsel has also informed the board that it has no power to order the removal of poles and wires in districts where no subways have been provided, so that a goodly portion of this order is inoperative also, as there are no subways in many of the streets in the district alluded to. During the first six months of this year 3,156 poles and 5,573 miles of wire have been removed by direction of the board.

The announcement of the appointment of the Council of the Society of Arts to act as the Royal Commission for Great Britain at the World's Fair has been very well received here. The commission has many noted names on its roll, beginning with the Prince of Wales, who takes a marked interest in exhibitions of all sorts. James Dredge, the well-known editor of *Engineering*, who has many friends in this country, is an active member of the commission. Among the noted civil and electrical engineers on the commission are Sir Frederick Abel, William Anderson, Sir Frederick Bramwell, Professor Dewar, James Forbes, Sir Douglas Galton, Professor Roberts-Austen, and W. H. Preece, the chief electrician of the postoffice telegraphs.

The Empire City Electric company, now in course of liquidation, has liabilities amounting to about $100,000. The company has lately been losing several thousand dollars a month, and O. E. Madden, the chief owner and financial backer of the company, at last decided to let it go into liquidation. The stock is now being sold by the receiver, Charles R. Beardsley, and the creditors expect to realize a large percentage of the amounts owing them.

W. I. H.

Pittsburg, Pa.

PITTSBURG, Pa., July 18.—The Department of Public Safety of this city has passed an ordinance directing that all street cars must come to a dead stop within twenty feet of every crossing of the streets in the lower or business portion of the city. The department was prompted to take [illegible]

[illegible]

The board of directors of the Pleasant Valley Electric street [illegible] the last six months. This is the second of the electric street railway companies declaring a dividend since it changed [illegible] operated [illegible] expenditures and net earnings was presented: Receipts for the last six months of 1890, $163,526.55, and for the six months of 1891, $183,884.44, showing an increase of $20,357.89. Receipts for the month of June, 1890, were $27,[illegible].05, and [illegible] June, 1891, $[illegible] of $5,953.30. The expenditures during the first six months of 1891 were $124,046.05, which shows the net earnings as $64,046.05.

The Second Avenue company of this city has decided to extend its line to Homestead, a distance of four miles. The history of this company will be of interest to street railway men. The Second Avenue Passenger Railway company is one of the oldest street railway companies in this city. It was one of the first to change from horse and mule equipment to the modern method of rapid transit, the electric motor. The Second avenue line was started by W. J. Burns, who is now general manager of the road. In 1876 Mr. Burns had a large number of stage coaches engaged at the Philadelphia Centennial exhibition, and when that celebration was over he anxiously looked around for a means of putting those coaches into service. He then obtained the right of way from the city of Pittsburg to run his coaches along Second avenue. The operation of these vehicles was continued for many years, but it was accompanied with but indifferent success. Mr. Burns was at last prevailed upon to sell his franchise, and the new management immediately laid tracks and ran a horse car line along Second avenue as far as Copperworks station, a distance of two miles from the starting point in the city. But if the coaches were a failure the horse cars were even worse. The road, during the time it was operated by horses, did not pay half the running expenses, and the new owners very soon became disgusted with their property. Several times Mr. Burns was approached, and inducements were offered him to take the road back again. He at last, in association with Wm. Callary and several other Pittsburg capitalists purchased the horse car road. The new owners immediately transformed the entire road. They sold the old horses, pulled up the rails, and work was at once commenced building an entirely new roadbed, putting down new tracks, and in the meantime contracts were made for electric motor equipments for ten cars. The line was also extended as far as Glenwood, a distance of five miles from the city. The first electric motor equipments were furnished by the Thomson-Houston Electric company of Boston, and the operation of the road was begun in March, 1890. From the day on which the road was first operated by electricity the financial success has been assured. Additional cars had to be put on to accommodate the increased traffic, and it was decided to utilize the Westinghouse single reduction motor system, which had recently been brought out. The Westinghouse company secured a contract for six additional cars, which were equipped with the Westinghouse single reduction motor. One of these cars is equipped with the first single reduction motor manufactured by the Westinghouse company. It is a remarkable fact that, although these motors were considered only experimental, and had been contructed for the purpose of developing the single reduction system, they have been operated on that car uninterruptedly ever since. For a long time it was the first car to leave the shed in the morning, and the last to come in at night, running 140 miles per day. During the entire period of the operation of this car with these motors the cost of maintaining the electrical equipment of the car perfect has not yet amounted to one dollar. The company has since purchased a number of vestibule cars with Gilbert trucks, which are all equipped with the Westinghouse system.

As an illustration of the fact that the road has been eminently successful since it has been operated by electricity it is only necessary to state that in spite of the road having only been operated for a little over a year the company has already paid a dividend out of its earnings. Encouraged by this success the company is now engaged in extending its line from Glenwood to Homestead, Pa., a distance of about four miles. To do this the company has to build a bridge across the Monongahela river. In addition to this extension the company is also laying a branch line to Schenley Park, which will be a great feeder to the main line when finished. The building of this extension will also entail the necessity of erecting a bridge. John Murphy is the superintendent and engineer of the road. B. L. W.

Minneapolis, Minn.

MINNEAPOLIS, Minn., July 18.—A scheme to connect Lake Minnetonka with Minneapolis by better means of passenger transportation than now exists has been under way for several months, and it is now stated that it will probably be carried out next season. T. B. Walker, a wealthy citizen of Minneapolis, and Cal. Goodrich, superintendent of the Minneapolis street railway system, have extensive property interests in the western suburbs of the city and in the vicinity of St. Louis Park, which lies geographically between Minnetonka and the city. Their project is to continue the Hennepin avenue line out West Lake street to St. Louis Park and thence in a direct line to the Hotel St. Louis at Lake Minnetonka, making the route little more than nine miles in length. Rail routes vary from twelve to eighteen miles to Minnetonka, and this shortening of distance would give the electric line a very great advantage in connection with the cheaper fares which it would of course be able to make. An electric line is emphatically what Lake Minnetonka and Minneapolis need for the immense summer travel that there is between them. The signal success of the interurban electric line is wha has led to the Minnetonka project. The gentlemen interested have no doubt that an electric line from Minneapolis to Lake Minnetonka would do a larger business than the interurban line, and the company which establishes such an enterprise will doubtless pay dividends the first year. Mr. Lowry was interviewed on the subject the other day, but declined to state anything definite with regard to it, confining himself to the general statement that the policy of the new street railway company would be against building new roads and extensions. This is well understood, but it does not prevent other corporations being formed to carry on the work.

The electric line between Minneapolis and Robbinsdale is completed, with the exception of a short distance on Thirty-second avenue, north, the construction of which is hindered by the attitude of the Minneapolis Street Railway company. There is about half a mile between the end of the Penn avenue line and the city limits, and under the terms of Mr. Lowry's franchise no one can build this track but himself. He holds off for reasons that are best known to himself. The matter is to be laid before the city council by residents of Robbinsdale as well as Minneapolis, and action requested in regard to the matter. It is probable that it will be satisfactorily adjusted, and the line in operation before winter.

Superintendent Sharp, of the Twin City Street Railway company, has resigned in order to accept a position with the New York Electrical Construction company. Mr. Heild, who has been acting as superintendent of electrical construction of the local lines, takes Mr. Sharp's place. J. T. Calderwood, formerly city auditor, has been appointed auditor of the Twin City Street Railway company, the place having been created recently.

Dr. C. H. Bates, a Minneapolis dentist, has perfected an electrical invention that is intended to do away with the overhead wire in electric street railways The invention is a closed conduit for the trolley wire laid on the ties between the rails. There is a slot-closing device consisting of three wheels, one of which on the passage of the car compresses downward the half inch strip of steel that is used for closing the slot. The other two wheels of the trolley meanwhile run in separate grooves upon a copper track, and keep up the current. Lead packing makes the conduit water tight. There is a lead cushion for the steel strip on the edge of the slot, but it is so arranged that [illegible] touch it. Dr. Bates [illegible] organizing a stock company for the introduction of the invention. It is said that the matter has been brought to the attention of Mr. Lowry with favorable [illegible]

Col. Clowry, vice-president of the Western Union Tele[illegible]

Milwaukee, Wis.

MILWAUKEE, Wis., July 18 —Matters electrical took up a great deal of the common council's last session. The mayor's veto of the Western Union extension resolution was sustained, and the judiciary committee's report in favor of the Western Union's aerial cable scheme was tabled. The ordinance extending the franchise of the Milwaukee Power & Lighting company was ordered to a third reading, but an effort to secure a final adoption under suspension of the rules was defeated.

Whether or not the wires of the Western Union Telegraph company strung along the streets of Milwaukee shall be forcibly removed depends upon the opinion of the city attorney, which was recently called for by the board of public works. An ordinance has been passed ordering the board to cut down the poles if not removed by June 1st. An extension was granted to July 1st, but the later ordinance did not contain the order for forcible removal, and the board is in doubt as to whether the whole of the first ordinance was killed by the superseding one.

The work of track laying on the Rapid Transit line running from the terminus of Walnut street to Wauwatosa has been commenced, and by September the road will be in operation. Electricity will be the motive power. There is talk of the company purchasing the Wauwatosa Electric light plant, and using it for power purposes. Storage batteries have been proposed, too, and then again it has been suggested that the necessary power be taken from the Pabst brewery. Capt. Pabst is interested in the road, and has just erected an immense power house at the brewery.

On the other Wauwatosa line, the Milwaukee & Wauwatosa railroad, work is also progressing. The stone foundations for the viaduct—2,100 feet long—across the Menomonee Valley are being laid. The construction of the viaduct is the principal work remaining uncompleted.

C.

Nashville, Tenn.

NASHVILLE, July 18.—The work on the various extensions of the present street railway system is steadily progressing. The United Electric company is extending its Line street line to the Clifton pike on the old Charlotte road. The most important extension is the Maplewood, and on this more than half the track has been laid.

At the annual meeting of the stockholders of the Overland dummy line the report of an expert appointed some time ago to estimate the cost of converting the line into an electric road was read, and is now under consideration. The directors have under advisement the extension of this line to Franklin, the county seat of Williamson county, and distant from this city 18 miles.

The project to convert the West Nashville dummy line into an electric road has been abandoned as impracticable for financial reasons and the company has also been denied the privilege of freight transportation because of the fear on the part of the citizens and the city government that the line would fall into the possession of the Louisville & Nashville Railroad company, which already enjoys a monopoly of ingress to the city. Now the dummy line company has made an official statement to the effect that this favor must be granted, or something else done to prevent the sale of the line by foreclosure, in which case the road would almost certainly be bought by the Louisville & Nashville. The situation was brought about by the fact that the public greatly prefers to travel on an electric road, and there is one running to the point reached by the steam dummy; therefore its passenger traffic is no longer profitable.

The shortage of Mrs. A. A. Alexander, ex-treasurer of the Cumberland Telephone company, has been made good. The alleged embezzlement extended over a period of seven months, and the plan said to have been adopted was very simple. As the amounts were abstracted they were charged up to the Memphis Telephone company, which is a branch of the Cumberland Telephone company, and the shortage appeared on the books against the Memphis branch. Mrs. Alexander still claims entire innocence. Hitherto she has always borne a most excellent character.

D. W. B.

Toledo, O.

TOLEDO, July 18.—The directors of the Toledo Electric company held a meeting recently to discuss plans for a new [illegible]

At present the quarters on St. Clair street are much too small. The company contemplates erecting two fine fireproof [illegible] one story in height, as soon as a suitable location can be secured.

[illegible] and L. B. Dodge were appointed a committee to [illegible] As the company desires railway [illegible] property adjoining the Wheeling [illegible] Lake Erie railroad, below Lagrange street, is spoken of as the probable site.

The jury in the great street railway damage case returned a verdict recently in favor of the "Robisons," by settling the price for the use of the tracks on Summit, Monroe and Ottawa streets, a distance of about ten blocks, at $12,333.40, and damages to the rest of the property at $3,308, thus ending the 110 day suit.

This total, $15,641.40, it will be seen, is less than was paid for Adams street from Michigan to Summit—$17,500—a distance of six blocks.

Samuel W. Allerton, the manager of the City Street railroad of Chicago, testified in this case, and said that the part of the Consolidated system which the Robisons desire to appropriate is worth $400,000. Mr. Lang, general manager, had placed it at $350,000. The attorneys for the Robisons objected to the court admitting such testimony, declaring it to be in violation of all previous rulings. Such a price, they said, would keep the plaintiff from the use of the tracks.

Besides Mr. Allerton, W. E. Hale, president of the Consolidated, Mr. Yerkes of the North and West Side cable roads of Chicago, and President Shaffer of Indianapolis testified.

Last Tuesday Judge Millard of the Probate Court refused to grant a new trial in the last and most important condemnation suits. Exceptions were noted, and the Robisons paid $17,310.69 in checks to the court, and the verdict was confirmed. Of this amount $15,641.40 is the amount awarded by the jury as compensation and damages, and $1,669.29 is the costs in the case. This money will not be accepted by the Consolidated, as it would be a surrender of the case and prevent the appeal which will be going on through the higher court. And Mr. Robison holds that even should the higher courts reverse the lower, it would never work a removal of the cars from the streets, but merely make a change in the amount fixed for compensation. Judge Millard begins his decision as follows:

"It lacks but three days of five months since the hearing of this case was begun in this court. Twenty-seven actual days of that time was taken by the jury which brought in the verdict now asked to be set aside.

"Under the first head of the notice for a new trial forty grounds are set forth as error, and three other subdivisions are given in the same motion, but in the nature of independent motions on nearly all of these the court has ruled in some form during the preliminary hearing on trial, and I yet see no good reason to change the rulings before made."

He named three reasons as most strenuously urged by the Consolidated. The first of these was that no proof of the fact that Toledo is a city of the third grade of the first-class had been made. He said that the Consolidated had elsewhere admitted this to be a fact, and pointed to legal decisions.

The second ground was that John Brown was summoned as a juror, and that Michael Brown answered to his name and sat as a juror. He answered all questions satisfactorily, and "to every appearance was a model juryman." His wife had taken the summons to Michael, with the assurance that it was for him, and he is sometimes called John Brown The judge did not think he was warranted in setting aside the verdict for this reason, after the trial had been finished, and no injury had resulted therefrom. The juror would have been set aside, however, if a challenge had been made. Brown, it is said, was instrumental in having the amount increased several thousand dollars.

The inadequacy of the verdict was the third point, and "it is one which will be left to go with the others." His honor believed in the capacity of the jury, and did not feel warranted in setting up his judgment against theirs.

The struggle between the two companies has been a long one, and the new company has been fought at every step by the more powerful corporation already in possession of the right of way, as it deems any additional franchises an infringement on its right.

Three years ago Mr. Robison promised the city council that he would run three or six routes of electric cars into the various suburbs of the city. This has been done, and to day there are five separate lines of cars in full operation. They have more than doubled their rolling stock; their engine force at the power house and the number of dynamos for the generating of electricity. They are also double-tracking their system with a 78-pound steel girder rail and extending their lines. They find this necessary to carry out their purpose of giving the city the best possible accommodations in rapid transit.

The Robisons have leased the building now occupied by J. W. Green & Co., pianos, corner Summit and Madison streets, where their general offices and transfer station will be located.

Judge Doyle, one of the attorneys for the Consolidated,

in speaking of the case said, "Oh, no, it is not ended yet, it is just the beginning. I will bring up the constitutionality of the law, for one thing, in the higher courts. And I don't and will not believe that the court will permit property that the Consolidated can sell any day for half a million to be given away for $15,000. It is the most atrocious robbery I have ever seen in this city."

Superintendent H. B. Wood of the Toledo Electric Street Railway company has severed his connection with the company to accept a position with the Put in-Bay Hotel and Steamboat company. Assistant Superintendent Whitton has been promoted to the position of superintendent.

The electric cars on the Consolidated are now running as far as Bellevue Park. The company has received ten new cars and two 250-horse power genera ors.

The Robisons have received six new motor cars from Lynn, Mass., and four new Westinghouse motor cars from Pittsburg. They are putting in place a new 500 horse power engine, which will be ready for use soon.

H. S. Walbridge is now getting the right of way for the Maumee electric street railway from Schuetzen Park into the city. F. C. H.

Indianapolis, Ind.

INDIANAPOLIS, Ind., July 18.—John P. Barrett of Chicago, chief of the Department of Electricity of the World's Fair, was in this city Wednesday visiting different manufacturers of electrical machinery in the interest of the great fair.

The Primier Steel company is about to add a new branch of manufacturing, having purchased the electrical and other patents for elevators of Frank Herdman, who has been connected with the Hale Elevator company of Chicago.

A company headed by President Kerper of the Cincinnati street car lines has secured all the options and rights of way of the old Broad Ripple Electric railway, and has been promised the right of way over several streets in the city. Electricity is to be used on all lines. M.

Concord, N. H.

CONCORD, July 18.—The Shawhan Electrical Works were incorporated on the 11th inst., with a capital of $50,000. The company will manufacture dynamos, motors and storage batteries for railroad use J. F. Shawhan, formerly of Detroit, Mich., will manage the new firm. Buildings have been secured, and work will be begun immediately.

The street railroad company here is opposed by an obstinate city council that objects to every proposed improvement or extension, notwithstanding the expressed wishes of the property owners. The superintendent, George W. Pierce, has labored hard and faithfully to bring the road up to its present efficiency. He has added more cars, a generator, engine and boiler, and the service of the road, as far as it extends, is all that could be desired. The route of the west end extension has been filed, and awaits the tardy routine of the council. C.

Louisville, Ky.

LOUISVILLE, Ky., July 18.—The new electric street railway on Market street was put in operation last Monday, and thus far has proved a great success. The line is about eight miles in length, extending across the city east and west. The cars are running now on a six minute schedule, but it is the intention of the company to run them every four minutes after August 1st. With the completion of this line Louisville now has forty-eight miles of electric street car service.

The Highland Street Railway company of New Albany, Ind., has contracted with the Edison company for a 100 horse power station equipment with which to operate its motors.

The Louisville Consolidated Street Car company has ordered of the Edison company a 1,000-horse power station equipment for its eastern power house.

W. F. Ferris of the Edison company of New York was in the city yesterday. He had just returned from Evansville, Ind., where he closed a large arc light contract with the city, and disposed of a mining plant to Ingle & Co., coal miners.

The Thumm Electric company has purchased of the Edison company a large dynamo and motor for experimental work.

The contract for wiring the Board of Trade building for 500 lights has been given to the Edison company.

The Balme Hotel company has contracted for an Edison 250 light machine.

The new factory of the Gaynor Electric company on Fifteenth street was completed Tuesday.

The Edison company has moved into its new quarters in the Louisville Power company's building on Third street near Green. They are much larger and more convenient than those which the company occupied before. The company now carries a full line of all styles of dynamos, motors, wire and fixtures. Before, owing to the crowded quarters, the company was able to handle only the smallest machinery. C. C. Y.

PERSONAL.

Alex. H. Lewis of Cincinnati was in Chicago last week and was heartily received by his old friends in the electrical fraternity.

F. N. Armour, who has been connected with the Chicago Edison company about two years, has resigned his position to assume the management of the isolated lighting department of the Northwestern Thomson-Houston Electric company at St. Paul.

Chas. A. Schieren sailed for Europe July 16th on the steamer "Fuerst Bismarck." Mr. Schieren will visit the International Electrical Exposition at Frankfort, where he will inspect the various devices for transmitting power by belting.

D B Dean, representing the Electric Merchandise company, Chicago, has just returned from a trip to the Pacific coast. Mr. Dean reports the outlook on the coast as extremely flattering, and says the electric railway business will experience a great boom in that territory the coming year.

O. B Osgood of the railway department of the Chicago office of the Westinghouse Electric & Manufacturing company has been appointed general manager of the Westinghouse railway department for the southeastern district, with headquarters at Atlanta, Ga. His territory comprises North and South Carolina, Georgia, Alabama, Florida, Louisiana and Tennessee; the last two named states being added to the district for the first time. D. A. Tompkins, the general district agent at Charlotte, will continue to manage the lighting department.

NEW INCORPORATIONS.

Artelectro company, Cleveland, O.; capital stock, $1,000,000; to manufacture and sell electrical devices of all kinds.

Columbian Electrical Works, Chicago; capital stock, $3,000,000; to manufacture, sell and use all classes of electrical apparatus.

Berkeley & Lorin Water & Light company, San Francisco, Cal.; capital stock, $250,000; to purchase, lease and sell water, water rights, light and power privileges and franchises.

Gaston Electric Manufacturing company, Sparta, Ill.; capital stock, $125,000; to manufacture, sell and apply any and all kinds of electrical and other machinery, apparatus, appliances or devices.

ELECTRIC LIGHTING.

The Napa, Cal., street lighting contract was recently awarded to the local Thomson-Houston company.

A number of Marion, Ind., aldermen were in Chicago last week to study the city's electric lighting system.

At the meeting of the board of directors of the Elgin Insane Asylum, July 16 h, the contract for installing a plant in the asylum was awarded to the National Electric company of Eau Claire, Wis.

Princeton, Ill., is proud of a new electric light plant, established by the Princeton Electric Light & Power company. The Thomson-Houston dynamo is used, and there are two dynamos, one having a capacity of 30 arc lights and the other capable of supplying 650 incandescent lamps.

The Western Electric company has just installed at Salem, Ind., for the Salem Electric and Artificial Ice company a 500 light National alternating dyanmo and a 50 light Western Electric arc plant to be used for both city and commercial lighting. The plant was put in under the supervision of W. H. Schott. E. Craycroft has been appointed superintendent. The plant is most complete in all its details.

The Oakland, Cal., Light & Motor company has decided to invest between $200,000 and $300,000 in extending its plant. New engines and boilers will be put into the Webster street building, and dynamos to furnish current to 100 additional arc lights and 3,000 incandescent lights will be installed. The incandescent lights will be on a meter system. New wires and poles will be put up and a power system will also be established.

The San Antonio Light & Power company has been formed in Los Angeles. One of the objects of the new incorporation is to utilize the waters of San Antonio creek in the counties of Los Angeles and San Bernardino for operating an electric light and power plant. The directors are Thomas R. Bard of Hueneme, N. W. Blanchard of Santa Paula, J. A. Dale of Pomona, John A. Hooker of Los Angeles, M. R. Campbell and C. G. Baldwin of Claremont, and A. W. Burt of Redlands. The capital stock has been placed at $240,000.

Carl Hoffman, Henry Ettenson, E. Michael, C. M. Salinger, Herman Bruns, J. H. E. Weigant and W. B. Walker have formed a company at Leavenworth, Kan., for electric lighting. The capital stock of the company will be $50,000. A special meeting of the city council will be held to consider the granting of a franchise to the new company. At the last meeting of the council an ordinance was presented granting the franchise, but the matter was laid over on the ground that the company at that time had no existence, having never been incorporated.

[illegible] laboratory.

The [illegible] Electric company for a plant consisting of one 10,000 and [illegible] lamps for its new building. Special permission was obtained for concealing the arc light wires in this building and a high grade of rubber covered wire will be used, [illegible] ing. A circle of six lights will be placed on the flag staff, so arrange[illegible] perfect ease by one man. Special fixtures for suspending the arc lamps, a number of which will be placed on the front of the building, have been designed, and the wires leading to these fixtures will be brought through the building front. In order to accomplish this, it will be necessary to drill in some cases through five feet of brick and terra cotta, and in other places through about three feet of solid granite.

ELECTRIC RAILWAYS.

The Boise City, Idaho, electric railway will soon be in operation.

An electric line is proposed at Auburn, Cal. The generators will probably be operated by water power.

The West Asheville, N. C., & Sulphur Springs Railway company has let the contract for an electric power plant to operate its street railway.

A syndicate headed by Commodore W. J. Kountz of Pittsburg will commence at once the construction of an electric line at Yankton, S. D.

Contract has been left for building the first mile section of the electric road at Alberquerque, N. M. The road must be completed within one year.

A franchise has been granted for an electric line between Redwood City, Cal., and Baden. Fifty thousand dollars' worth of work is to be done the first year.

It is said that Pittsburg capitalists have decided to convert the Paterson, N. J., street car lines into an electric system, and anticipate the change will cost $350,000.

The West Side Rapid Transit company of Salt Lake City contemplates replacing its steam dummies with the storage battery system, as there is considerable objection to the operation of the dummies within the city limits.

The Davenport, Iowa, Electric Railway company has petitioned the city council for permission to pipe the streets for the purpose of supplying steam for heating purposes in the business portion of the city, with the intention of extending it later into the residence district.

By the extensions now about completed the Cicero & Proviso Electric railway of Chicago has about eleven miles of double tracked road. The company will soon carry passengers from the western terminus of the Madison street cable line to the cemeteries along the Desplaines river.

The Santa Monica Wharf & Terminal Railway company of Los Angeles is considering the question of changing its line to connect with the electric system by way of the Pico street line, and operating the whole road by electricity. The company has nearly all the right of way, and good terminal facilities at Santa Monica have been secured. The plan includes a wharf and complete shipping facilities.

In the federal court of Indianapolis the Edison General Electric company last week filed suit against the Broad Ripple Rapid Transit company of that city. It is alleged in the bill that the Edison company contracted with the incorporators of the Transit company to build an electric line and delivered $40,000 worth of material. When the work had been let to the sub-contractors it was discovered that the Transit company was not responsible. The Edison company has been sued by all the sub-contractors and now demands a judgment of $100,000 in damages for the alleged deceit practiced by the Transit company.

ELECTRIC MINING.

An electric tramway, the first for this purpose in Canada, will be put in the new Vancouver coal mines at Nanaimo, B. C. The plant, of which the first installment will cost $20,000 consists of an [illegible] horse power generator and two 30 horse power electric locomotives, each of which will haul at a speed of nine miles an hour [illegible] cars. Other generators will be used to furnish lights in the mines, 600 of which will be used. Electricity will also be employed in working coal drills and cutters.

Dr. Kosmann and Messrs. Lange and Brieg, says the [illegible], have recently proposed a new electrolytic separation of zinc, capable of being applied on a large scale. The process consists in the simultaneous preparation of metallic zinc and [illegible] acid by electrolyzing solutions of the sulphite of zinc or other soluble salts of this metal in the presence of free sulphurous acid, the latter being [illegible] in the form of gas or as a liquid. The sulphurous acid, SO_2, is obtained on a large scale in the roasting of [illegible]. It is either kept in solation in water, [illegible]

as produced, being passed into the electrolytic bath. In the separation of zinc on a large scale by this process, the zinc bearing mineral is partly roasted in the presence of some form of carbon or even an organic debris. It is then crushed and well mixed with water, either in a vat or revolving drum. The powdered mineral is kept in suspension in the liquid by constant agitation, and at the same time sulphurous acid gas, arising from the roasting of other zinc ore, is passed in; the result is the formation of sulphite of zinc. The liquid is now exposed to electrolysis, either in the same vessel or after removal to a more convenient receptacle, and while electrolytic action is going on, sulphuric acid gas is still passed in, so that all the oxygen that is produced during electrolysis becomes used up in the formation of sulphuric acid.

TELEGRAPH.

Experiments made at McGill university demonstrate the fact that a telegraphic signal can be sent from Montreal to Ireland and back, a distance of 8,000 miles, in 1.05 seconds.

On July 17th, several assumpsit suits were filed against the Hyde Park District Telegraph Electric company, Chicago. William Kemp sued for $1,000; John W. Wheelock, $7[illegible]; William Mueller & Co., $200, and George F. Ebert, $1,[illegible].

The Postal Telegraph & Cable company has had a large force of men engaged for some time in laying a submarine cable from Oakland, Cal., to Goat Island, which, when completed, will be connected with one similar extending from the Clay street wharf in San Francisco to the west side of the island. The company's men have stretched the ærial cable from the company's office at Market and Post streets, across Market to the south side of the street. This cable will run to the Clay street wharf, where a connection will be made with the submarine cable, thus completing the circuit. The total length of the cable to be laid will be nearly eight miles, five of which will be submarine. It is expected that the cable will be in working order by the latter part of the month.

MISCELLANEOUS.

Eastern capitalists are reported as about to erect a plant in Middlesborough, Ky., for the manufacture of electrical devices.

An electric transfer table 70 feet long, and with a capacity of 225,000 pounds, is now in use in the Denver shops of the Union Pacific railroad.

The National Electric company has been incorporated at Alexandria, Va., with P. Mason, president, and W. J. Dante, secretary. The capital stock is $1,000,000.

Herbert Longfellow of Henrietta, N. Y., was killed by lightning last week while storing hay in a barn. Two men who were assisting Longfellow were prostrated by the shock, but will recover.

The United States Corporation Bureau of Chicago reports 245 completed corporations in the United States for the week ending July 17th, with a total capitalization of $121,470,350, including sixteen light, heat, power and transportation companies, capitalized at $12,870,000.

The Ohio state university at Columbus has an electrical engineering course among its departments. Two new buildings are to be erected the coming year. Three new departments have just been created, and two more professors in agriculture and botany are soon to be added, making the total number of teachers forty-five.

It is proposed to hold a large international electrical exhibition at Melbourne about the end of the present year. The exhibition will be held in the exhibition building used for the Centennial Exhibition of 1888. To obtain exhibits and support from those countries in which great attention is paid to electricity, the Victorian government has been approached, not with the idea of obtaining a subsidy, but merely for countenance and assistance in communicating [illegible].

[illegible] has a story—apparently more ingenious than truthful—of the manner which a deaf man took to inform himself when his electric door bell was rung. In one of the rooms of his house he fastened an electro magnet on the wall about four feet from the floor. The armature [illegible] so that when it was attracted by the magnet a catch was released and a [illegible] was a section [illegible] and two feet [illegible] made between the armature and the magnet the log dropped to the floor [illegible] could not hear [illegible] apprised him [illegible] the door.

TRADE NEWS.

[illegible]

[illegible]

[illegible]

entitled "Magnolia Valse" by Caroline Bennett Knott. It is also indebted to this company for a fac-simile of a very handsome gold medal awarded it at the exposition held at Edinburgh last fall.

Milliken Bros., New York and Chicago, have lately completed tests made at Cornell University of their poles showing ultimate strength, elastic limit and corresponding deflection in connection with standard pipe and wooden poles. A complete report of the tests is promised at an early date.

After several years of severe tests the Law battery has attained a position which, for practical results, is second to none on the market. The Law Telephone company is receiving orders from foreign countries which are keeping it very busy, although this is supposed to be a quiet time of the year in the electrical trade.

BUSINESS.

Samuel T. Williams, 447 North street, Baltimore, reports that hardly a day passes that he does not receive new orders for his engine, which he sells under a guaranty of regulation within one per cent. It is said that some of these engines that have been in use over six years are today as good as new.

J. Lang & Co., 44 Michigan street, are building for the Edison company two large switches, to be used in the Auditorium. These switches are of the Andress double pole pattern, one of 1,600 amperes and one of 1,000 amperes. They are to be mounted on mahogany bases, highly polished, and of thoroughly first-class workmanship throughout.

Brownlee & Co. of Detroit have just designed and built a large lathe to be used in turning a round pole to be used for street railway and electric light work which they are offering at a price but a little above that asked for the ordinary cedar pole. These poles are symmetrical, the lathe making a uniform taper, and when painted will undoubtedly make a very handsome and serviceable line.

O. A. Foster, 8 Oliver street, Boston, has just sent out to the trade a handsome little catalogue illustrating and describing his 1891 electric motor and 1891 electric battery. For the motor, simplicity, economy, durability and low price are the great advantages claimed; and for the primary battery, that it is the most efficient and economical yet brought out. The catalogue is gotten up in an attractive style.

The Johnson Electric Service company, 113 Clyburn street, Milwaukee, is having an unusually busy season thus far and reports the outlook as most promising for the coming fall and winter. The owners of fine buildings are coming to appreciate the convenience of the heat regulating device built by this company, and are also coming to understand the saving that results from its use. In a large building by keeping a uniform heat the saving in one season, it is claimed, will amount to nearly the entire cost of the appliance.

Milliken Bros. of New York and Chicago still report business rushing. In the line of iron roof work, of which this firm makes a specialty, they have lately secured contracts for Allentown, for the new electric line, for a large boiler house at New Orleans, La., and for the Newark, N. J., power house. After sharp competition they have secured contracts for their patent poles for the new electric line in New York city and at Providence, R. I. Both contracts are large. At the suggestion of Mr. McIntire this firm has introduced a new form of eye bolt in tops of poles which contains an additional insulator. It is made in the form of a fork having a special porcelain insulator in the end.

Geo. H. Bliss and F. H. Soden, both well known to the business and electric interests of Chicago, have formed a co partnership under the name of Bliss & Soden to conduct business as electrical experts, engineers and contractors. Both gentlemen are pioneers in electric lighting in the West. Mr. Bliss opened the initial office in Chicago for the Isolated Edison company some years ago, and later was general manager of the Western Edison company, while Mr Soden during the last five years has been manager of the engineering and construction departments of the Western office of the Thomson-Houston company. These gentlemen are both competent, aud will undertake nothing but high grade work. They will undoubtedly meet with the success they so well deserve.

The Columbia Electric company of St. Paul has just issued an attractive catalogue showing a large line of new apparatus that has recently been perfected and now for the first time put on the market. The Columbia company will manufacture motors from 1 to 50 horse power; power generators from 25 to 100 horse power, and dynamos from 25 16 candle power lamps to 500 16 candle power lamps capacity, and in addition a large line of specialities. The corporation is a strong one, having an extensive factory at Upton Grove, a suburban town, and a fine office and salesroom at 207 E. Fourth street. The officers are Egbert G. Handy, president; Jos. A. Humphreys, secretary and treasurer, F. S. Kirkpatrick, attorney, and Frank Mulligan, superintendent and electrician.

ELECTRICAL PATENTS.

Issued July 14, 1891.

455,7[illegible]. [illegible]-switch. William M. Goodridge, Highland Park, Ill.

[illegible] especially designed for use as a part of the [illegible] board apparatus of a telephone exchange.

[illegible] and Connection for Electric Railways. William Osner, Chicago, Ill.

[illegible] a [illegible] bar or plate in con[illegible] the track [illegible] form [illegible] slot for the passage of the shank of a current transferring arm. This current transferring arm has a contact wheel attached thereto, adapted to move in contact with the supply conductor.

455,765. Electric Motor. Harry H. Porter, New York, N. Y.

455,773. Alternating Current Motor. William Stanley, Jr., Pittsfield, Mass., and John F. Kelly, New York, N. Y.

The invention is based on the well-known property or feature possessed by a condenser of neutralizing or counteracting the effects of self-induction of a circuit with which it may be connected. It consists in the combination of a motor with a condenser included in the field circuit or that circuit having the higher self-induction.

455,788. Thermostat. Henry A. Chase, Boston, Mass.

455,789. Process of Manufacturing Insulated Conductors. Charles Cuttriss, New York, N. Y.

455,790. Dynamo-electric Machine or Motor. Justus B. Entz, New York, N. Y.

455,796. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

455,798. Trolley for Electric Cars. Walter H. Knight, Newton, Mass.

455,800. Electric Cut-off Apparatus. Edwin W. Rice, Jr., Lynn, Mass.

455,808. Electric Magnetic Ore Separator. Jonas Wenstrom, Orebro, Sweden.

455,809. Magnetic Separator. Jonas Wenstrom, Orebro, Sweden.

455,812. Fire Alarm Apparatus. Henry A. Chase, Stoneham, and Howard F. Eaton, Cambridge, Mass.

455,813. Thermostat. Henry A. Chase, Boston, and Howard F. Eaton, Cambridge, Mass.

455,815. Electro Phonometer and Phonoscope. Isaiah H. Farnham, Wellesley, Mass.

The invention consists mainly of a diaphragm mounted in front of and close to a magnet, and a coil or helix of insulated wire adapted by means of suitable connections to be included in any electric circuit, and capable of being moved along the magnet from end to end. Suitable means are provided for said sliding motion of the coil. An index or scale with pointer attached to the coil denotes the advance thereof on said magnet.

455,837. Electric Switch. Carl G. Dahlgren and John H. Svensson, Gothenburg, Sweden.

455,855. Electric Indicator. Earl C. Eldredge, Springfield, Mass.

455,856. Holder for Carbon Brushes of Commutators. Clarence H. Farrington, Milford, Mass.

455,873. Signaling Apparatus. Howard F. Eaton, Quincy, Mass.

455,887. Armature for Dynamo-electric Machines. Edwin W. Rice, Jr., Lynn, Mass.

455,898. Electric Motor or Dynamo-electric Machine. Charles G. Curtis, New York, N. Y.

In this invention each field magnet coil is surrounded by an independant water tight casing.

455,904. Insulated Electrical Conductor. Edwin D. McCracken, Alpine, N. J.

455,955. Lightning Arrester. Charles S. Van Nuis, New Brunswick, N. J., and Jonathan H. Vail, New York, N. Y.

455,956. Electric Railway System. Samuel P. Wilcox, Elkhart, Ind., and Joseph D. Partello, Rochester, Mich.

455,968. Secondary Battery Plate. John R. McLaughlan, Philadelphia, Pa.

455,971. Armature for Dynamos. Frederick L. McGahan, Indianapolis, Ind.

455,972. Electro Medical Lighting Apparatus. Paul Oudin and Henri O. Kratz-Boussac, Paris, France.

455,981. Apparatus for Administering Electricity. Geo. H. Bethel, Sydney, New South Wales.

455,984. Magnetic Separator. Henry G. Fiske, New York, N. Y.

455,985. Magnetic Ore Separator. Henry G. Fiske, New York, N. Y.

455,986. Terminal for Electric Batteries. Hammond V. Hayes, Cambridge, Mass., and Angus S. Hibbard, Morristown, N. J.

We quote claim two:

"The combination of a voltaic battery and terminal attachments therefor, each consisting of a copper wire molded to its respective battery-plate and each adapted to form a soldered connection with its complementary circuit wire by a coating of solder or easily fusible alloy applied to its free end."

456,006. Street or Station Indicator. William T. Snedden, San Francisco, Cal.

456,021. Electric Belt. Lewis N. Fancher, Kansas City, Mo.

456,023. Railway Time Signal. Joshua C. Dickover and Walter Scott, Hot Springs, S. D.

456,098. Street or Station Indicator for Cars. Geo. H. Tietjen, San Francisco, Cal.

456,110. Automatic Circuit Closer for Telegraph Keys. James W. Brown, Van Wert, Ohio.

456,120. Insulated Electric Conductor. Edwin D. McCracken, Alpine, N. J.

The conductor is surrounded by insulating cords ranged practically parallel and is in contact with them, but the insulating cords are separated from each other. An exterior insulating material holds these cords in place.

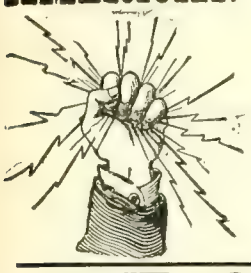
EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,



Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and **is guaranteed to be waterproof, and will not deteriorate, oxidize or crack,** and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS FANS

FOR ELECTRIC MOTORS.

MANUFACTURED BY

THE TURNER BRASS WORKS,

4 LaSalle Ave., Chicago.

Write us for prices.

ELECTRICAL ENGINEERING.

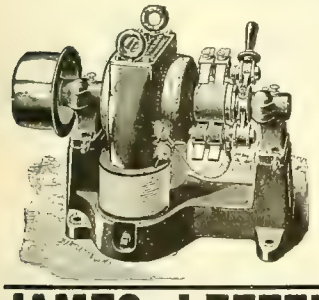
OHIO STATE UNIVERSITY,

COLUMBUS, OHIO

A new and commodious building. Dynamos of commercial size, for arc and incandescent lighting, by direct and alternating currents. Motors, storage batteries, etc., etc. A fine collection of standards, testing instruments, etc. Extended practice in well equipped mechanical and physical laboratories. Entrance requirements modified. Special courses given. Send for catalogue

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

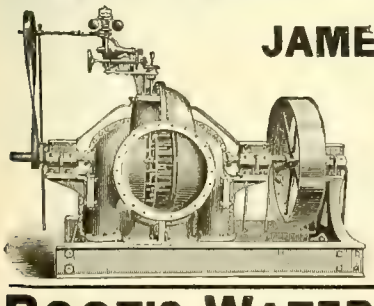
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS



BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

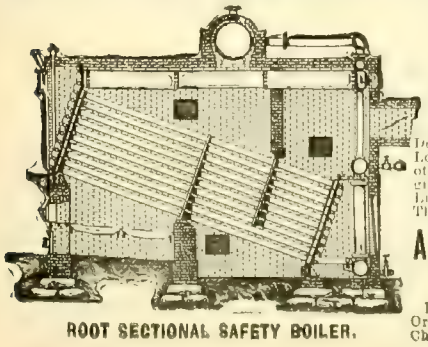
ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE **JAMES LEFFEL & CO.**

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ROOT'S WATER-TUBE BOILER.



ROOT SECTIONAL SAFETY BOILER.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Electric Light Companies** of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City, and a great many others; also by the Ansonia & Sims Engine Co., Providence, R. I., the Lynn Belt Line Street Ry. Co., Lynn, Mass., and the Thomson Houston Electric Co., Lynn, Mass.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

AN ELECTRICAL ENGINEER

Who has designs for a line of very economical Constant Pressure Generators and Motors desires to locate in Denver or some other city in Colorado, as I would like to hear from parties who can furnish capital to manufacture. Full information will be furnished parties who have capital and mean business.

Address "**ENERGY**," Care WESTERN ELECTRICIAN, Chicago.

WANTED.

Position wanted by a [illegible] of an Electric Plant, Central Station or Railway. Is a machinist by trade, and has four years experience in [illegible] work. List of references [illegible].

Address "**Machinist**," Care WESTERN ELECTRICIAN.

CHICAGO. *The Electrical Construction Co.* 43 YEARS ST. FRANCIS ST.

C. A. HARTER, Manager. Telephone, 1718.

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES

A SPECIALTY

L. BLATZ, 103-107 West Monroe St., CHICAGO.

The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

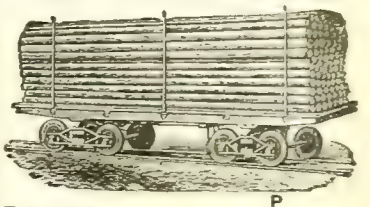
85 John St., NEW YORK.

UNION ELECTRIC WORKS.

Electric Specialties manufactured on royalty or **purchased of inventors.** Repair work of all kinds given careful attention.

Room 506, Springer Building, Chicago.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N.Y.**

MEASURE YOUR INCANDESCENT LAMPS WITH

Queen's Portable Bunsen Photometer.

In every Central Station there is constant occasion to measure the candle power of Incandescent Lamps, and to meet these requirements we have designed our **Portable Bunsen Photometer.** It is **compact,** gives **accurate results,** is **simple in operation,** and the **price is low.** Dimensions, 37 inches long and 5½ inches square. Total weight, 13 pounds.

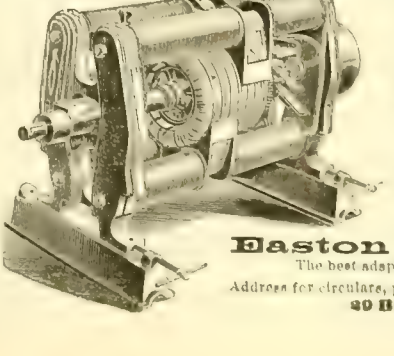
PRICE, $30.00.

Indispensable to the Economical Operation of Every Central Station.

CORRESPONDENCE SOLICITED.

Send for Illustrated Catalogue of Electrical Test Instruments No. 1-68.

QUEEN & CO., PHILADELPHIA.



THE EASTON ELECTRIC CO.

CAN SUPPLY

An Arc Light Plant complete for - $300
An Incandescent Light Plant complete for 200
A combined Arc and Incandescent Light Plant for - - - - - - - - 400

MANUFACTURERS OF THE

EASTON UNIVERSAL ARC LAMP

(Adapted for any dynamo of any system)

AND OF THE

Easton X Arc Lamp,

The best adapted for use in incandescent circuits.

Address for circulars, prices and information,

39 BROADWAY, NEW YORK CITY.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.
No. 180 MAIN ST.
FITCHBURG, MASS., U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

FOR SALE. WEST END ST. RAILWAY COMPANY, 81 Milk St., Boston. This company having adopted the long car for traffic on its most populous lines, is now able to dispose of a portion of its box and open cars. Roads in want can be promptly supplied at advantageous prices. We invite correspondence, but believe an examination of our stock by a representative of parties in want would be to their advantage. HENRY F. WOODS,
JUNE 19, 1891. Purchasing Agent.

George P. Barton Charles A. Brown.

Barton & Brown,
ATTORNEYS AND COUNSELORS,
Rooms 907 and Temple Court Bldg.,
225 Dearborn Street, CHICAGO.
Patent, Trade-Marks and Copyright Cases

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

EXCURSION TO CHAUTAUQUA
VIA THE ERIE LINES.

On August 4 the Chicago & Erie R. R. will run an excursion to Chautauqua Lake, for which tickets good to return within fifteen days will be sold at **One Fare for the Round Trip.** This will positively be the only opportunity this season to visit Chautauqua Lake and the famous Chautauqua Assembly at reduced rates.

As the through trains of the Erie Lines between **Chicago** and **New York** all run via the Lake, no change of cars is required via this route.

For details of the excursion, sleeping car reservations, etc., call on, or address,

D. I. ROBERTS, Ass't Gen. Pass. Agt., Erie Lines, 802 Phenix Building, Chicago.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

REMEMBER That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

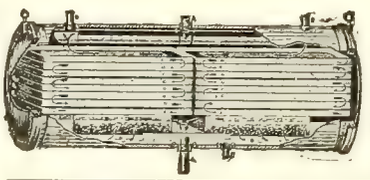
SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

Being manufactured continually. Adopted by the largest Electric Plants of the West.

Write for Prices and samples. S. TAUSSIG, Agent, 45 River St., CHICAGO.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

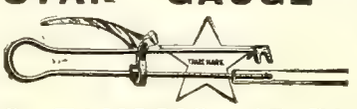
FOR SALE.
New 10 and 25 Light
Arc Dynamos and Lamps.
HIGH TENSION. CHEAP.
JAS. McLAUGHLIN, Mfg. Electrician,
50 N. Clinton St., Chicago.

SLATE.

Six samples showing all finishes for $1 50.

T. J. MURPHY,
96 Columbus Ave., NEW YORK.

STAR GAUGE GLASS CUTTER.



A necessary tool in every engine room. Sent by mail on receipt of price.

No. 1. Cuts over 5 inches $1 50
" 2. " " 8 " 2 00

S. TAUSSIG, 45 River St., Chicago. WESTERN AGENT.

73-75 W. Jackson St.
RELIABLE

WE ARE FITTED WITH
RELIABLE Machinery and Tools,
And Employ RELIABLE Workmen.
All Kinds of Electrical Apparatus to Order.
CHICAGO ELECTRIC MFG. CO.

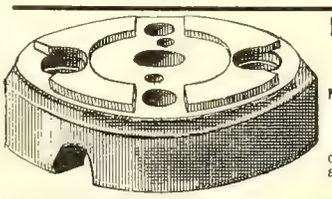
This cut represents our Class A

STAR SIGHT "UP-FEED" LUBRICATOR.

There are no joints about it. Arms and body cast in **One Piece**, so you won't be annoyed by leaking and it will work to your entire satisfaction. Will let you try it before you buy it.

For sale by Jobbers, or apply to

THE WM. POWELL CO., - CINCINNATI, O.



EMPIRE CHINA WORKS,
144 to 156 Green St., Green Point, BROOKLYN, N. Y.
MANUFACTORY OF
Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT
IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP
FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt
ALL LEATHER
NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY.
BY COVERING YOUR PULLEYS WITH
SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER

BRANCHES: 164 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St. Chicago. | St. Louis, Mo.

NO LONGER A SUMMER RESORT.

Chicago has long been famed for its delightfully cool weather in Summer, but at least a portion of its population are now finding it altogether *too hot* for them. We refer to the competitors of the

ECONOMIC INCANDESCENT LAMP,

who are now leaving the City for *St. Louis* and other cool places.

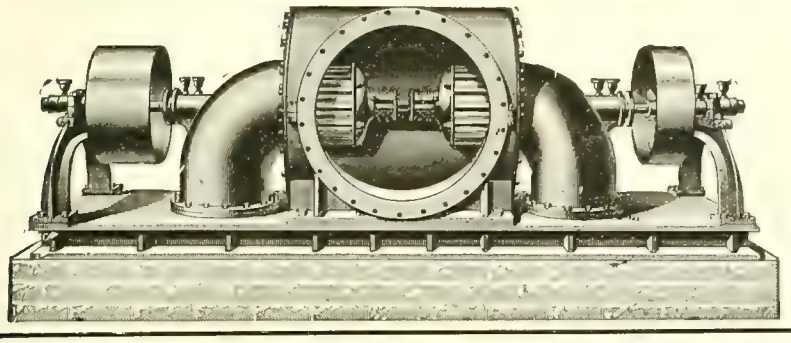
By the way, hadn't you better buy lamps while they are cheap? We are still selling at the same *popular prices.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

GEO. L. KIRKHAM, Manager. 1017 Chamber of Commerce, CHICAGO.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES [illegible] CELE-BRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** [illegible] diameter, being **double** the **Power** of most wheels of [illegible] number of the leading electric companies with great [illegible] ical use of water it is without an an equal, producing [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ALUMINUM

IN ALLOYS 75c. PER POUND.

Aluminum in alloys equal in purity to any on the market, 75c. per pound for the contained Aluminum.

Cowles' Pure Aluminum in ingots is offered as low as that of any American concern; quality guaranteed.

THE COWLES

Electric Smelting & Aluminum Co.

LOCKPORT, N. Y.

HARRISON CONVEYOR

FOR HANDLING

Grain, Coal, Tan Bark, Seeds, Etc.

Will convey all kinds of grain without mixing. Will carry two different kinds of material in opposite directions at the same time.

Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illus. Catalog. **BORDEN & SELLECK CO., 48 and 50 Lake St., Chicago, Ill.**

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),

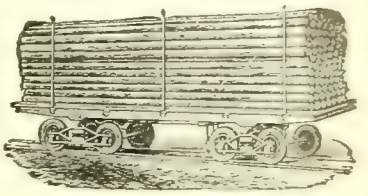
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

ESTABLISHED 1878.

SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

THE SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

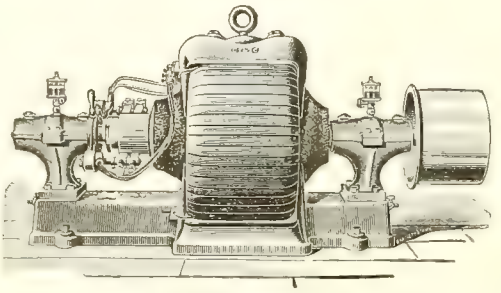
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS.

WIRES.

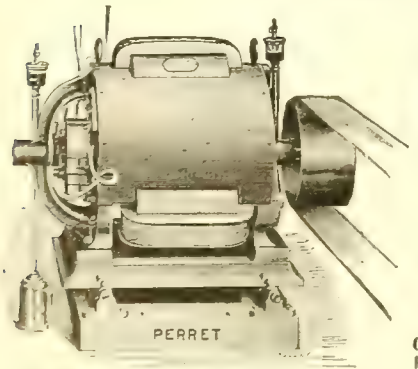
You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK. G. H. MEEKER, Western Manager.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.



Perret 5 H. P. Motor, Speed 550, Weight 1,300 lbs.

—MANUFACTURERS OF—

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY, LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.

JOHN STEPHENSON CO.,

LIMITED,

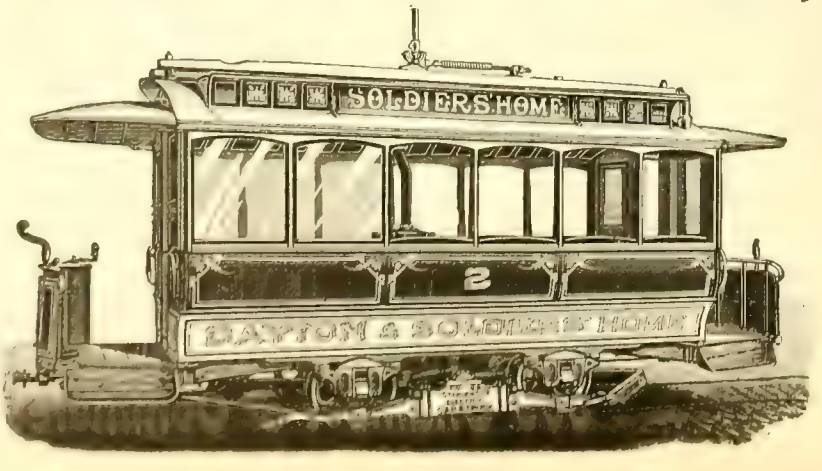
NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.



For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.

Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

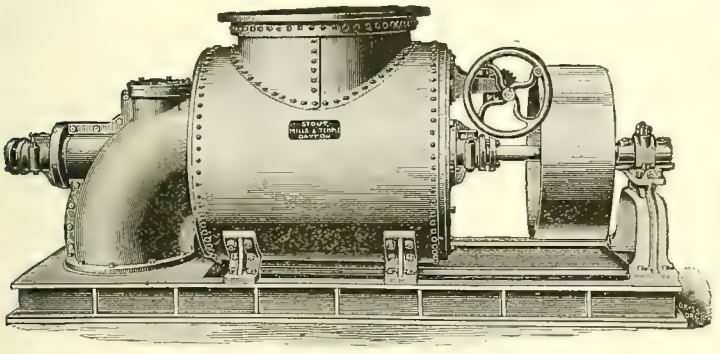
OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | **CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.**

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

OKONITE TRADE MARK

SOUTHERN ELECTRICAL SUPPLY CO.,

823 Locust St., ST. LOUIS, MO.,

Okonite Wires AND Cables.

AGENTS FOR THE CELEBRATED PACKARD LAMP.

Made to Fit any Socket.

We also have a full stock of Sockets made to fit any Lamp.

SEND US A TRIAL ORDER.

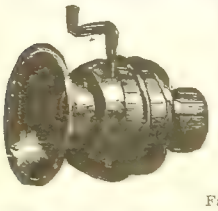
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC

HIGH SPEED STEAM ENGINE

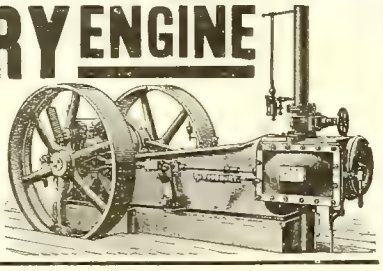
for Electric Lighting and Street Railway Service,

WITH BOILER PLANT COMPLETE

Catalogue sent on application.

STEARNS MFG. CO. ERIE, PA.

BRANCH OFFICES Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO.

HALF TONE PLATE A SPECIALTY

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

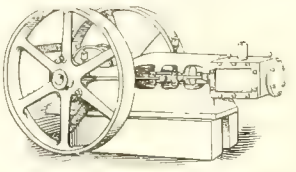
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,

ST LOUIS. CHICAGO. KANSAS CITY.

OMAHA. DALLAS. SEATTLE.



WILLIAMS AUTOMATIC ENGINE.

For all purposes requiring steady power.

WILLIAMS ENGINE WORKS. No. 447 North Street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE

MADE ONLY BY THE BALL ENGINE CO ERIE PA.

TRIPOD BOILER

Three Points of Superiority Guaranteed: Safety, Economy, Low First Cost

Repeated tests prove that it is absolutely Non-Explosive and the most Durable ever made.

Strong testimonials from hundreds of users, in all parts of the country.

Sizes 10 to 1,000 H. P.

For full information address,

HAZELTON TRIPOD BOILER CO.

809 Monon Block., CHICAGO, ILL.

Binders FOR THE Western Electrician $1.00.

WESTINGHOUSE ENGINES

USED BY THE FOLLOWING GOVERNMENTS.

UNITED STATES.

U. S. Torpedo Station, Newport, R. I., 43 H. P.
U. S. Army Department, San Antonio, Tex., 50 H. P.
U. S. Engineer Corps, St. Louis, Mo., 8 H. P.
U. S. Military Post, Fort Canby, Wash., 4 H. P.
U. S. Government Quartermaster Department, Vancouver, Wash., 62 H.P.
U. S. Government Quartermaster Department, New Orleans, La., 15 H. P.
U. S. Senate, Washington, D. C., 150 H. P.
U. S. House of Representatives, Washington, D. C., 75 H. P.
U. S. Government Ice Factory, San Antonio, Tex., 4 H. P.
U. S. Navy Yard, Norfolk, Va., 125 H. P.
U. S. Navy Yard, Brooklyn, N. Y., 125 H. P.
U. S. Government, Ellis Island, N. Y., 120 H. P.
U. S. Dispatch Boat "Lucerne," Norfolk, Va., 50 H. P.
Washington Monument, Washington, D. C., 25 H. P.
MEXICAN: State of Guerrero, 15 H. P.
JAPANESE: In Government Coal Mines, 150 H. P.
HOLLAND: Government Physical Laboratory of Leiden, 15 H. P.
RUSSIAN: Moscow Imperial Technical School, 10 H. P.
NEW SOUTH WALES: Government of New South Wales, 160 H. P.
TASMANIAN: Alexandria Battery, Hobart, 75 H. P.
ENGLISH: Number unknown. Details not reported. Over 30 engines.

Many others sold by agents, but not reported.

THE WESTINGHOUSE MACHINE COMPANY. PITTSBURGH. PENNA. U.S. OF A.

"MERIT LEADS TO SUCCESS."

HEISLER

LONG DISTANCE SERIES INCANDESCENT LIGHTING

HAS NO EQUAL.

ONLY successful method of distribution covering a large area WITHOUT swamping the plant with INTEREST on Copper Wire or cost of FUEL.
Transformers or Converters are a CONSTANT source of TROUBLE and EXPENSE, will cost MORE for repairs in a year than to renew the Lamps by our system.
Our PLANTS can be operated with [illegible] ELECTRICALLY and FINANCIALLY where no others can.
Positively SIMPLE, CHEAP and EFFICIENT.
LAMPS from 16 C. P. up, noted for BRILLIANCY and BEAUTY of the light.
ARC SERIES LAMPS of any C. P. for Arc Light Circuits.
Gold Medal, Paris Exposition, 1889.

Estimates furnished on application, for erection of plants in any section. Correspondence solicited.

HEISLER ELECTRIC LIGHT CO., Drexel Building, PHILADELPHIA, PA.

Send for Circular.

IMPORTANT TO BUYERS!

FOR SALE.—The Entire Stock of

ELECTRICAL SUPPLIES

OF THE

EMPIRE CITY ELECTRIC COMPANY,

15 and 17 Dey Street, - NEW YORK.

The directors of the Empire City Electric Company have deemed it best for the interest of all concerned to voluntarily dissolve the company and liquidate its affairs, and the Supreme Court of the State of New York has appointed me receiver. It being desirable to close up the business without delay, I offer for sale, in lots as wanted, the entire stock of General Electrical Supplies, consisting of:

HOUSE FURNISHING GOODS.

Electric and Magnetic Bells, Gongs, Electro-Mechanical Gongs, Batteries, open and closed circuits, of every description, Annunciators, Burglar Alarms, Automatic Drops, Wood and Metal Push Buttons and Gas Keys, large variety, Letter Boxes, Door Pulls, Door Openers, Binding Posts and Connectors, Gas Lighting Apparatus of every kind, Induction Spark Coils, Window and Door Springs, Window Tubes, Speaking Tube Material of all kinds, Fan Motors and Outfits, Gas Igniters, Porous Cups, Soldering Salts, Cleats, Rubber Tubes and Rods, Soft Rubber Tubing, Carbon Plates, Double-pointed Tacks, Staple Drivers, Sal Ammoniac, Blue Vitriol, Bichromate of Potash, Sulphate of Zinc, Quicksilver, Etc., Etc., Etc.

TELEPHONE AND TELEGRAPH GOODS.

Poles, Cross Arms, Oak and Locust Pins, Brackets, Glass and Porcelain Insulators, Cross Arm Braces, Lag Screws, Pole Steps, Nails, Spikes, Shovels, Spoons, Digging and Tamping Bars, Pikes, Soldering Stoves, Strip and Bar Solder, Screw Drivers, Vises, Eccentric Clamps, Tree Trimmers, Pliers, Pole Counters, Construction Tools of every Description, Telegraph Instruments, Binding Posts, Magneto and Extension Bells, Batteries and Battery Material, Zincs, Coppers, Blue Vitriol, Sal Ammoniac, Telephone Cords, Lightning Arresters, Torches, Blasting Apparatus, District Call Boxes, Splicing Clamps, Come Alongs, Hill's and Weldon's Climbers, Take Up Reels, Etc., Etc., Etc.

ELECTRIC LIGHT AND POWER GOODS.

Incandescent Lamps, Globes, Reflectors, Shades and Shade Holders, Wire Guards and Handles, Sockets, Cut-Outs, Main and Branch Blocks, Rosettes, Fuse Boxes, Fuse Links, Fuse Wire, Gas Attachments, Arc and Incandescent Switches, Flexible Cord, Glass Floor Insulators, Tree Insulators, Soldering Torches and Charcoal Furnaces, Electric Light Carbons, Testing Instruments, Tapes, Splicing Compound, Adjusting Balls and Cleats, Moulding, Cleats, Tool and Carbon Bags, Linemen's Body Belts, Splicing Clamps, Swing Ball Lightning Arresters, Vulcanized Fibre, Hard Rubber Sheets, Etc., Etc.

BARE AND INSULATED WIRES.

Hard and Soft Drawn Copper, Iron and Steel, German Silver and Fuse Wires, Annunciator, Burglar Alarm. Office, Magnet, Gas Fixture, Underwriters', Weather-proof and Rubber Covered Wires, Reels, Spools, Etc., Etc.

ELECTRO-MEDICAL APPARATUS

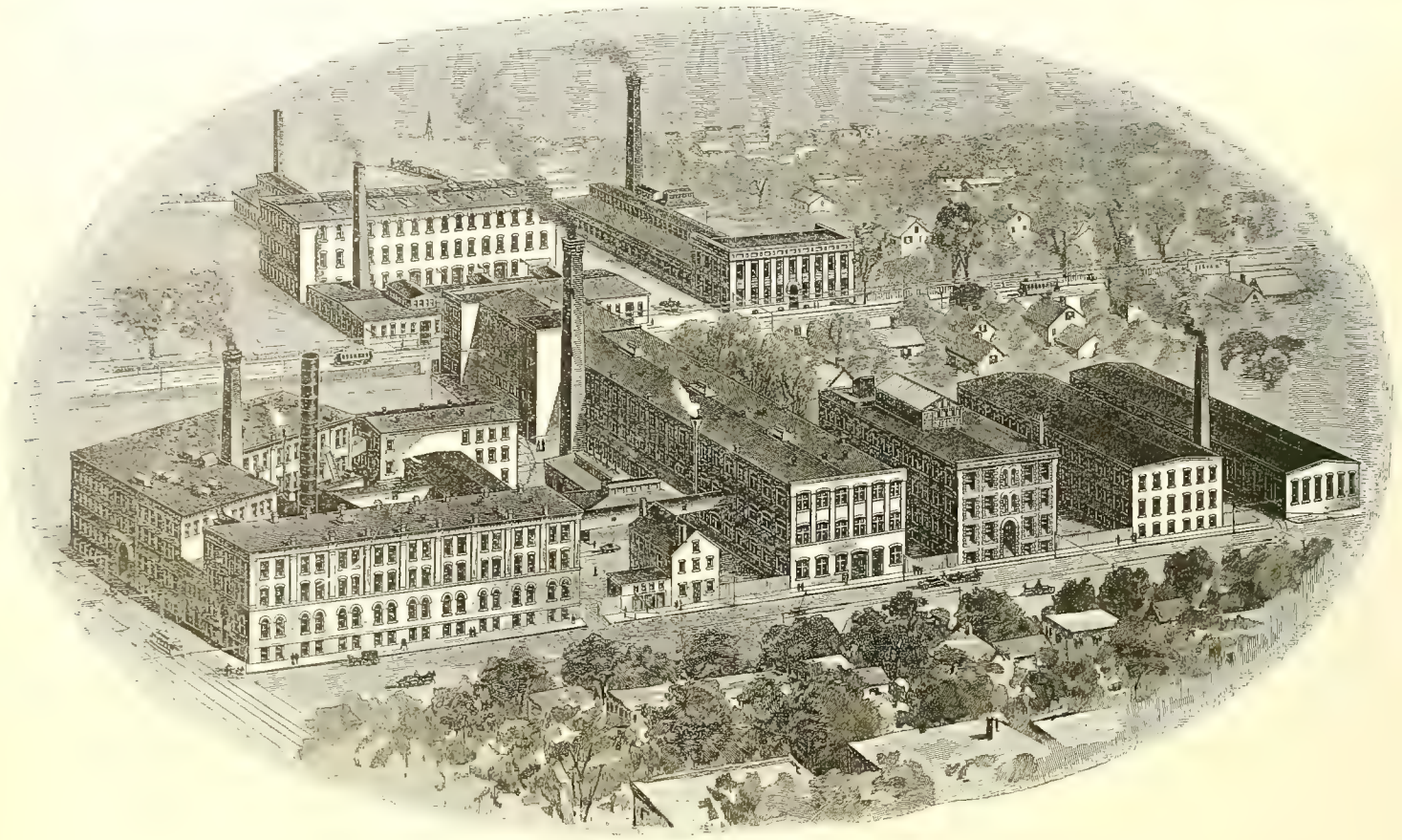
Of every description, including Empire, Perfection, Vesta, Florence, Williams, Kidder, Drescher, Gaiffe and other makes of Medical Batteries and Magneto-Electric Machines, Induction Coils, Handles, Cords, Sponges, Extra Zincs, Etc., Etc., Etc.

ALL IN FIRST-CLASS CONDITION.

Write for what you want if you cannot call and examine the goods.

CHARLES S. BEARDSLEY, Receiver, 15 & 17 Dey St., NEW YORK.

THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.

The KNAPP ELECTRICAL WORKS,

GENERAL AGENTS FOR

"SAFETY"

WIRES, CABLES AND CORDS

For Inside, Underground and Submarine Use.

"SAFETY" Fire-Proof House Wire. "ATLAS" Line Wire.

R. B. WATSON & CO., Agts., DETROIT, MICH.

J. W. MASON, Agt., 527 Delaware Street, KANSAS CITY, MO

POST & CO., Agts., CINCINNATI, O.

THE PERKINS ELECTRIC LAMP CO.

LAMPS

TO FIT ANY SOCKET.
ANY CANDLE POWER.
ANY VOLTAGE.
LONGEST LIFE.
HIGH EFFICIENCY.

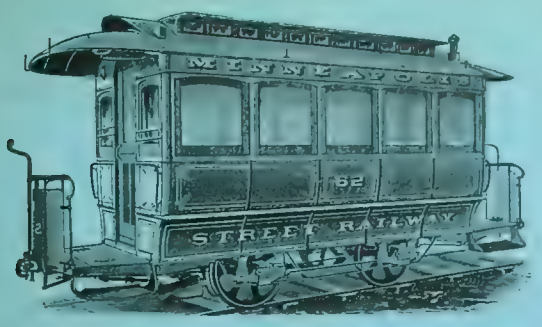
MANUFACTURERS OF

ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

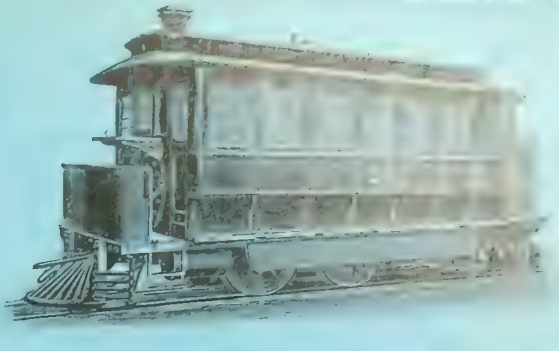
54 and 56 Franklin Street, CHICAGO.

SEND FOR CATALOGUE.

FACTORIES: Ansonia, Conn.
The ELECTRICAL SUPPLY Co.
104 Michigan Av. CHICAGO
FORMERLY 111 Randolph St.
Sole Western Agents
STANLEY FAN MOTOR



STREET CARS



FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

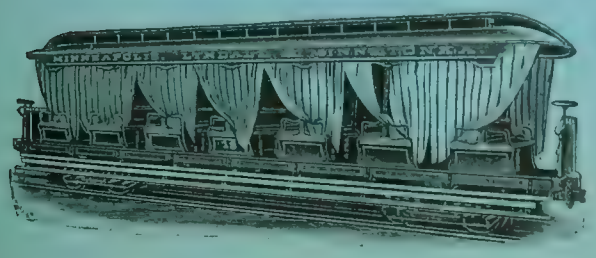
MINNEAPOLIS STREET RAILWAY CO.,

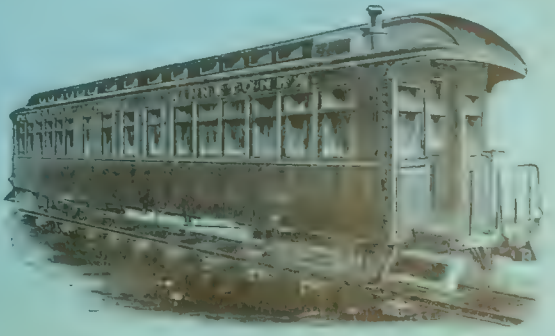
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

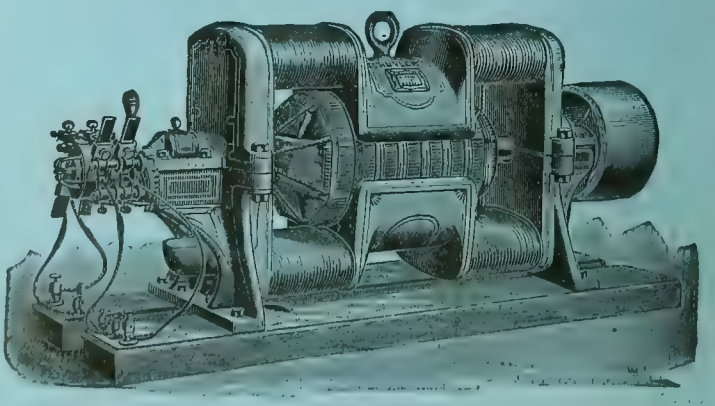
FACTORIES AND GENERAL OFFICES. BALTIMORE, MD.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, AUGUST 1, 1891. No. 5

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes
Telephonic transmission through Our Cable an easy
CAME.

An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices.

Standard Underground Cable Co., New York, Pittsburgh, Chicago.

THE HOLTZER-CABOT ELECTRIC CO.,
MANUFACTURERS OF AND DEALERS IN
EVERYTHING ELECTRICAL.
SEND FOR 256-PAGE CATALOGUE,
111 Arch Street, BOSTON, MASS.
SPECIAL AGENCIES: CLOWER & HARRIS, Dallas, Texas. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.
A full line of our manufacture can be found at our Agencies.

Nuttall Trolley. Patents Pending.

THE BEST!
$30.00
WRITE US.
Electric Railway Specialty COMPANY,
29 Broadway, NEW YORK.

KELLOGG
COMBINATION STEEL CENTER AND SIDE
POLES.
ENGINEERING EQUIPMENT CO.,
SOLE AGENTS,
NEW YORK, 143 Liberty St.
BOSTON, 126 Pearl St.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.
OKONITE TRADE MARK
INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.
BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP
AGENTS
J. W. PEALE, 1 BROADWAY, NEW YORK.
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.

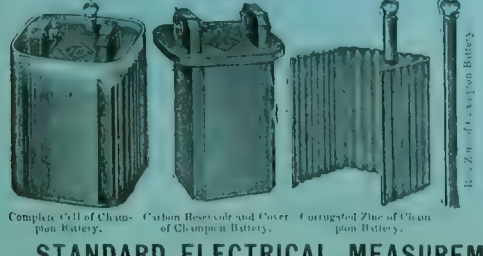
GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

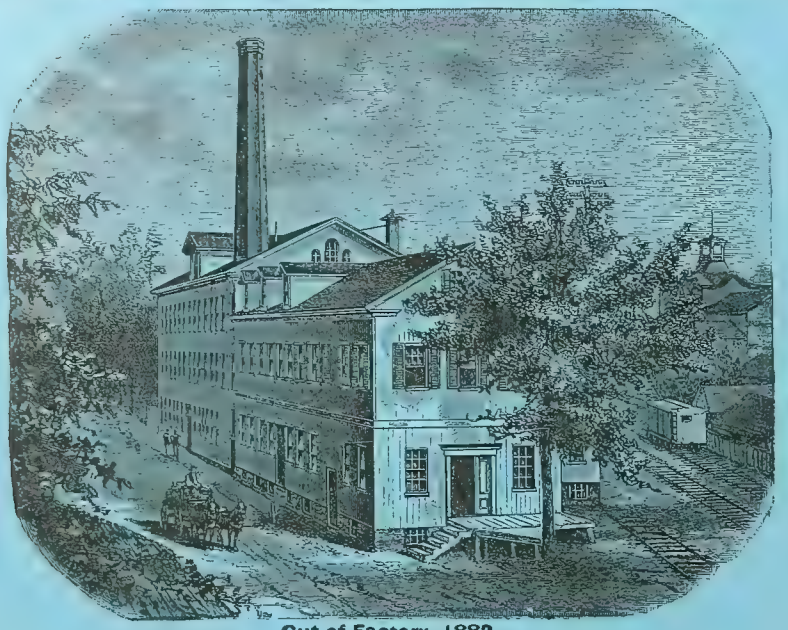


Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. R. Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.
Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.
STANDARD ELECTRICAL MEASUREMENT APPARATUS.

ELECTRIC RAILWAY SUPPLIES
For All Systems.
EXCLUSIVELY.
SEND FOR CATALOGUE.
ELECTRIC MERCHANDISE CO.,
11 ADAMS STREET, CHICAGO.
W. R. MASON, General Manager.

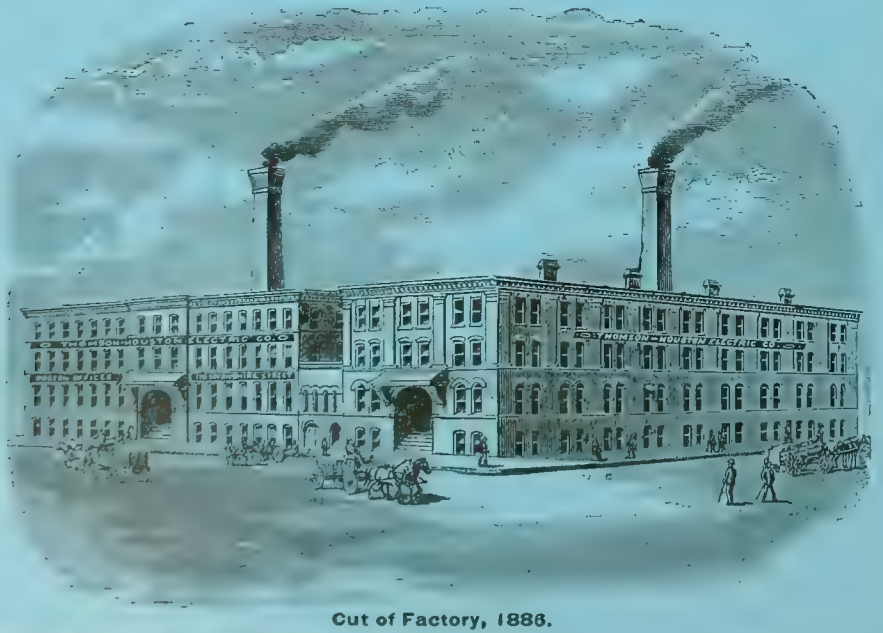
IS THE THOMSON-HOUSTON ELECTRIC CO.'S SYSTEM OF LIGHTING A SUCCESS?



Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, 1,653 Lamps.	None.	None.



Cut of Factory, 1886.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, 21,840 Lamps.	29 Companies, 11,275 Lamps.	None.

Read the Answer on Page xx.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The........xxiv
Abendroth & Root Mfg. Co....——
Alexander, Barney & Chapin.....i
American Electrical Works.....xvii
Andrews & Co., A. H.......xiv
Automatic Switch Co...........x
Baggot, E..................xiv
Bain Electric Mfg. Co...........xvi
Ball Engine Co.............xviii
Barton & Brown...............xiv
Baxter Electric Motor Co.......xxiv
Beardsley, Chas. S., Receiver..——
Bernstein Electric Co.........——
Blatz, L.........................——
Borden & Selleck Co.............xv
Braun Illustrating Co..........xviii
Brownlee & Co..................xii
Brookfield, Wm..................xii
Brush Electric Co..............xvii
Butler Hard Rubber Co.........viii
C. B. & Q. R. R.................xiv
C. & C. Electric Motor Co. ...xvi
Card Electric Motor & Dynamo Co...................——
Central Electric Co.......... ... v
Chicago Electric Mfg. Co........xiv
Chicago Insulated Wire Co....xvii
Cleverly Electrical Works.....——
Colburn & Co., I. W..........xiv
Coolidge, Fuel & Supply Co....——
Cowles Electric Smelting and AluminumCo..................xv
Crocker-Wheeler Electric Motor Co..........................xiii
Day's Kerite Insulation...........i
Dayton Globe Iron Works Co.xviii
Eastern Electric Cable Co.......xiii
Easton Electric Co............xiii
Edison General Electric Co.,—Motor Dept.....................vi
Edison General Electric Co, Wire Department...............vii
Electric Construction & Sup. Co. viii
Electric Merchandise Co..........i
Electric Secret Service Co.......vii
Electric Railway Specialty Co.....i
Electrician Pub. Co........x, xxiii
Electrical Construction Co., The.xiii
Electrical Engineering Co.......xiii
Electrical Supply Co., The....xxii
Elektron Mfg. Co...............xvi
Empire China Works.... xiv
Engineering Equipment Co.......i
Evans Friction Cone Co.......xvii
For Sale................xiii, xiv
Fort Wayne Electric Co......xxiv
Freeman, Coleman & Co.......xiv
Globe Carbon Co..............xv
Great Western Electric Supply Co......................——
Greeley & Co., The E. S..........i
Hale Elevator Co..............vii
Hazelton Tripod Boiler Co......xviii
Heisler Electric Light Co.......——
Hill Clutch Works...........xvii
Hine Eliminator Co...........——
Holmes, C. H...................xiii
Holmes, Booth & Haydens.......iv
Holtzer-Cabot Electric Co.........i
Hood, Wm......................x
Hunt Machine Co.,Rodney......xiv
India Rubber & Gutta Percha Insulating Co...................iv
Interior Conduit & Insulation Co..xii
International Okonite Co...........i
Kartavert Mfg. Co.............xiv
Knapp Electrical Works......xxi
Law Telephone Co............xiii
Leffel & Co., Jas...............xiii
Loud, H. M. & Sons Lumber Co........................xiv
McLaughlin, James xiv
Mason, James H...............xiii
Milliken Bros...................iv
Minneapolis Street Railway Co..——
Monitor Electric Co..............x
Munsell & Co., Eugene.........xiii
Murphy, T. J....................xiv
National Carbon Co.............iv
National Electric Mfg. Co.......ix
N. Y. Belting & Packing Co.....——
New York Insulated Wire Co.. viii
New York & Ohio Co..............i
Northwestern Electrical Specialty Co........................——
Ohio State University..........xii
Ostrander & Co., W. R.........xiv
Palste, H. T.......................xii
Page Belting Co..................xiv
Partrick & Carter Co..............x
Payne & Co., Geo. W...........xix
Pearson & Co., W. B.........xviii
Phoenix Glass Co...............xvii
Pond Engineering Co..........xviii
Powell Co., The Wm..........——
Purdue University.............xiv
Queen & Co....................xiii
Rockford Electric Mfg. Co......xii
Sargent & Lundy................xiii
Sawyer-Man Electric Co...........xi
Schieren & Co. Chas. A.........xii
Schoonmaker, A. O............xiii
Schuyler Electric Co............xix
Short Electric Railway Co.......xii
Shultz Belting Co. ....——
Standard Underground Cable Co....i
Standard Paint Co..............xii
Stanley Electric Mfg. Co......xix
Star Iron Tower Co............——
Stearns Mfg. Co..............xviii
Stephenson Co., Jno...........xvi
Sterling, W. C...................xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co.....xv
Taussig, S.......................xiv
Temple, J. C......................xv
Thomson-Houston Electric Co. Lighting Department .... ii, xx
Turner Brass Works..............xiii
Union Electric Mfg. Co., The. ——
Union Electric Works.............iv
Union Hardware Co..............xii
United States Electric Lighting Co............................xi
Van Nuis C. S.......................i
Vulcanized Fibre Co.............xv
Wanted....................xiii, xiv
Wenstrom Consolidated Dynamo & Motor Co., The x
West End Street Railway Co.. xiv
Western Electric Co...........viii
Westinghouse Electric and Mfg. Co..........................——
Westinghouse Machine Co.....xviii
Weston Electrical Instrument Co..............................xii
Williams Engine Works.......xviii
Woodbridge & Turner Engineering Co xv
Worthington, Henry R..........xii

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co.,The.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Beardsley, Chas. S.
Central Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Stephenson Co., John.
West End Street Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co , The
Fort Wayne Electric Co.
Engineering Equipment Co.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Beardsley, Chas. S.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Monitor Electric Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Beardsley, Chas. S.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Colburn & Co., I. W.
Easton Electric Co.
Electrical Engineering Co., The.
Fort Wayne Electric Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.
Union Electric Works.

Electric Railways.
Edison General Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Beardsley, Chas. S.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Easton Electric Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Beardsley, Chas. S.
Brookfield, Wm.
Butler Hard Rubber Co.
Central Electric Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Monitor Electric Co.
New York and Ohio Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Wenstrom Consolidated Dynamo & Motor Co.

Lamps, Incandescent—Contd.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
[illegible]

Mining Apparatus, Electric.
[illegible]
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
[illegible]
U. S. Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., Wm.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Beardsley, Chas. S.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
West End Street Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co , The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Hunt Machine Co., Rodney.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Universities.
Ohio State University.
[illegible]

Wire, Bare.
American Electrical Works.
[illegible]
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

UNION ELECTRIC WORKS,

207 SOUTH CANAL STREET, CHICAGO, ILLINOIS.

The BEST ELECTRIC BELL in the market; Nickel plated Gongs; Double magnet, Platinum Contacts, side adjustment with set screw. The simplest and most durable Annunciator, all sizes, for elevators, hotels and offices.

— WRITE FOR PRICES. —

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class Work.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

56 LIBERTY STREET, NEW YORK.

MANUFACTURED BY MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." PATENT "K.K." LINE WIRE TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO, Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent, 25 Park Place, NEW YORK.

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.,

— MANUFACTURERS OF —

VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES.

CONCENTRIC CABLES, any millage. FLEXIBLE CORDS. SILK, HEMP, COTTON, DYNAMO WIRES and CABLES, very pliable. Every variety of INCANDESCENT CORES.

HABIRSHAW

RUBBER COVERED

WIRES.

CABLES AND CORES.

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High Insulation and Long Life, all milage

If you are not acquainted with the merits of Habirshaw Insulation we shall be pleased to send you samples upon application.

W. M. HABIRSHAW, Gen'l Mgr. OFFICE: 315 Madison Ave., Cor. 42d St., New York.

FACTORY: Glenwood, Yonkers, N. Y.

WESTERN AGENTS, The Electrical Supply Co., 171 Randolph Street, Chicago, Illinois.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 LOCUST ST., ST. LOUIS, MO.

BANNER WIRE.

OKONITE
TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 DELAWARE ST., KANSAS CITY, MO.

A NEW WEATHER-PROOF WIRE.

Double, Triple and Quadruple Braid.

This is the best finished, best insulated, most durable, and generally the most satisfactory of all the ordinary weather-proof Wires. Send for samples before placing your construction orders.

PRICES LOW. SHIPMENTS PROMPT.

Also GENERAL WESTERN AGENTS for

OKONITE
TRADE MARK

AND

IMPROVED CANDEE WEATHERPROOF WIRES.

These Wires are positively the best of their respective classes.

BRANCH BLOCKS,
MAIN CUT-OUTS,
SOCKETS,
PAISTE SWITCHES
AND GENERAL ELECTRICAL SUPPLIES.

CENTRAL ELECTRIC COMPANY,

116 & 118 FRANKLIN ST.,
CHICAGO.

OKONITE
TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., OMAHA, NEB.

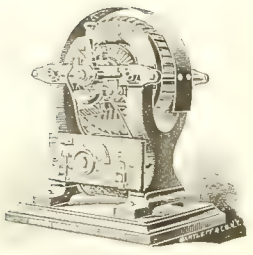
Connected by private wire with Postal Telegraph-Cable Company's System.

OKONITE
TRADE MARK.

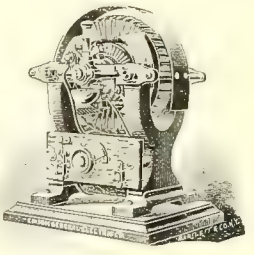
ELECTRIC POWER AND TRANSMISSION CO.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.



NEW



ELECTRIC MOTORS.

MINIMUM OF ATTENTION AND REPAIR.

Highest Efficiency,
Slow Speed,
No Sparking.

H. P.	LIST PRICES.	PRICES TO USERS, 45 PER CENT. OFF LIST.
1-12	$ 40	$22.00
1-6	60	33.00
1-3	100	55.00
1-2	125	78.75

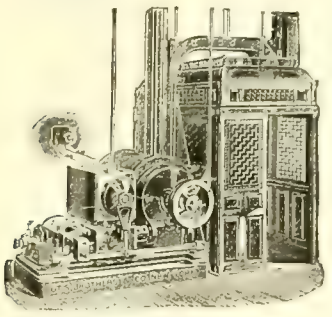
Independent Coils,
Improved Lubrication,
Mechanically Perfect.

SEND FOR DESCRIPTIVE CIRCULAR TO NEAREST DISTRICT OFFICE.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, Rialto Building, Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

PASSENGER AND FREIGHT,

Hydraulic and Electric

ELEVATORS.

THOMAS STURGIS, President. WM. C. LANE, Secretary and Treasurer. C. P. MACKIE, General Manager. S. S. BOGART, General Agent.

ELECTRIC SECRET SERVICE CO.,

45 BROADWAY, NEW YORK.

Owning the patents of Mosher, Gill, Hatch, Foote, Kintner and Moore for

INDIVIDUAL TELEGRAPH CALL AND CUT-OUT APPARATUS.

OTHER PATENTS PENDING.

The only practical and reliable system of electric selection invented.

Use either ***Morse Key*** or ***Automatic Transmitter.***

From every station selected an ***Automatic Answer back*** is received.

Gong rings until shut off by operator.

Any office on line can be selected without disturbing the others and either called up or cut out. No interference with regular telegraph service. No resistance added to main line. Easily applied. Economical. Convenient. Reliable.

Applicable to arc lights, singly or in groups; fire alarm service; police telegraph; electric motor circuits; railroad signals, etc.

The public is warned against infringing companies and devices.

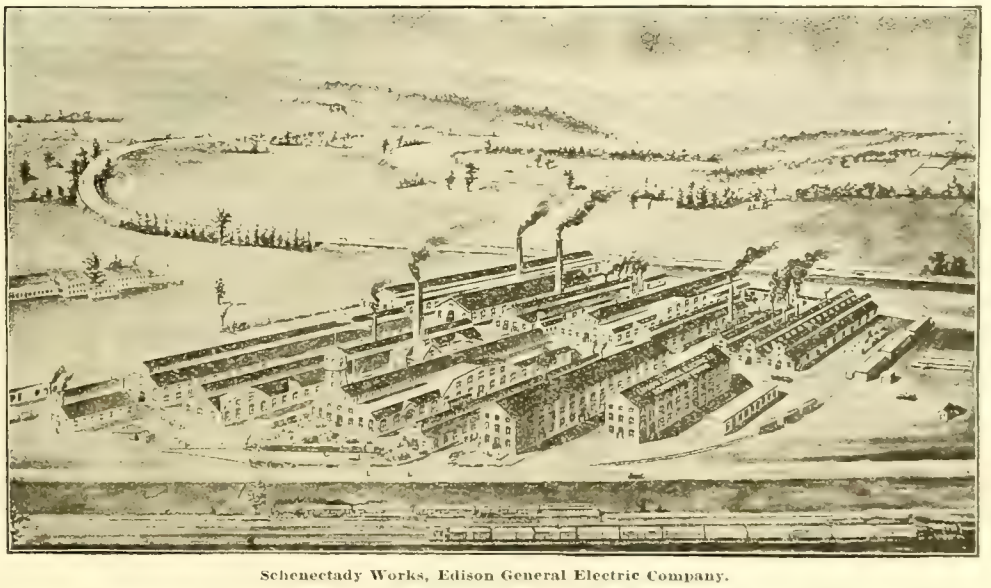
For terms and other particulars, address as above.

SIEMENS CABLES.

Submarine,

Telegraph,

Underground,



Telephone,

Interior,

Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Wire Department, Edison General Electric Company,

EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

WESTERN ELECTRIC COMPANY,

CHICAGO,
NEW YORK,
LONDON,
ANTWERP,
BERLIN,
PARIS.

MANUFACTURERS AND DEALERS IN

Arc and Incandescent Electric Light Apparatus, Patterson Underground and Overhead Cables, I. C. Weather-proof Wire, Washburn & Moen's Hard Drawn Copper Trolley and Galvanized Iron Wires, House Goods, Testing Apparatus, District Telegraph Apparatus, Line Supplies, Tools, and all other Electrical Appliances.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS. **WIRES.** You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK. G. H. MEEKER, Western Manager.

"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

WE GUARANTEE OUR LAMPS ELECTRICALLY AND MECHANICALLY.

In corresponding please give full particulars and state voltage.

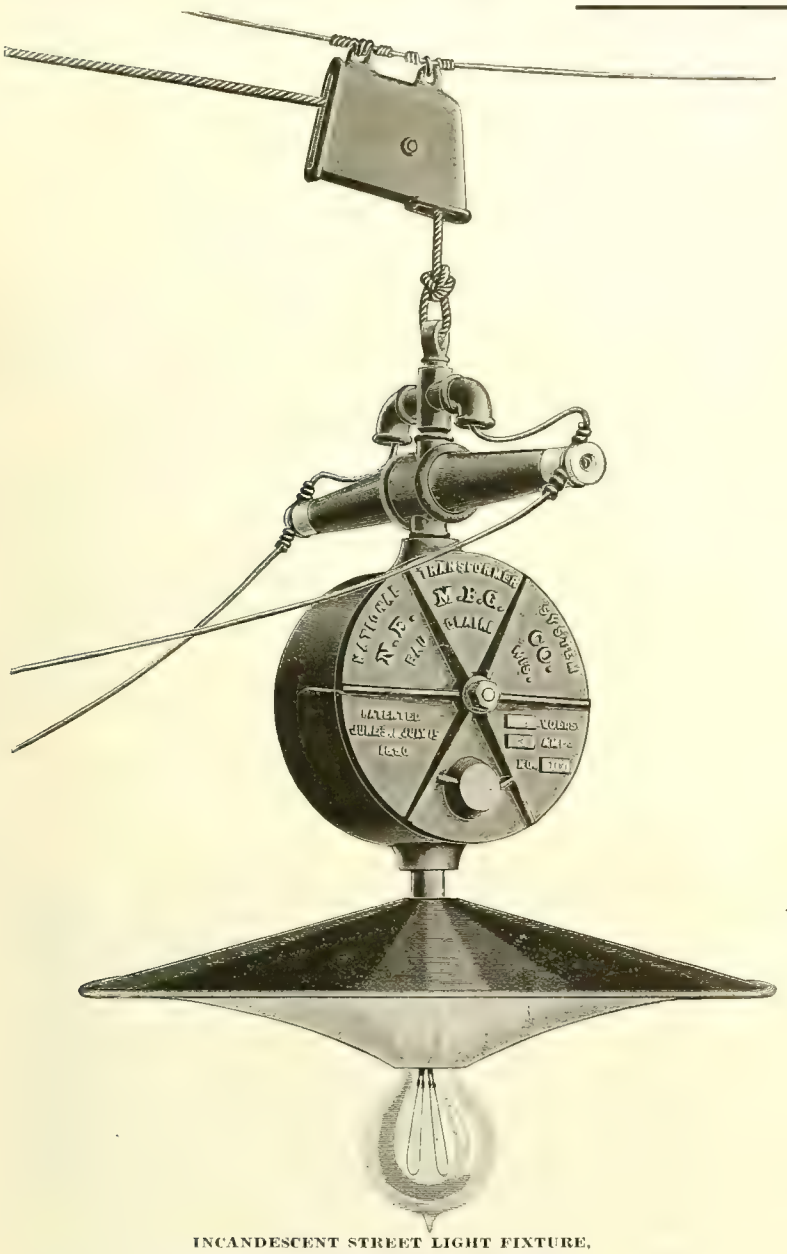
ELECTRIC CONSTRUCTION AND SUPPLY COMPANY,

Phenix Bldg., CHICAGO, ILL. 18 Cortlandt St., NEW YORK CITY.

ESTABLISHED 1881.

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



INCANDESCENT STREET LIGHT FIXTURE,
SERIES TRANSFORMER, REFLECTOR CANOPY AND 32 C. P. LAMP.

WHY

USE ARC LAMPS

WHEN THE

NATIONAL

SERIES TRANSFORMER

ENABLES YOU TO DO

STREET LIGHTING

ECONOMICALLY
EFFICIENTLY
SATISFACTORILY ???

Send for Circulars and Prices.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

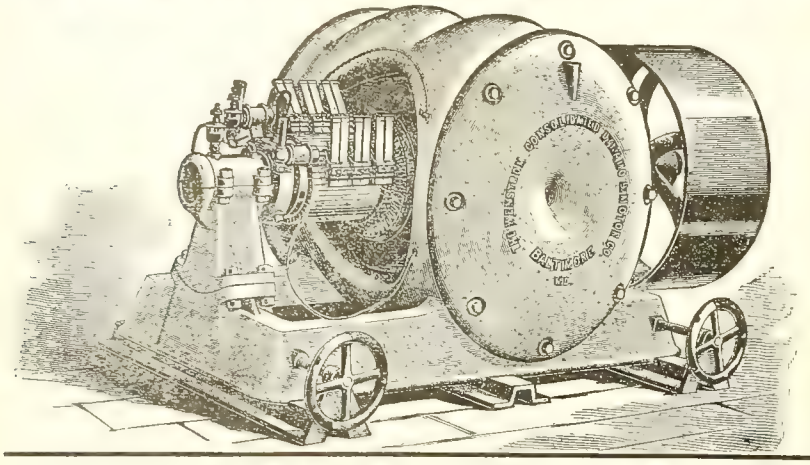
AGENTS:

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	**ST. PAUL, MINN.,**	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	**DETROIT, MICH.,**	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	**DENVER, COLO.,**	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	**WINNIPEG, MAN.,**	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	**SAN FRANCISCO, CAL.,**	National Electric Development Co.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

WM. HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES!

16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

MONITOR CARBON BATTERY

Unsurpassed in Strength and Durability.

LIBERAL DISCOUNT TO THE TRADE.

Write for Quotations.

G. A HARMOUNT, M'gr,

Monitor Electric Company

149 WABASH AVENUE,

. . . . Chicago, Ill.

Western Agents Alfred F. Moore's Wires and Cables.

A NEW BOOK.

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

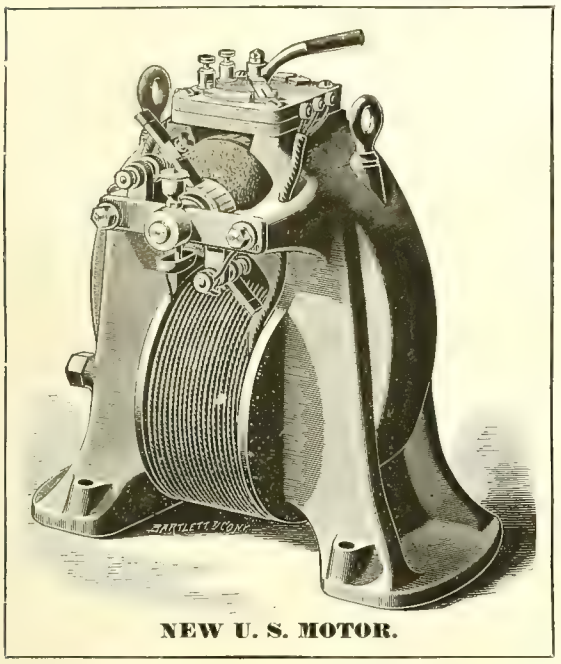
NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

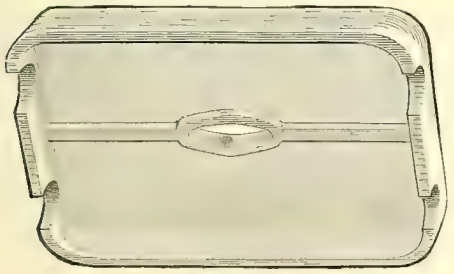
MOTORS and GENERATORS

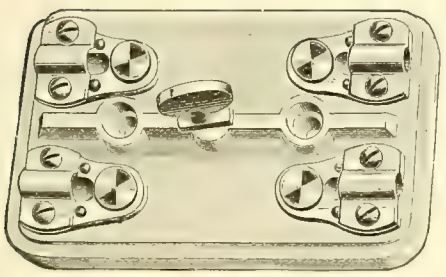
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

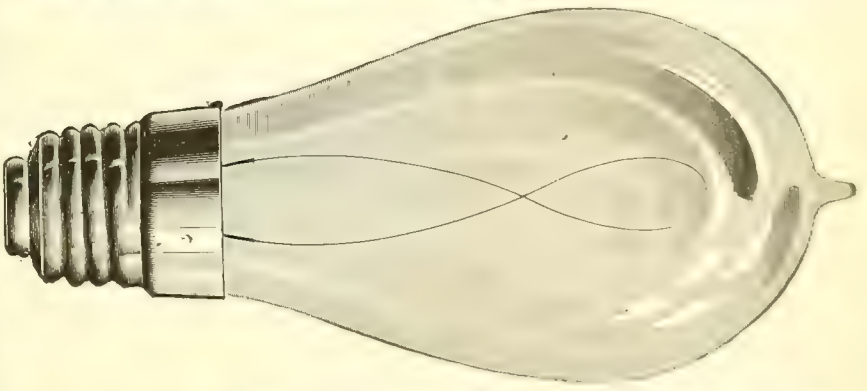
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

ROCKFORD ELECTRIC MFG. CO.,

ROCKFORD, ILL.,

MANUFACTURERS OF

ELECTRIC MOTORS, (Stationary and Railway,)

Incandescent Dynamos and Generators,

(MAYO SYSTEM.)

These Dynamos are specially adapted to Isolated Plants, as they are self-regulating, thoroughly reliable, and any one can run them. The Motors are the most efficient now in the market.

Agents Wanted in Unoccupied Territory.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO. ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

ELECTRIC RAILWAY SUPPLIES

FROM RAIL BONDS TO 250 HORSE POWER DYNAMOS, FOR SALE BY

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, O.

THE NEW CATALOGUE

—OF THE—

UNDERGROUND CONDUIT SYSTEM

OF THE **Interior Conduit & Insulation Company**

Copies mailed upon application to

IS NOW READY.

INTERIOR CONDUIT & INSULATION COMPANY.

EDWARD H. JOHNSON, President.

WORKS, 527 to 531 W. 34th St. and 526 to 528 W. 35th St.

H. M. UNDERWOOD, Gen. Western Agent, Rookery Building, Chicago.

GENERAL OFFICES, 42 & 44 BROAD ST., NEW YORK.

B. FRANK JOHNSON, Gen. Agt. for Pa., Provident Bldg., Philadelphia, Pa.

THOS. DAY & CO., Gen. Agents for California, San Francisco, Cal.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

ELECTRICAL ENGINEERING, OHIO STATE UNIVERSITY, COLUMBUS, OHIO. A new and commodious building. Dynamos of commercial size, for arc and incandescent lighting, by direct and alternating currents. Motors, storage batteries, etc., etc. A fine collection of standards, testing instruments, etc. Extended practice in well equipped mechanical and physical laboratories. Entrance requirements modified. Special courses given. Send for catalogue.

H. T. PAISTE,

Paiste Electrical Specialties.

341 THE ROOKERY CHICAGO, ILL.

1201 MARKET ST. PHILADELPHIA, PA.

PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

P. AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, AUGUST 1, 1891. No. 5

Henry M. Byllesby.

That an intimate knowledge of the scientific and mechanical branches is of great value to the head of an electrical enterprise is shown by instances in which experts have become successful managers. True, it is necessary in such cases to combine executive ability and scientific knowledge—a combination that is generally considered out of the question. Yet that there are such cases is known to all acquainted with the managers of the great electrical houses of this country. One of the most conspicuous of this class is Henry M. Byllesby, the subject of this sketch, whose portrait is herewith presented.

Mr. Byllesby was born in January, 1859, in Pittsburg, Pa., his father being the late Rev. D. C. Byllesby of the Episcopal church. His early days were passed at Mount Holly N. J. Later he accompanied his father to Allentown, Pa., and while residing there entered the class of 1878 at Lehigh University, Bethlehem. He was not able to complete his scientific studies at that institution, however, as he found it necessary to accompany his father to Roselle. While at Roselle he was for a time employed in the general office of the Central Railroad of New Jersey in New York city. From 1879 to 1882 he was employed by Robert Wetherill & Co. of Chester, Pa., as a draftsman and mechanical engineer.

In 1882 he became connected with the Edison company, and maintained this connection until 1885, spending most of his time as manager of the Canadian department of that company. In 1885 he accepted an offer from Geo. Westinghouse, Jr., to become eastern sales agent of the Westinghouse Electric company. Soon after he was appointed general manager, and then elected first vice president, holding these positions until December, 1890, when his resignation was reluctantly accepted. In February, 1891, he became connected with the Thomson-Houston Electric company. In May, 1891, he was elected vice-president of the Northwest Thomson Houston Electric company, with headquarters at St. Paul, and in June was promoted to the presidency of that company.

From childhood Mr. Byllesby has been interested in all branches of mechanics, his greatest pleasure as a boy being the building of miniature steam engines and other mechanical toys. He has always been an enthusiastic worker at his profession, and the patent office records bear evidence of the results of his work. His greatest success was, however, in directing and managing the mechanical and selling departments of the Westinghouse Electric company. Mr. Byllesby is a member of the American Society of Civil Engineers, American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

HENRY M. BYLLESBY.

In 1882 he married a daughter of H. P. Baldwin, general passenger agent of the Central Railroad of New Jersey.

Mr. Byllesby is a man of fine physique, splendid business judgment, rare tact and has already made hosts of friends in St. Paul. The Northwest Thomson Houston Electric company is to be congratulated on its good fortune in having Mr. Byllesby at its head.

Electric Light Plant for the Masonic Temple, Chicago.

The contract for the electric light plant for the Masonic Temple in Chicago, which will be one of the largest isolated plants in the world, has been awarded to the western isolated lighting department of the Thomson-Houston Electric company. The generating plant will consist of six 80,000 watt generators, and between 7,000 and 8,000 ghts will be wired. Nearly every company in the field made proposals for this contract, and the isolated lighting department of the Thomson-Houston company naturally feels elated at securing it. In addition to the generating plant and wiring, an order was secured for about eight thousand Thomson-Houston incandescent lamps and the necessary sockets.

The New Ticket Distributer at the Chicago Telephone Exchange.

Some months ago the WESTERN ELECTRICIAN contained an article describing the manner of handling a "busy" call by an improved system which had been newly introduced in the main telephone exchange of the Chicago Telephone company. Within the last month there has been introduced an improvement which still further facilitates the handling of these calls. This improvement is a ticket distributer contrived and arranged by J. J. O'Connell, the company's electrician. Under the former arrangement the "busy" tickets were made out and distributed at the "target" or "busy" board, the call sometimes passing through the hands of several operators. With the aid of this new device the tickets are distributed to six operators, each operator receiving only the tickets belonging to her section. The distributer consists of a brass box, two inches in width and twenty one feet in length, having six channels, each channel terminating in a slot placed before an operator. Under the box passes a cotton band, forming an endless belt. At one end of the distributer is placed a desk composed of six sections, each section being provided with six slots, and each slot leading to one of the six channels of the distributer. At each section of this desk an operator is stationed, who receives the "busy" call, writes out the ticket and deposits it in the channel which bears it to the

operator at the [illegible] connection [illegible] nection.

Electricity at "A Night in Pekin."

On Tuesday, Thursday and Saturday nights of each week crowds of people fill the large amphitheater at the corner of Sixtieth street and Cottage Grove avenue, Chicago, where the big spectacular entertainment "A Night in Pekin" is presented. Behind the realistic bombardment of the city, its subsequent overthrow and the beautiful pyrotechnic display following, which are alone apparent to the eyes of the spectators, there lies the usual mass of detail and discipline necessary to accomplish these outward results. A representative of the WESTERN ELECTRICIAN, through the courtesy of Mr. [illegible] performance, was allowed to inspect the region behind the scenes. Among other interesting features is that of igniting the explosives by electricity. The equipment is somewhat similar to that used in blasting and mining operations. Four cells of battery furnish the necessary current.

The detonator, instead of inclosing the wire in a brass or a glass tube, as is usually the case, has its wire protected in a paper sheath. The platinum wire which is made especially for the current is delicate and thin. The fulminate caps attached to the wire are about ¾ of an inch in length. Separate wires are strung to each district of the city of Pekin which is destined to destruction. When the proper moment arrives, the electrician, by manipulating a switch and lever, turns the electric current on the different wires in rapid succession; the walls of the city tremble, the tall buildings totter, crash follows crash. Pekin has fallen.

J. Smith of Compton, N. J., is the electrician who plans and furnishes the electrical equipment for numerous spectacular shows which James A. Pain & Sons are operating in American cities. It will be remembered that Mr. Smith is the gentleman who managed and accomplished the blowing up of [illegible] in New York harbor some time ago.

Electricity at the World's Fair.

The foundations for the World's Fair electricity building have been put in and work will soon be begun on the superstructure.

Electric fireworks on an elaborate scale are proposed as a feature of the dedicatory ceremonies of the week of Oct[illegible] Eugene & Paul Champenois of [illegible] France, has presented a plan for a display that would be very imposing and attractive. One of the leading pieces is [illegible]

"The City of Chicago, personified as a statue of fire, seated, and surrounded by figures of the states of the American Union. She will receive the great powers of the world, which will defile one by one before the assemblage of states. As each figure passes [illegible] it will halt, bow, and then lay down its flag or shield at Chicago's feet and receive a [illegible] then pass on, disappear, and another take its place. This superb picture of itself will be a grand firework, for every point [illegible] which it is composed [illegible] or colored, and the successive appearance of the allegorical figures will be in multi-colored moving fire, making a marvelous and splended kaleidoscope, forming one part of the display. Innumerable pieces of fireworks will form the background of this [illegible] a surface of 24,000 [illegible] time for the display of the allegorical pieces can be from 30 to 40 minutes, and [illegible] time every night. At each [illegible] be changed, for it would be impossible to show the 40,000 or 50,000 effects comprised in [illegible] the space of half an hour. [illegible] display can be shown at no other [illegible]

stalled, than that of operating the electrical plant. About 2,800 horse power working for one hour, would be required. The display of rockets is accompanied by detonations more or less violent as is desired, or these can be entirely suppressed if unpleasant to the ear, in which case they can be replaced by one or more bursts of military music, which will make of the combined harmony of sound and fire a wonderful delight. The fireworks contain neither gunpowder nor dangerous explosives. In firing rockets there are none of the inconveniences occasioned by rocket sticks falling among the spectators, nor by sparks causing fires among neigboring buildings. Wherever the point may be that a "sun" or a star may suddenly appear, on the fleeting and capricious line of the rocket, the operator is absolutely master of the situation, making the display appear or disappear, as he may wish. The fireworks, whether fixed or moving, are as varied in effect as they are unexpected and harmless, even to spectators not six feet from them. Their duration is indefinite. There is nothing which can stop them, except the breaking of the electric current or the will of the electrician in charge. It is claimed that that which can be produced has as much diversity for the eye as has music for the ear, and the owners claim that they will sustain the artistic comparisons they make."

Train Lighting by Electricity.

An English system of train lighting by electricity was described in the WESTERN ELECTRICIAN of June 6th, and a special type of dynamo designed for this work by J. H. Holmes was illustrated. Further details of this system are now presented, the accompanying drawings being reproduced from the London *Engineering Review*. Mr. Holmes' system is an adaptation of the plan of driving the dynamo from the car axle. This system is generally condemned on account of the varying speed of the axle and the stopping and reversal of the train. Mr. Holmes claims, however, to have provided against all such emergencies and objections.

At the maximum speed of the train the magnets of the generating dynamo are excited by a high resistance shunt; when the speed becomes lower, an extra excitation is given to the magnets by means of secondary batteries and a small regulating dynamo in order to make up for the reduction of speed, and so keep the electromotive force at the terminals the same as before; and when the speed of the train becomes less than a certain minimum, or when it is stopping, a governor switches the generating dynamo out of the circuit, and the circuit is then fed temporarily by the accumulators until the speed rises again.

An elevation of the dynamo is shown in Fig. 1. By referring to this cut it will be seen that there are two dynamos, Q and R, whose armatures, A and B, are fixed to the same shaft. Q is the main dynamo for supplying current to the lamp circuit e, Fig. 2, and R is a smaller dynamo for regulating the main dynamo. The current from Q passes along the wires d to the main circuit e. The accumulators C are placed in a shunt from the main circuit The field magnets of the main dynamo have two windings, one a high resistance shunt a, and the other a low resistance shunt b. The shunt b is in series with the conductor of the armature B of the regulating dynamo R. Another shunt c magnetizes

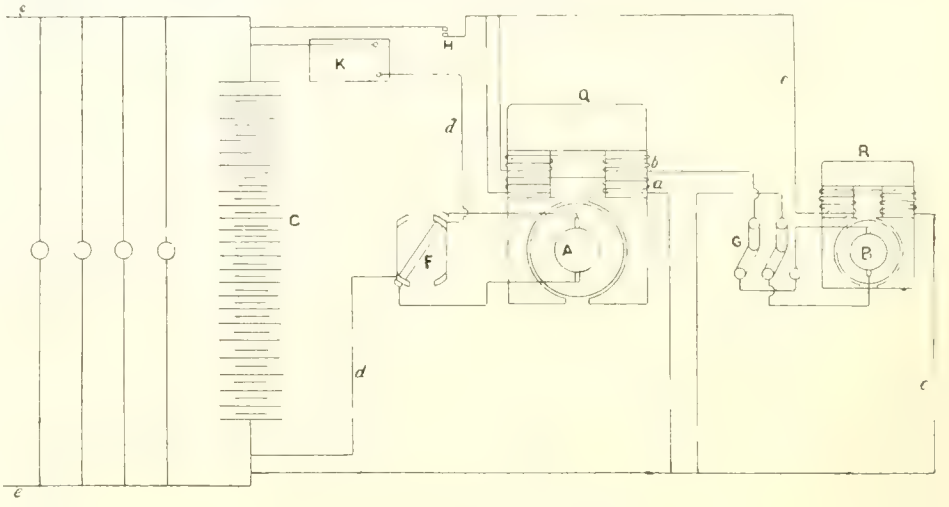


FIG. 2. TRAIN LIGHTING BY ELECTRICITY.

exited by the current in the high resistance shunt a, for the two currents in b neutralize each other. As the speed decreases so does the electromotive force in the armatures of the main and regulating dynamos. The currents due to the shunts a, b and c from the main circuits are practically constant for all speeds, owing to the presence of the accumulators C in the shunt. The magnetization due to a and c are therefore constant. The electromotive force in b due to the shunt is also constant, but the opposing

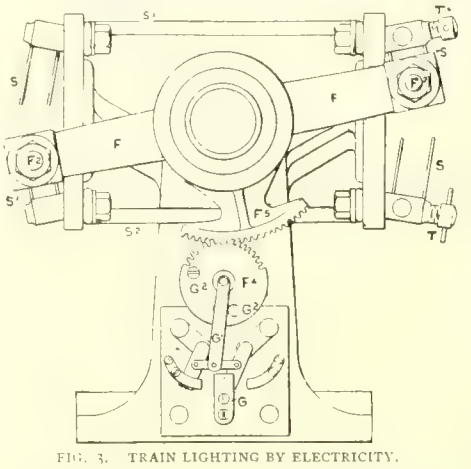


FIG. 3. TRAIN LIGHTING BY ELECTRICITY.

electromotive force in series with it, due to the armature B, becomes less as the speed decreases. The difference between these pressures supplies the field magnets of Q with extra excitation, and thus the electromotive force of the current generated in the armature A is raised again by an amount equal to what it lost by the reduction in speed of the train. When the speed of the train gets below a certain minimum, the governor M breaks contact at the switches H and K and puts the generator out of circuit with the lamps, the current of the accumulator then feeds the circuit until the speed of the train again exceeds the minimum speed. It will be seen therefore that the pressure in the lamp circuit is kept constant under all conditions.

There is a special apparatus which is an essential feature in the design of this dynamo, *i. e.*, for altering the lead and reversing the polarity of the brushes of Q automatically when the axle commences to revolve in the opposite direction, so that the current shall always go in the same direction along d, and also for keeping the direction of the current coming from the armature of R always in the same direction in which ever direction the armature revolves. The brushes D are radial to the commutator and are held in spring-holders D^1 which are carried by bars F^1 projecting from the movable arms FF. These arms F are mounted loosely on the armature shaft, and they can be rocked automatically from one position to another according to the direction of revolution of the shaft. The arms F are connected together by pins F^2. These pins are made to enter between one or the other pair of contact jaws S or S^1, which are connected respectively to the screw terminals TT^1 for the circuit wires, so that as the polarity of the brushes is reversed on the reversal of the direction of rotation of the shaft, their connection with the circuit is at the same time reversed by the movement of the arms F. The jaws SS^1 on the right hand side are coupled respectively with the jaws SS^1 on the left hand side by means of the copper bars S^2. A friction disk N is loose on the shaft and it carries a pinion N^1, which gears with a toothed sector F^3. This sector is fixed to a spindle which passes through the standard V and which carries at its other end a pinion F^4 gearing with a toothed sector F^5 on the boss of the arms F. A second friction disk N^3 is carried round by the shaft, but can slide longitudinally on it. This disk has a neck into which the ends of the governor M take. When the shaft is revolving very slowly and near its point of changing from one direction of revolution to another, the springs of the governor cause the arms to press the disk N^3 against the disk N and to carry it around by frictional contact. When this disk N is turned around with the shaft, it turns the pinion N^1, sector F and pinion F^4; the arms F are thus brought into the opposite inclined position, and the brushes moved to the right position of lead for the reversed direction of rotation of the shaft. As soon as the arms F have passed as far as they can into the jaws S or S^1, the disk N^3 will slip upon N. A groove in the disk N^3 is embraced by the fork of an arm N^4 which, when the disk is slid backward by the governor to a certain position, acts upon the pivoted arms H of two contacts and so cuts off the current from the shunts a, b and c. The spindle which carries the sector F^3 and the pinion F^4 also carries loose upon it an arm G^1, which acts upon a switch G so as to reverse the connection of the armature B with the circuit b, at the same time that the polarity of the brushes D is reversed; the motion of the arm G^1 is effected by pins G^2 on the pinion F^4. Fig. 3 illustrates the automatic brush shifter already referred to.

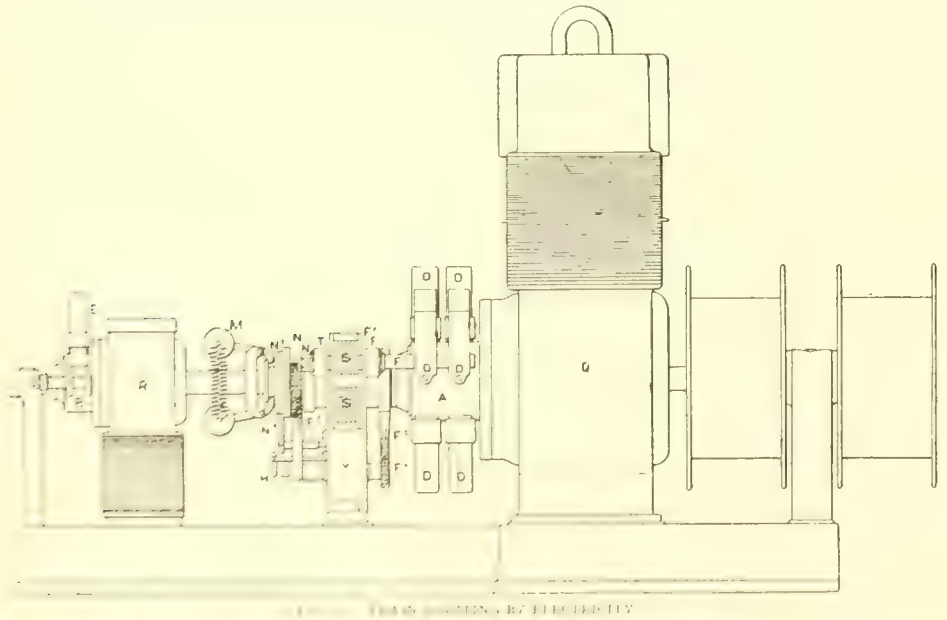


FIG. 1. TRAIN LIGHTING BY ELECTRICITY.

A movement is on foot to build an electric road from Port Norfolk, Va., to Portsmouth.

In a list of private soldiers of the regular army who have distinguished themselves by meritorious services *Harper's Weekly* mentions Private Gustave Kipper of the artillery. He showed that he was a good theoretical and practical electrician. He devised and set up an electrical apparatus for the artillery school, and invented a circuit-breaker for use in ballistic firing, and it did the work capitally, and so Kipper is mentioned, as he deserved, for specially meritorious acts or conduct in service.

Stations of the Edison Electric Illuminating Company at Paterson, N. J.

Until about a year ago there were two electric light companies in Paterson, N. J., and competition was rife. To-day a different state of affairs exists, and the Edison Electric Illuminating company has the field. The old Paterson Electric Light company, with its franchises and contracts, is now under the local Edison company's management. Prior to the consolidation the Paterson company was operating the Thomson-Houston arc and incandescent systems. The conductors were all overhead, and for incandescent house lighting the three-wire system was employed. Alternating current, however, was used for street lighting, and about 800 20 candle power incandescent lamps were in service. At that time the station equipment of the Paterson company consisted of eight one hundred horse power horizontal tubular boilers made by Smith of Paterson, N. J.; one 200 horse power Harris-Corliss engine; eight Ball engines of 90 horse power each; ten 400 light Thomson Houston incandescent dynamos; eight 50 light Thomson-Houston arc dynamos; and one 1,300 light alternator for the street lighting. The station supplied about 3,000 incandescent lamps and 290 arc lamps on city and commercial circuits.

The Edison plant, which, at the time referred to, was under the control of those now operating the united systems, consisted of two Babcock & Wilcox boilers of 300 horse power each; three Ball engines of 180 horse power each; one Ball engine of 100 horse power; one Buckeye engine of 175 horse power; eight 800 light Edison dynamos, and two 50 light Sperry arc machines.

The last mentioned company's system covered the business section of the city. The Edison underground tubing and a system of conduits for commercial arc lighting were employed. Both arc and incandescent systems are connected with overhead conductors in certain outlying districts.

About 5,000 incandescents, 55 commercial arc lamps and 80 horse power of motors took current from this plant.

Since the consolidation of the two interests many changes have been effected and others are in process. The entire commercial incandescent system, carrying 135 horse power [illegible] Edison station [illegible] of the two plants [illegible] Paterson company's station were withdrawn from service.

The reader can obtain a good idea of the completeness of the Edison plant [illegible] are respectively views of the dynamo and engine room and the switch-board gallery. The disposition of the machinery in the other station is clearly shown in Figs. 3 and 4.

To meet increasing demands an additional 300 horse power Babcock & Wilcox boiler has been added to the Edison plant. One will supply steam to one 300 horse power cross compound Ball engine, which will drive a pair of 100,000 watt Edison machines. Another improvement will be the new 200 foot chimney with a capacity for 2,500 horse power of steam plant.

Only the arc lamps of the company and also those incandescent lamps supplied from converters will in the future take current from the old Paterson station. New contracts with the city and county have been recently consummated, covering a period of ten years. The outlying districts now lighted with 20 candle power incandescent lamps will be covered with at least 150 arc lamps. The company is under contract to complete this work by the first of October. For lighting the county roads there will be required from 150 to 200 arc lamps. To provide for the above the company will install seven 50 light dynamos and 300 double arc lamps. The company is also about closing a contract with the Paterson Street Railway company to furnish current for its electric line, which is now being equipped by the Field Engineering company of New York. This will require about 600 horse power in engines and four 100,000 watt dynamos.

Not considering the prospective railway work, the two plants with recent additions and contracts have a boiler capacity of 1,600 horse power, about 2,000 horse power of engines, and a dynamo capacity of 10,000 incandescent lamps, there being at present over 10,000 lamps in service. The above equipment, together with the fifteen 50 light [illegible] stations, representing [illegible] lights.

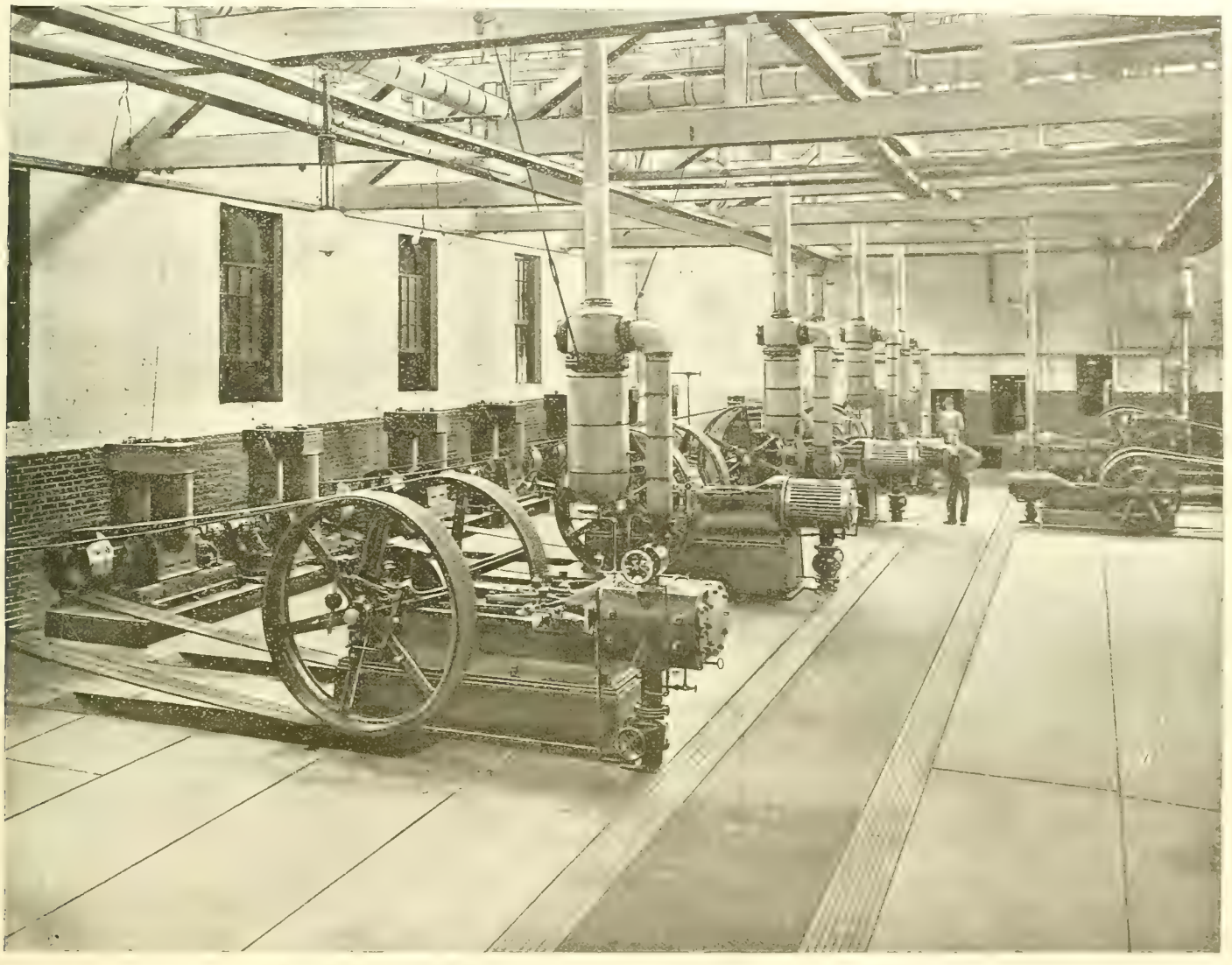


FIG. 1. THE STATIONS OF THE EDISON ELECTRIC ILLUMINATING COMPANY AT PATERSON, N. J.

Stopping an Engine by Electricity.

[illegible] wheel that turns the motive shaft driving the governor. The outer or belt wheel is journaled on a stud projecting from an arm pivoted to a lateral strut, the free end of the arm being connected to a link, which in turn is connected to a second arm, likewise pivoted, and whose free end is confined normally by a latch bar which holds the arm against the outward pressure of a spring. Adjacent to the latch arm is a magnet, which [illegible] pressing any one of the push buttons, draws the latch out of engagement with the arm, which flies outward, releasing the clutch pulley, allowing the governor to stop, and with it the engine.

The Ferranti System.

Mr. Ferranti stated at the meeting of the [illegible] Engineers, according to the [illegible] that high pressure electrical engineers could now guarantee that 95 per cent of [illegible] tion could be delivered, and [illegible] they could guarantee this, it was evident that in practice they could surpass this amount. It is stated that the Deptford [illegible] The districts around Blackfriars are being wired, and several installations are [illegible] mondsey. At Hayes, where [illegible] a complete new low tension network has been laid down and a new [illegible] horse power [illegible]

New York city has [illegible] stations, representing [illegible] lights.

Electric Power Transmission.

[illegible]

The most prominent modes of long distance transmission in use to-day, are: The steam, hydraulic, wire rope, pneumatic and electric systems.

For distances over one-half mile, or where power must be distributed to a large number of smaller machines, the electric system has been proven to be by far the most economical.

Steam can be transmitted economically for short distances only, owing to the large loss in condensation in long steam pipe lines, which are very expensive, both as to first cost and repairs; besides fuel is easily portable and a number of isolated steam plants in most instances can be operated cheaper than a large boiller plant, distributing steam through many thousand feet of steam pipe. If fuel is scarce and transportation high, the use of steam power, of course, will be unprofitable in either case.

Water power is portable only to a very limited extent. Mountains or steep grades may necessitate tunneling or the construction of very expensive canals. In the past manufacturers were, therefore, compelled to erect their factories, mills, etc., close to the river or falls instead of transmitting the water power to locations best adapted for their purposes. In many instances water power could not be utilized at all; for example, in mining, as, of course, the location of a mine could not be changed.

Wire rope transmission cannot be applied for long distances nor can it transmit great amounts of power. The loss by friction and the cost of maintenance of heavy cables are too great. It is claimed for the cable car systems in Chicago (which may be considered as an illustration of wire rope transmission) that their commercial efficiency is less than 20 per cent.; or, in other words, 80 per cent. of the engine power is wasted in keeping the cable in motion, while only 20 per cent. is delivered at the grip cars. No wonder electric street cars are taking the lead. They will eventually replace the cable system, except in a few instances as pointed out in Theo. P. Bailey's paper read before the Chicago Electric club, November 17, 1890.

Compressed air was until a few years ago the only method of transmitting power to great distances. In mining it was used almost exclusively. This power was used in the construction of the famous St. Gothard tunnel which connects the Italian railway systems with those of Switzerland and Germany. If such a tunnel should be built to-day, it may be safely said that electrical energy would be the agency. The main sources of water power in Switzerland are, as in the mountainous western states, characterized by small volume and great head, and could easily be used for driving water wheels of the Pelton or similar types coupled directly to electric generators.

Probably the largest pneumatic transmission plant in this country is near Marquette, Mich., which delivers at a distance of three miles 390 horse power as indicated at the engines at the Chapin and Ludington mines. This 390 horse power represents 27 per cent. of the horse power indicated by the compressors at the power station. The cost of this installation was about $500,000, the pipe line [illegible] distributed to a large number of smaller machines, the electric system is preferable. Instead of going into any lengthy arguments, a few paragraphs may be quoted from a letter dated Rock Island Arsenal, February 17, 1890, from J. M. Whittemore, colonel of ordnance commanding, to the chief of ordnance:

"The water wheels being connected in sets of four with generators, each generator will be able to transmit its electrical energy through a copper wire to anyone motor at any one time at any one shop, at a maximum loss of 60 horse power out of 200, giving 140 effective horse power to do the work.

"With the wire rope and rigid shafting transmission, this 200 horse power would not sffice even to move the shaft for doing any work in shops A and B.

"With a capacity of 700 horse power, which is all that [illegible] the present condition of the Water [illegible] power would be lost in friction and 190 left to do work.

"[illegible] horse power would be lost, [illegible] power available for work, or a surplus of [illegible] power in favor of electricity.

"[illegible] the practicability of the system of transmission [illegible] concerned there are reliable firms ready to [illegible] for the work, and guarantee its success."

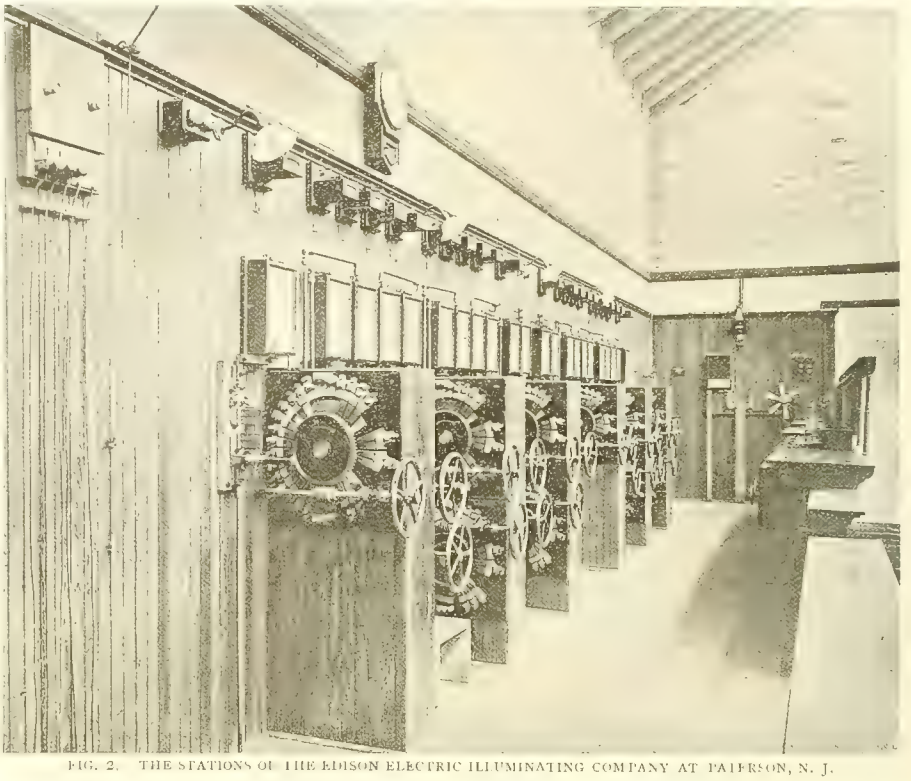
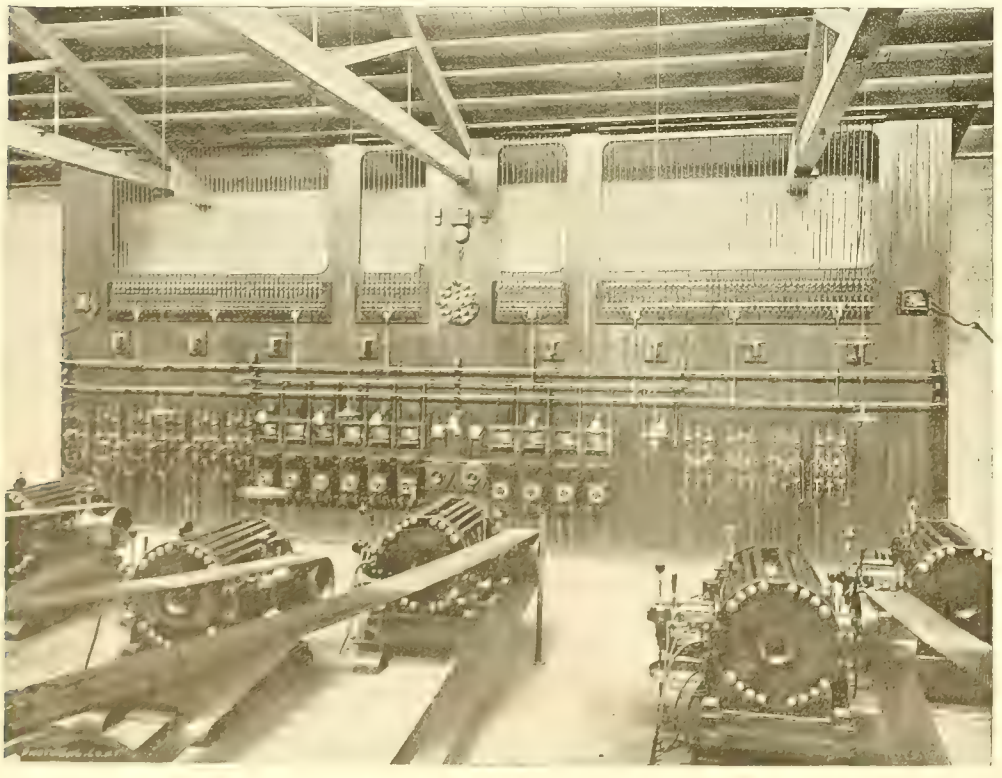


FIG. 2. THE STATIONS OF THE EDISON ELECTRIC ILLUMINATING COMPANY AT PATERSON, N. J.



[illegible] PATERSON, N. J.

Much more might be said comparing the different systems of transmission.

The main object is first, to answer in a plain, and, we hope, practical manner such questions as power-producers, and other prospective customers will ask electric manufacturers relating to power transmission; and secondly, to give practical rules and hints to engineers and motor inspectors in charge of transmission plants.

Questions often asked are:

Is electrical power transmission a practical and commercial success, and not a mere experiment?

What are the general advantages of electrical transmission over other systems?

To what distances may electric energy be transmitted, how many mechanical horse power can you recover at the motor shaft out of one hundred mechanical horse power delivered at the generator pulleys, and what percentage of electrical energy is lost in the conductors?

What is the approximate cost of generators and conductors to deliver power at various distances?

The first question can easily be answered by the following statistics:

On January 1, 1891, there were in use in the United States as nearly as can be estimated from statistics published since August, 1890:

In Central Stations:—

	Horse Power.	Capital Invested.
Arc and Incandescent Lighting.... ..	[illegible]	$128,000,000
Electric Railways....	100,000	50,000,000
Stationary Motors on Independent Power Circuits....	26,000	9,000,000
Total	522,000	$187,000,000

Isolated arc and incandescent plants are not included in the above figures.

Over half a million horse power is, therefore, generated every day throughout the United States to deliver electric energy over circuits from a few hundred feet to fifteen miles and more in length. Whether this electric energy is used for street cars, for stationary motors or for lighting, is immaterial; it is electric power transmission, pure and simple. Arc or incandescent lamps may be taken out of the circuit and electric motors substituted, and, *vice versa*, arc or incandescent lamps may be operated on any power circuit. It is generally known that electric street cars are lighted and heated by the electric current, which is taken from the wire conveying electric energy to the street car motors.

It is hardly necessary to say any more relating to the first question, whether electric power transmission is an experiment, considering the fact that over half a million horse power is generated every day and almost $200,000 000 invested for this purpose in the United States.

It has already been pointed out in a general way why electric long distance transmission is superior to other modes.

The electric transmission system is very flexible—it means in most instances an air line from power to motor; the conducting wires are cold and clean, they may be bent around sharp corners, and to the casual observer there is no evidence that they are conveying, possibly hundreds of horse power. Mining Engineer Browne of World's Fair Mine fame, who read a paper before the Chicago Electric club December 1, 1890,[1] explained most graphically the advantages of electricity in mines, and the drawbacks in long compressed air or steam pipe lines.

Steam especially is disliked by miners as it heats the mines, fills the air with moisture, and makes the problem of ventilation still more difficult.

New applications of electric transmission of power

1. [illegible]

are made almost daily, as is shown in the following quotation from the *Mining and Scientific Press* of San Francisco:

"In this day of steam, electricity and fast transportation in general, the motive power of the old canal—the mule—cannot be considered as a thing to be continued. In discussing the question now being agitated in Eastern Pennsylvania and New York in regard to the necessity for remodeling the motive power employed by the Washington & Cumberland Canal company, in view of the rapidly increasing coal and timber business crowding upon their line of transportation, the *American Manufacturer* says 'The motive power of the old canal—the mule—is not to be thought of. Steam offers but few more advantages, because it takes up so great a percentage of the carrying capacity of the boat, while the locks and the amount of help required stand in the way of using tugs. It was finally suggested that electricity should be used. The trolley system, by which small screw propellors could be run by electricity, was looked upon as the best solution of the problem. By using electricity the weight of the machinery to be carried would be small, and one man could control the motor and the steering apparatus without trouble. The plan is under serious consideration, and will probably be given a thorough test. If it prove successful, it may result in the restoration of abandoned canals and induce capital to seek an investment in new ones between points where heavy freights not requiring rapid transit, are shipped extensively.'"

Another application for electric transmission is that for irrigation. W. Forman Collins pointed out some time ago how vast areas now barren and worthless can, by this means, be made fertile and enormously enhanced in value. Mr. Collins refers in this connection to the report of Col. W. Tweeddale to the Kansas State Board of Agriculture.

It will be only a short time when the old dream of utilizing Niagara Falls for electric transmission will be a reality.

Before the application of electricity these power transmission schemes were never thought of. Only electricity enables man to transmit natural water powers economically to the places of application.

The three elements of electrical transmission of power are: (1st) The generators, which are placed at the power station and which are driven by the water wheel or steam engine or other prime mover; (2d) the copper conductors, which are placed on poles like telegraph wires, and which conduct the electric current from the generators to (3d) the motors, which deliver the electrical energy to all kinds of machinery. The motors are either belted or geared to these machines.

Electric generators are machines for converting mechanical into electrical energy, while electric motors reconvert electrical and mechanical energy.

The capacity of generators is therefore given by the manufacturers in watts or in electrical horse power, while the capacity of motors is generally given in mechanical horse power.

Hence in order to test these machines it is necessary to have electrical instruments (ampere meter and voltmeter) to measure the output of the generator in electrical horse power, while the output of the motor should be measured in *mechanical* horse power by means of a dynamometer.[1]

In practice, however, engineers often measure the electrical horse power delivered at the motor terminals and then deduct a certain percentage to get the rating in mechanical horse power.

Ordinarily electric manufacturers allow for motors up to 20 horse power 1,000 watts per mechanical horse power, indicating 75 per cent. efficiency of the motor; from 20 to 50 horse power, 900 watts per mechanical horse power, indicating 83 per cent. efficiency of the motor; over 50 horse power, 830 watts per mechanical horse power, indicating 90 per cent. efficiency of the motor.

A similar rule will hold good for generators. Up to 20 horse power the output in electrical horse power will be about 75 per cent. of the mechanical horse power applied to the pulley. From 21 to 50 horse power the output in electrical horse power will be about 83 per cent. of the mechanical horse power applied to the pulley. Over 50 horse power the output in electrical horse power will be about 90 per cent. of the mechanical horse power applied to the pulley.

Seven hundred and forty-six watts (one watt = ampere × volt) equal one electrical horse power. If we therefore deliver, as in the example mentioned, 1,000 watts—1.333 electrical horse power—to the motor, and the latter has a commercial efficiency of 75 per cent., it will deliver 75 per cent. of 1.333=one mechanical horse power at its pulley.

Or, if we deliver one mechanical horse power to the pulley of a generator of 90 per cent. efficiency, the electrical output will be 90 per cent. of one electrical horse power, or .9 electrical horse power, or .9×746=671.4 watts.

It is only fair to state that machines of the best makes will show higher efficiences, but these figures may be considered as a conservative estimate.

In the following there will be assumed both for generator and motor a commercial efficiency of 90 per cent. or a loss of 10 per cent. in conversion.

1. The standard dynamometer is a Prony brake, consisting of a belt around the driven pulley, one end of which is attached to a spring balance, the other end to a weight. The difference between the two readings gives the pull exerted by the belt, and this multiplied by the velocity of the belt gives the power absorbed by the brake. The ratio between this power and the power delivered to the pulley by the motor is the efficiency of the latter.

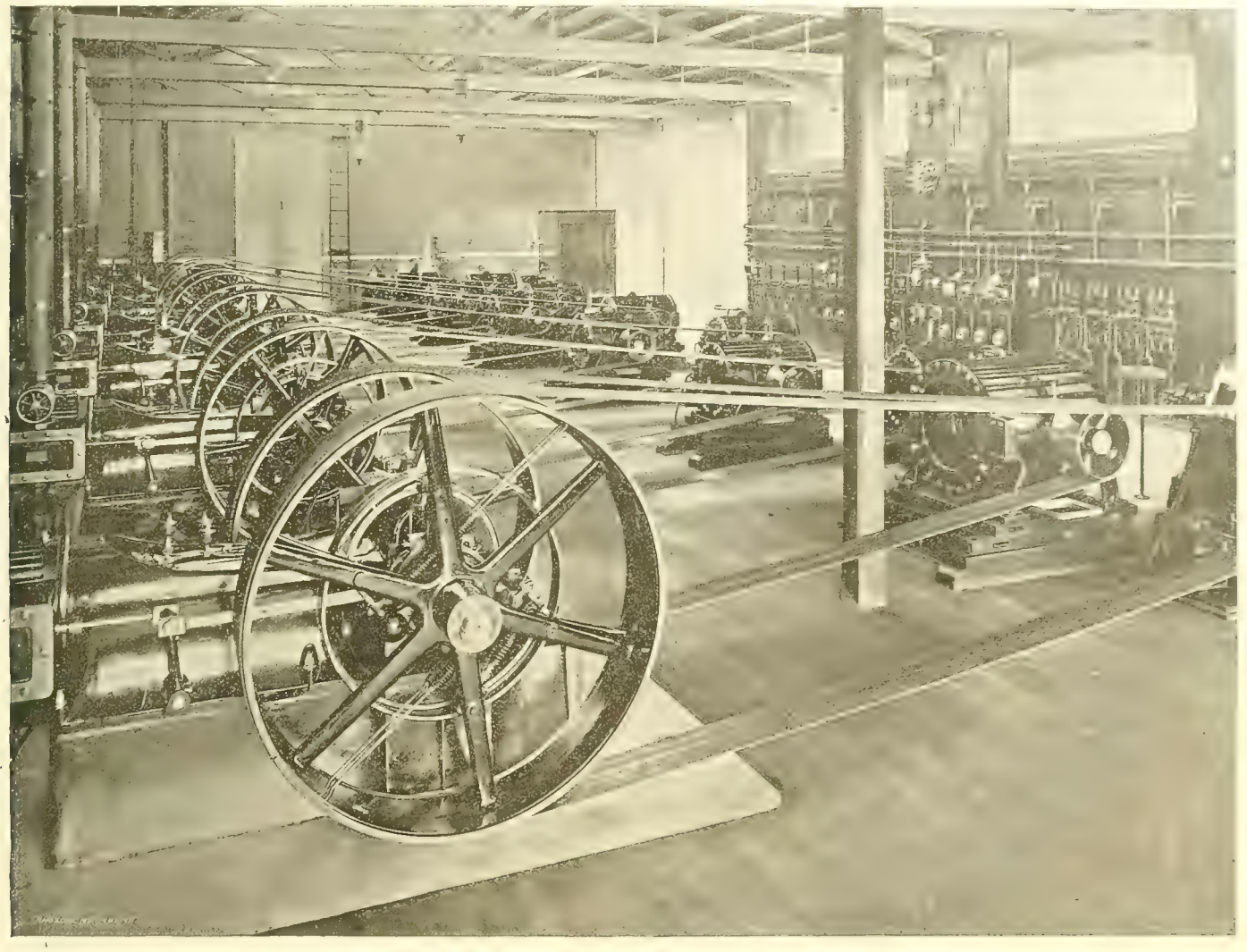


FIG. 3. THE STATIONS OF THE EDISON ELECTRIC ILLUMINATING COMPANY AT [illegible], N. Y.

This efficiency of a couple of electric machines connected as generator and motor, including the connecting conductors, is often called the "couple efficiency."

In practice the generator and motor are so far apart that there is a loss of electrical energy in overcoming the resistance of the conductors. This loss depends upon three factors, viz.: distance, pressure at generators, and size of copper conductors. For a given case the first factor, distance, is constant; pressure and size of conductors are variable at will; therefore, the loss in the conductors is a variable percentage desired.

It should be stated that only "complete metallic circuits" will be considered, or, in other words, it will be assumed that the generator is connected to the motor by means of two conductors. "Earth returns," which are much used in electric railway work, will not be considered.

If a "couple efficiency" of 81 per cent., a loss of 10 per cent in the conductors is assumed, there will be:

[illegible]

Or the commercial efficiency of the whole system from generator pulley to motor shaft would be almost 73 per cent.

The city council of Salem, Va., has granted [illegible] to the Salem Street Railway Company [illegible] to the property of the [illegible] the south side of [illegible] to extend this line [illegible] the lands of [illegible] city of Roanoke [illegible]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, ... Editor and Publisher

J. B. O'HARA, ... }
F. L. PERRY, ... }Associate Editors.
W. E. KEILY, ... }

J. L. BAKER, ... Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK

W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions, foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application

CONTENTS OF THIS NUMBER.

PAGE.

[illegible] M. B[illegible]sby, with portrait 57
[illegible] Plant for the Masonic Temple, Chicago 57
[illegible] Distributer at the Chicago Telephone Exchange . . 57
[illegible] at a Night in Pekin 57
[illegible] at the World's Fair 57, 58
[illegible] by Electricity. Illustrated. 58
The Stations of the Edison Electric Illuminating Company at [illegible], N. J. Illustrated 59, 60, 61
[illegible] by Electricity 59
[illegible] System 59
[illegible] Power Transmission. By F. B. Badt 60, 61
[illegible] 62
[illegible] in Stenotelegraphy. Illustrated 63, 64
[illegible] Methods for Measuring Electric Currents. Illustrated 64
[illegible] Convention 64
[illegible] Management at Detroit 64
[illegible] 64
[illegible] Illustrated 65
[illegible] Inventions 65
[illegible] Illustrated 65
[illegible] Manufacturers Consolidate 65
[illegible] Illustrated 65
[illegible] Interests 65
[illegible] Illustrated 65
Copper Production in the United States 65, 66
[illegible] 66
[illegible] . . . . 6[illegible], 67

DEPARTMENTS.

[illegible] 67, 68, 69
[illegible] 69
[illegible] . . . . [illegible]
[illegible] . . . . [illegible]
[illegible] . . . . [illegible]
[illegible] . . . . [illegible]
[illegible] . . . . [illegible]
[illegible] . . . . 7[illegible]
[illegible] 70
[illegible] 70
[illegible] . . . . 7[illegible]

[illegible] considerable time in [illegible] that will design [illegible]. It would per[illegible] that the Eng[illegible].

[illegible] use. The advancement in this line will be watched with [illegible] engaged [illegible].

and if New Yorkers hope to have an efficient system of surface roads they should take advantage of the experience of their neighbors.

BROOKLYN, which has been the scene of a bitter controversy over the electric railway question, will have a trolley system after all. The State Board of Railroad Commissioners has finally decided to allow Deacon Richardson to build twelve miles of electric road. When the people of Brooklyn realize the advantages of the electric system there will be little opposition to extending the service and the entire city may shortly have electric cars.

RAPID transit in New York city does not appear to be as near solution as was at first hoped. The second report of the commissioners is discouraging to those who desire the adoption of a system that will provide for the future. It appears that the commissioners have not fully appreciated the needs of the city, and the measures suggested by them will undoubtedly prove inadequate unless radical changes are made.

THE question of electric power transmission to which considerable space is devoted in this issue is one of the most important problems with which the electrical engineer has to deal. In this country especially the subject is already assuming great prominence, and it is becoming more important every day. The rapid development of the electric railway has occupied the attention of a large proportion of those interested in power transmission, but now the application of electricity to mining bids fair to assume equal importance. Each week brings additional evidence of the confidence of the mining companies in electrical apparatus. The water powers in this country which have long been permitted to go to waste are now being utilized, for generating electric power. The article presented elsewhere will be of special interest to all who are engaged in this department.

THE controversy over the accumulator patents was practically ended last week, when Judge Coxe of New York handed down a decision upholding the patents of Charles F. Brush. The action under which this decision was given was between the Brush and Accumulator companies, but as the old Julien company has control of the Brush patents the decision is a victory for that company over its old rival, the Accumulator company. Judge Coxe awarded Brush the honor of being the inventor of the present form of accumulator. The result of this controversy will no doubt result in the development of a first-class storage battery system. Pending the decision accumulator companies held back, evidently fearing to invest heavily in expensive plants. They were unwilling to put money into the business until the patents had been sustained. Now that a decision has been secured it is not unlikely that great advances will be made, and an effort made to introduce a storage battery system that will be both practical and economical.

IT seems that over in Buda Pesth, Austro-Hungary, they are seriously considering the question of using electric power to drive light machinery. An Austrian correspondent of a London technical journal tells how the project is being gravely discussed: "The management of the Buda Pesth city railway," he writes, "has been seeking permission for some time past to supply electrical power to private persons for industrial purposes. The chief city engineer is of opinion that the supply of electrical power would be very advantageous in the carrying on of small industries. He states, moreover, that the electrical central station is quite sufficient for the working of the railway and for supplying power to private works. This would be the case even if the railway were to be further developed, since the central station can be enlarged." The naivete of the last sentence is delicious. Here in Chicago, where hundreds of electric motors attached to central station circuits are employed to operate light machinery of all kinds, it seems strange that the feasibility of such installations should be debated. And it is stranger still that the question should be raised in such a progressive and enlightened city as the new underground conduit electric railway shows Buda Pesth to be.

STREET railway managers in this country have been watching with interest the proceedings of the Toronto officials who have been negotiating street railway franchises. It will be remembered that at the expiration of the thirty-year [illegible] of the [illegible] company recently the city assumed [illegible] of the [illegible] railway line, and it was announced [illegible] the operation of the [illegible] that [illegible] for the [illegible] period of the [illegible] one of the companies which endeavored to secure control. Charges of bribery were openly made last week, and a press dispatch says that an ex-alderman applied for an injunction to restrain the city council from entering into an agreement with the Everett company, alleging that the recommendation of the Street Railway committee to award the franchise to the Everett company was procured by dishonest and corrupt means. It appears that the city fathers of Canadian municipalities resemble American aldermen in this respect. The people of the city of Toronto should need no further evidence of the danger of permitting great public enterprises to be controlled by irresponsible bodies of politicians who grasp every opportunity to secure boodle. It is well for the city of Toronto that this example has been brought before the public, and other cities should profit by it too.

JUDGE COXE said in his opinion on the accumulator patents that "the nomenclaturist should not seek the reward for his labors in the patent office. A person is not entitled to a patent because he has invented a new word." Many of the patent office examiners evidently take a different view of the case. They believe, it would seem, that where there is much legal verbiage which they do not understand, the applicant must be deserving of a patent. In the case in point several claims on several patents were allowed by the examiners, which were practically covered in one claim. It is these things that bring the patent office into disrepute and make patents in this country worthless until they have been sustained after long and expensive litigation. We have on several occasions called attention to this matter. In our issue of Aug. 16, 1890, nearly a year ago, we alluded to a most ridiculous example afforded by the patent office, which issued two patents on the same "invention" to two applicants. These patents were issued the same day. At that time we said: "The patent law is becoming too attenuated when one who invents a coating of conducting substance, 'in which the conductivity decreases from one place upon the surface to another,' may be prevented from using an exactly analogous 'conducting substance which gradually decreases in breadth from one point to another.' We submit that it is not invention, but a mere change of form or modification which any mechanic could make without the exercise of inventive faculty. In short, we contend that patents should be issued for inventions and not for mere forms of expression—slight, meaningless verbal changes."

Judge Coxe's decision strongly supports the position we assumed at that time. He seems to be thoroughly impressed with the idea that there is too much hair splitting at the patent department, and too little common sense employed.

Electricite, an electrical journal published in Paris, has fallen into a grave error in construing some of the criticisms made in this paper on the Construction Department of the World's Columbian Exposition. "The WESTERN ELECTRICIAN," it says, "has now laid down its arms and announces that the exposition, of which it has hitherto been an eager supporter, will be a fiasco." We have done nothing of the kind; and, unless the misrepresentation has been intentional, we shall be grateful to our French contemporary if it will do what it can to rectify the false impression it has created. We have perfect confidence in the overwhelming success of the World's Fair in general and of the display in the Department of Electricity in particular. We have had occasion in the past, and may have again in the future, to point out mistakes committed by the Construction Department in the preliminary work; but it has never occurred to us to doubt for an instant the complete success of the fair. Indeed, our contention has been so much the reverse that we have held that the electrical building, as planned by the architects, was only about half large enough for the demand that we foresaw would be made on its space. How can that position be reconciled with the statement that we predicted failure for the exposition? The idea is absurd. We have always said that the electrical display would be a grand one in any event, adding that the electrical fraternity would, however, take hold of the matter of making exhibits with greater enthusiasm and in a better spirit if their reasonable demands were complied with. As Chief Barrett remarked a short time since the difficulty will not be to get exhibits but to find a place to put them. Our friends in France should bestir themselves and send over their applications for space at once unless they wish to occupy a position very humiliating to their national pride. Neither should they let the McKinley bill act as a bugbear. Whether that much-discussed measure is beneficial or mischievous in principle, it certainly has little or no effect on the electrical interests of France and the United States. So there is nothing to prevent and everything to encourage the French electricians in making a fine display in Chicago in 1893.

Improvements in Steno-Telegraphy.

Considerable advancement has been made of late in perfecting a system of steno-telegraphy which, it is hoped by those engaged in the experiments, can be substituted for the Morse system. It is claimed that recent improvements in this line have made it practicable to transmit 150 words per minute, delivering a typewritten message.

In the accompanying cuts is illustrated a system devised by M. Cassagnes, which has been in practical operation some time between Paris and Marseilles. M. Cassagnes has devoted most of his time to this system since 1886, and

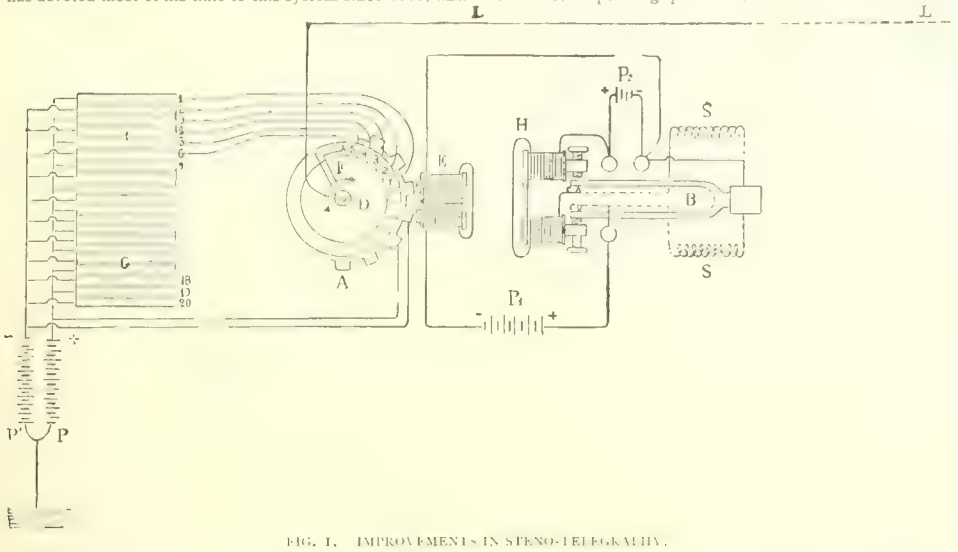


FIG. 1. IMPROVEMENTS IN STENO-TELEGRAPHY.

he has now succeeded, he announces, in presenting a complete system for commercial work. The recent improvements have greatly facilitated operations, and permit great rapidity in manipulation.

The transmitter for the system consists of a keyboard of twenty keys, each of which represents a phonetic sound. These twenty signs are all that are required for any modern language. The receiver is constructed in a similar way, and each of its keys terminates in a steel engraved type, the impression of which is received on a paper tape, moving automatically with the operation of the instrument. It is claimed that by means of this instrument as high as 200 words per minute can be transmitted. In the original system a cable of 20 wires was used for connecting the transmitter with the receiver, but by adopting the LaCour phono-wheel only one wire is required between stations.

In Fig 1 *CC* is the keyboard of the transmitter. Each of the twenty keys is alternately connected to the positive and negative pole of two batteries P^1 and P^2, the opposite poles of which are joined to the ground. From the keys extend wires to fixed contact points 1, 2, 3, etc., placed on an insulating desk *D*. Above the rotating phono-wheel and on its vertical axle is mounted a sliding contact *F*, from which connection is made to the line. When key number 6 is pressed down, as shown in the illustration, it will be seen that connection is made with the line at the instant only when the brush *F* passes over the point 6. As the two rotating brushes are synchronous the impulse of the current will pass from point 6 in station one to point 6 in station two, thence to relay 6 and to ground.

A local battery P^3, Fig. 2, is closed through contact *V*, relay 6 and through a corresponding magnet in the receiver, which attracts the key lever and makes this strike against the paper tape. *G* is a drum for holding the tape, and *M* is a magnet joined in the outgoing battery wire *V*, and operating a lever which releases a tape winding device.

The phono-wheel, which is the vital point of this system, is the invention of Paul LaCour of Copenhagen, and consists of a horizontal wheel *A*, Figs. 1 and 2, of soft iron, having teeth cut in its circumference, and turning on a vertical axle. On the top of the wheel is a cylindrical box *Q*, Fig. 3, filled with mercury. In front of the wheel is an electro magnet *E*, Fig. 2, receiving an intermittent current from the battery P^1. When current passes through the magnet it will attract the nearest tooth of the wheel, and during the interruption of the current the wheel passes on, so that the next impulse of current is brought to bear upon the next tooth of the wheel, and thus keep it in constant rotation. The interruption of the current is obtained by means of a tuning fork *B*, which opens and closes a pair of electric contacts for each oscillation. One of these governs the circuit and electro magnet *E*, and the other the electro magnet *H*, which serves to maintain the vibration of the fork. Fig. 3 gives a perspective view of the instrument.

When the wheel is set in motion by hand it will continue to rotate, the speed depending on the number of teeth in the wheel and [illegible] the wheels at the two stations are exactly alike, and the tuning forks have the same tone, the oscillation of both and consequently the rotation of the wheels will be the same even at a great distance [illegible] is perfect, and as the slighest variation in the conditions described will result in one wheel dropping behind the other, an automatic regulating device is provided. In Fig. 1 two regulator wires extend from the two poles of the battery *P* and P^1 to two blank contact points on the distributer *D*. A corresponding point on the distributer of the receiver station is connected to a polarized regulating relay *R*, Fig. 2. When the speed of the wheels becomes uneven the brush on the transmitter will pass over either the positive or negative contact the same instant the receiver brush

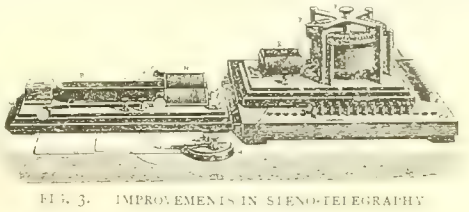


FIG. 3. IMPROVEMENTS IN STENO-TELEGRAPHY.

is in contact with the regulating relay. This device will then be actuated, the armature will be drawn either right or left, cutting in or throwing out resistance in the circuit of the vibrator magnet *H*, decreasing or increasing the magnetic force, and consequently the vibration of the tuning-fork.

The keyboard of the receiver has been greatly altered of late, and important improvements introduced. Instead of using signs indicating phonetic sounds the common alphabet has been applied, and the construction of the receiver changed, so that by pressing two, three or four keys at once a full syllable of a word can be transmitted and impressed on the paper tape in a single rotation of the phono-wheel. Fig. 4 is a detailed view, and Fig. [illegible] of this instrument. It consists of twenty electro magnets, [illegible], etc., each of which is mounted with an armature lever, and the spool has passed [illegible] brushes of the distributer make 100 turns per minute, as on the line between Paris and Marseilles [illegible] will transmit [illegible] words a minute [illegible]

The [illegible]

tion. When current is passed through one of the electro magnets *E* it attracts its armature and releases the corresponding sliding bar, which is drawn toward the printing wheel [illegible] screw *V*. The printing wheel, which has also been released, turns until the sliding bar strikes against a tooth in the eccentric cam-wheel *S*, the distance which the wheel has advanced, or the distance from the tooth to the center of the arbor, will correspond to the stroke of the bar, and this again depends on the number of bars which are released simultaneously. The letter which in this instance is on [illegible] impression on the paper. A second arbor *C* with an eccentric disk operates a series of levers, which releases the printing wheel, presses the tape carrier against it, and finally replaces the sliding bars in their original position. *I* is an [illegible] the paper tape.

With this instrument it is possible to send a telegram with the speed of a stenographer, and to receive it as a printed message at the same rate of speed. The saving in time effected by this system is apparent. A stenographer will require about six hours to write down the notes he has taken during one hour. With the Cassagnes system it is claimed that the same work can be accomplished in one or two hours. For systematic service the inventor has applied a puncher, together with an automatic transmitter, to take the place of the keyboard in station one. A paper tape is passed through a perforating instrument manipulated by the operator, and having twenty buttons, each of which is fastened to a lever terminating in a smaller steel punch placed in a vertical row, these punches corresponding to the signs of the keyboard. The paper tape is perforated near its border for the purpose of guiding and advancing the paper when placed in the transmitter. When thus prepared the tape is taken to the transmitter, where it passes under two smaller cam-wheels. Whenever a perforation is encountered a lever slips through and makes a contact. The impulse is transmitted over the distributers to the receiver at the next station, and recorded as a typewritten message.

By this arrangement of automatic transmission the reliability of the instrument is claimed to be almost perfect,

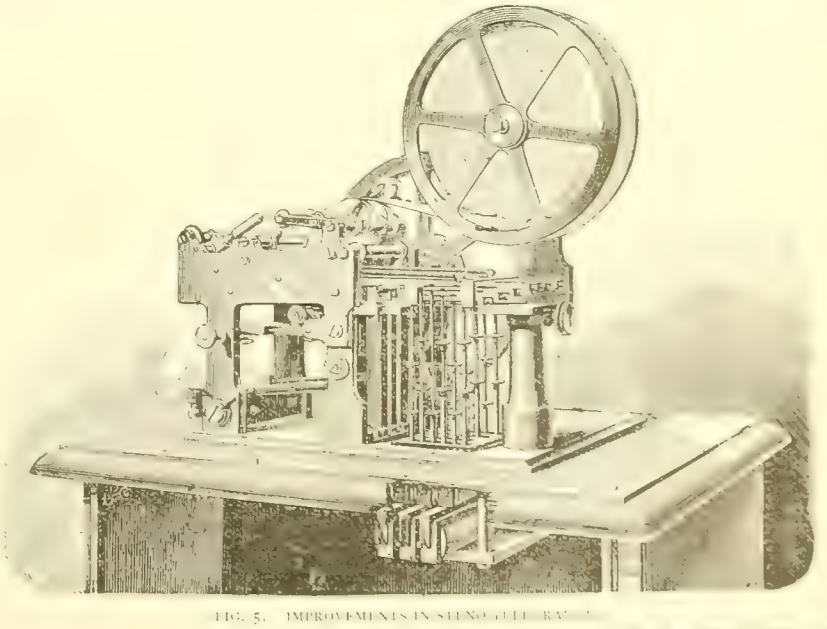


FIG. 5. IMPROVEMENTS IN STENO-TELEGRAPHY.

[illegible] an electric light plant at Ellicott City, Md.

Thomson's Method of Measuring Electric Currents.

The accompanying cut shows a vertical section of a device designed by Elihu Thomson for measuring electric currents. Heat is generated by the current to vaporize a liquid, the amount of vaporization indicating the electricity employed. This may be ascertained by condensing it in a suitable chamber and measuring the amount condensed.

In the cut B is a bulb or receptacle of glass or other suitable material containing alcohol A or other vaporizable fluid which has been well boiled in the bulb in which it is sealed while the vapor is escaping, thus producing in the space above an alcohol vapor at the tension due to the temperature as no air is present.

Within the bulb is an electric conductor H, connected with outside conductors by wires sealed in the bulb. This conductor may be of platinum wire of small gauge, so as to be readily heated by the current. N is a sheath or cover for the bulb and is designed to prevent the escape of heat. The vapors produced by the heating of the liquid pass from the receptacle to a chamber B^1, in which they are condensed and collected as liquid. By means of a suitable scale applied as shown the amount of liquid condensed may be noted.

The Montreal Convention.

The citizen's committee of Montreal is active in making arrangements for the National Electric Light association convention in September. At a recent meeting it was stated that the finance committee of the common council had recommended an appropriation of $2,000. It was decided to give a conversazione at McGill college, and many other forms of entertainment were discussed.

Chairman Gulick of the committee on exhibits has issued a circular to intending exhibitors giving the following information:

It has been found, in order to carry out the plans formulated by this committee, that the general expenses of the exhibition, namely, rent, flooring of a portion of the rink, lighting, music, attendance, superintendence and miscellaneous expenses, will amount to a total of $4,500. This estimate is the result of a careful consideration of several gentlemen who have had a large experience in exhibition matters, and has been made liberal. Assuming as a basis the above expense, and dividing by the total exhibiting space, the cost per square foot has been obtained, which amounts to 30 cents. This has been fixed upon, therefore, as the charge for space. You can therefrom readily arrive at the total charge to you for the above mentioned items. In addition to this, we wish to call your attention to that clause of the rules and conditions noted in the application blank which you have filled out, under the head of "Care of Exhibit," which reads as follows:

Exhibitor must take charge of and care for [illegible] space during the [illegible] and [illegible] expenses on account of [illegible]

One-half of the charge for space is payable upon acceptance of the awarded space, and the balance not later than the 1st of September. Should it be found at the close of the exhibition that the expenses amount to less than $4,500, Bovey, kindly offers several hundred horse power at a cost of operating expenses. For small powers, such as for motor, or other work, it is expected that an arrangement can be made for obtaining the same from the plant of the Windsor hotel, adjoining the exhibition building.

We have had applications for much more than half the available space, and, in addition, applications which bring the total of the space applied for much in excess of that available. An entrance fee of 25 cents willbe charged, but complimentary tickets will be issued at the request of the exhibitors. Arrangements have been made for the admission of all goods in bond, and the exhibition building

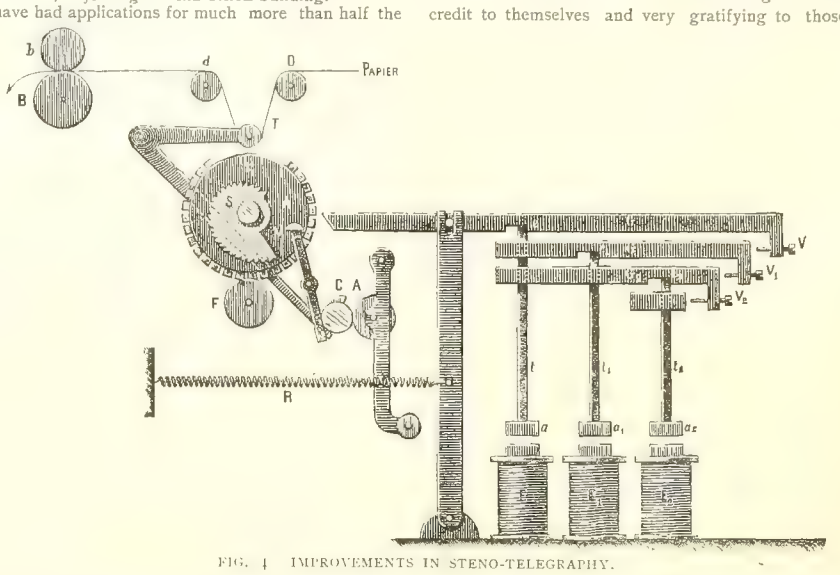
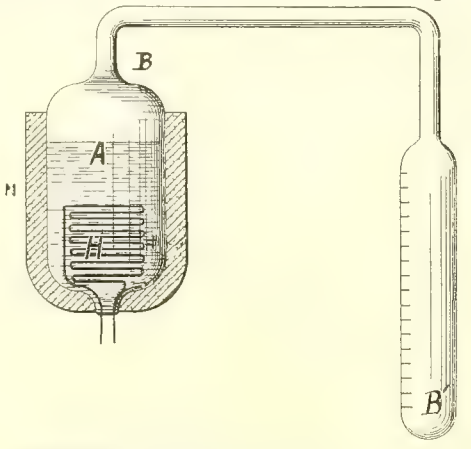
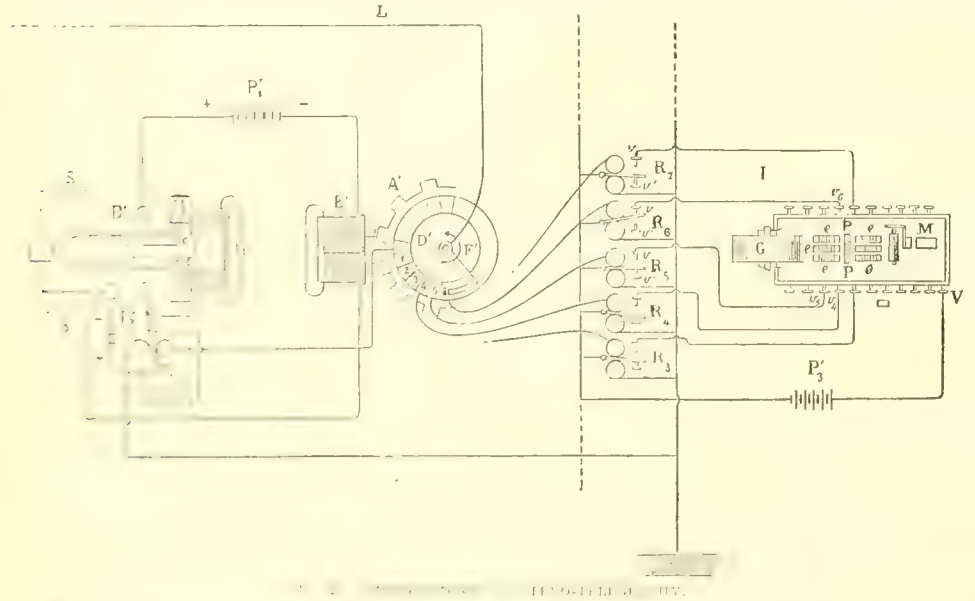


FIG. 1 IMPROVEMENTS IN STENO-TELEGRAPHY.



THOMSON'S METHOD OF MEASURING ELECTRIC CURRENTS.



[illegible] be constituted a temporary bonded warehouse. Duty to be paid only in case of sale. Ample space adjoining the building has been secured for the storage of packing cases without charge.

[illegible] to proceed at once [illegible] the space [illegible] to rising [illegible] to make [illegible] The good [illegible] in this [illegible] the fact that [illegible] the first place [illegible] any other convention exhibition, yet the applications for space have been in excess of that available. With the cordial support that the management has had there is now no question that the association and the exhibitors will make a showing that will be a credit to themselves and very gratifying to those who have the true interests of electric lighting at heart.

It is hoped that the governor-general of Canada will open the exhibition, starting the machinery in motion. Plans will be made for music afternoons and evenings, special features in decoration will be carried out, and the Canadian members of the committee on exhibits promise great interest from their countrymen and a very large attendance. In view of the many new and pleasant features which will distinguish the convention, a very large number of the members of the association propose to attend the convention with their families, and already the hotels of Montreal are flooded with applications for rooms

New Railway Management for Detroit.

The rumors which have been freely circulating in Detroit for the last week are fully substantiated in the announcement of the purchase of the Detroit street railway and Grand river avenue lines to a syndicate composed of Boston and New York capitalists, headed by ex Gov. Waller of Connecticut and Williard B. Ferguson of Boston.

These two gentlemen have been in Detroit for some time quietly carrying on the negotiations which led to the completion of the transfer and its public announcement last week. It appears that offers were made to Mr. Hendrie, the president of the company, in May last, but that these offers were refused at the time. Shortly after this the company suffered somewhat from a strike of its employes.

At the close of the strike the negotiations which had been temporarily suspended were resumed. Aided by the discontent manifested by the citizens against the old horse system, the new synd'cate was successful in buying out the old stockholders. Both parties to the transaction decline to reveal the sum paid; but it is learned from reliable sources that the price asked by the street railway companies was $5,000,000, which was finally reduced to $4,500,000.

Gov. Waller is reported as saying that the new company will give rapid transit to Detroit, without further delay. It is stated that the Fort Wayne and Elmwood line is not included in the deal, but that the purchase does cover the Highland Park electric road. The new company contemplates bringing every line in the city under one management. The system includes about eighty mites of road.

S. Harrison Wagner, a partner of ex-Gov. Waller, says the consideration was more than $5,000 000. The change from animal to electric power will throw 2,300 horses on the market.

Bell Telephone Stock.

A special dispatch from Boston to the *Chicago Tribune* states that the bears created a rumpus on 'Change on July 24th, attacking Bell Telephone stock so savagely that it dropped from 183 to 175. Then the bulls rallied and forced the price back to 178. It was rumored on the board that the drop was occasioned by the alleged discovery that the company was in the market trying to borrow money, but a conservative lawyer, who is an attorney for the company, was among the buyers, brokers were not inclined to place much reliance in the rumor. It seems to be the general opinion that the decline was due to tired holders of long stock. The Bell Telephone company made a net gain of 61 instruments for the month ended July 20th, against 1,900 for the same period in 1890. Since Dec. 20, 1890, the net gain of instruments has been 4,149.

Chicago Trolley Clamp.

The accompanying illustrations show a new trolley [illegible] clamp devised by John S. Gustin, purchasing agent for the Electric Merchandise company, Chicago. The clamp is formed in three distinct parts, having two sections with opposing lips, one of which is provided with a threaded projection upon which the clamping nut is screwed, the other having a dog inclosed by the protruding lower rim of the nut. Through the lower portion of these opposing sections, a grove is formed to contain the trolley wire, the

CHICAGO TROLLEY CLAMP.

size of which does not call for a different construction of the clamp. The opposing lips are cut at such an angle that they still engage each other when the largest trolley wire is inserted in the groove. The screwing down of the nut upon the threaded projection and over the dog causes the lips to slide one within the other, thus forcing together the lower sections of the clamp upon the wire, preventing all possibility of falling. The movement of the wire from expansion and contraction is provided for in the hinge joint included in the nut. With this clamp it is claimed that an absolutely reliable support is provided for the trolley wire, while at the same time its simple mechanism makes its adjustment at any place upon the wire, or entire removal therefrom, an easy task. The clamp is said to be equally efficient whatever may be the style of insulator used. The Electric Merchandise company, Chicago, is sole agent for this device.

Claims an Interest in Edison's Inventions.

A press dispatch from Boston says taht Judge Nelson has made and important order in the arguments presented recently in the suit against Thomas A. Edison in the United States Circuit Court. This action was begun in 1883 by E. Baker Welch, who asked $250,000 damages on the strength of a contract made between him and Mr. Edison

CHICAGO TROLLEY CLAMP.

in 1869, which Welch claims entitled him to one-half interest in Edison's inventions. The court rules as follows:

"As to further answers to interrogatories, denied; on production of books and writings, ordered that plaintiff file originals or copies of all communications from defendant or between plaintiff and Milton F. Adams, Jr., or Charles Williams, Jr., and of all receipts, promissory notes or contracts exchanged between plaintiff and defendant, and also that plaintiff produce all books of account showing money payments between the parties. As to the bill of particulars, ordered that plaintiff file a statement of all patents, inventions, improvements, instruments, principles, methods and systems of defendant in which plaintiff claims an interest. The motion to amend answer is allowed. The motion for auditor is to stand for further consideration after the thirty days [illegible] to comply with the orders of the court.

A New Insulating Joint.

Numerous devices have been designed for insulating combination fixtures from the connecting gas pipes, but it may be said many of these have been more ingenious and complicated than practical. The Wirt joint shown in the illustration is extremely simple, having only two parts which are securely fastened together by a hard insulating compound. There are no screws or [illegible] pieces. It is made by the Electrical Supply company, 101 [illegible] avenue, Chicago.

Prominent Asbestos Manufacturers Consolidate.

The H. W. Johns Manufacturing company and the Chalmers-Spence company, New York; the Asbestos Packing company and Chas. W. Trainer & Co., Boston, and the Shields & Brown company of Chicago, the five largest asbestos manufacturers in the United States, have formed a corporation under the name of the H. W. Johns Manufacturing company, to control most of the output in their line of business. The officers of all the companies and their chief employes will remain with the new concern. H. W. Johns is the president; R. H. Martin, formerly president of the Chalmers-Spence company, the new vice-president: C. H. Patrick, treasurer, and G. P. Erhard, secretary, both of the last two named having previously been with the H. W. Johns Manufacturing company. The H. W. Johns Manufacturing company was the name chosen for the new corporation because the old company of that name was the pioneer in the business, and had besides the largest factory. H. W. Johns began the manufacture of asbestos goods in 1858. Englishmen took their cue from him and have set up asbestos factories, but American manufacturers export their goods to Great Britain and elsewhere in Europe in considerable quantities. The factory of the old H. W. Johns Manufacturing company at the foot of Thirty-ninth street, Brooklyn, N. Y., is already the largest one devoted to the manufacture of asbestos goods in the world; about 125 men being employed. A new building will shortly be erected which will employ double that number. Factories will also be run in Chicago and Boston. The old H. W. Johns Manufacturing company also made asbestos fire and water-proof paints and roofing,

NEW INSULATING JOINT.

an important branch of the business, while the other concerns confined themselves solely to the manufacture of asbestos steam pipe and boiler coverings, steam packings, fire proof cements, fabrics, ropes and twines. The new company will also be sole agent for the sale of Vulcabeston, which is used largely for electrical purposes in the manufacture of switch-boards, armature sleeves, battery cells, and insulating parts for arc and incandescent lights, motors, etc. The new H. W. Johns Manufacturing company will have headquarters at 87 Maiden Lane, New York City. There will be branch offices in Boston, Chicago and Philadelphia, and agencies in London and elsewhere abroad.

New Porcelain Insulator.

The accompanying cut illustrates a porcelain insulator of new design. The slot around the base of the insulator, inclining downward, effectively prevents any moisture covering the insulator from the conductor to the supporting base. These insulators are highly glazed, with a counter-sunk base. They have given satisfaction to those who have used them. They are being placed on the market by the Central Electric company of Chicago.

Chilian War Affecting Telephone Interests.

A recent number of the London *Electrical Review* contained an abstract of the last directors' report of the Chili Telephone company, Limited, covering the affairs of the company up to April 1st last. The report contains several interesting references to the civil war in that country, as will be seen by the following extracts:

"After the outbreak of the civil war the business of the company was stopped by the order of the government, which has since had the entire use of those of our lines situated within the districts remaining under its control; but business has been resumed for the public at Iquique and other stations in districts held by the Congress party. On the 31st of March, when the present account ended, the public service at Santiago had been suspended for one month and eighteen days. For the loss of business the government will compensate the company, and $62,000 had on the 31st of March been received on account of such compensation.

"The company's property has sustained damage only in [illegible] authorities."

[illegible] paid-up capital, as against a distribution of 5 per cent. for the previous year.

"In [illegible]

NE[illegible]

with very indefinite prospects of its ending—and also in view of the fact that for capital purposes it has been necessary to use, temporarily, the income of the company until the capital exchequer be rep'enished by further issue of securities—which cannot be done on satisfactory terms at the present time—the directors recommend that no dividend be paid, carrying forward undivided the whole balance of £14,209 10s. 1d. until peace is re-established, and the future of the company becomes more secure

"The company is now in sole possession of the whole field. Its system is already in far better order than ever before. It has established new exchanges throughout the country, and its prospects—but for the revolution—are brilliant."

New Incandescent Socket.

The accompanying cut illustrates the new incandescent socket of the Union Electric Manufacturing company of Bridgeport, Conn. The device has been received with much favor, and the company is making a specialty of it. There are very few parts to it, the chief novelty being the method of holding the key in position by peculiarly shaped projections on the key, pressed up against one of the frame posts by a spring. In the most recent form the contact ring on the top is done away with, and two screws are substituted, one going into each of the frame posts. The whole socket can then be easily taken apait for repairs when necessary.

Copper Production in the United States.

Census bulletin No. 96, relating to copper production in the United States, prepared by Charles Kirchhoff, special agent, under the supervision of Dr. David T. Day, has just been issued by Superintendent Porter. It contains many facts of interest and importance to the electrical fraternity.

The report shows the United States to be the largest producer of copper in the world, its product for the year 1889 being 226 055.962 pounds, or 113.028 short tons.

NEW INCAN[illegible]

The total expenditures involved in this production were $12,[illegible], of which there was paid in wages, $[illegible] 025, in salaries, $120,[illegible] to contractors, $[illegible] for materials and supplies, $[illegible] $1,442 [illegible], the total capital invested being $[illegible] and the total employes, [illegible]

The five leading states in the production of copper [illegible]

Mo[illegible]	[illegible]
M[illegible]	[illegible]
A[illegible]	[illegible]
New Mex[illegible]	[illegible]
C[illegible]	[illegible]

Since the tenth census report Arizona and Montana have made wonderful progress in the mining and [illegible]

[illegible] ... seen from the [illegible] production, [illegible] Michigan [illegible] [illegible] pounds.

Almost all copper used for electrical purposes in the United States comes from the Lake Superior district, and the portion of the report dealing with that locality is therefore of particular interest. Following is an extract:

"From an industrial point of view the conditions under which the Lake Superior copper mining companies work are unique. The occurrence of the metal in the native state created problems for the solution of which experience in older mining regions could furnish no guide. Untrammeled by conventional methods, they have been attacked in a characteristically American manner. After an experience extending over a generation it may well be claimed that the practice of the majority of the mines is entitled to the claim of ranking with the best in this country. By systematic mining, by the liberal introduction of power drills, by the cheap handling of large quantities of rock, and by the development of crushing apparatus of great power, well adapted to the special requirements, it has become possible in the Lake Superior district to profitably extract copper from very low-grade rock.

"While the district possesses certain great advantages, it is unquestionably hampered by drawbacks. The metal exists in the rock in the native state. The ore needs only to be crushed and washed to leave behind a product called mineral, consisting of metallic copper. From the fact that the product of 117,804,926 pounds of mineral yielded 87,455,675 pounds of ingot, it follows that the average percentage of copper is 74.24. But, on the other hand, the amount of native copper in the rock is small in the majority of cases. The total amount of ore hoisted to the surface, not including the few small mines worked by tributers and one of the larger mines, was 2,363,733 short tons. This yielded 86,604,283 pounds of ingot. The average yield of the principal mines was only 1.83 per cent of ingot. Excluding, however, the two phenomenally rich mines, the Calumet and Hecla and the Tamarack, the others produced from 1,369,180 tons of rock, 27,330,536 pounds of ingot, so that the yield was .998, or almost exactly 1 per cent. of ingot copper. It follows, therefore, that a large tonnage must be hoisted to produce a moderate amount of copper. This, in turn, means very extensive underground development, and a large investment in plant and machinery for power drills, hoisting, crushing, and washing. Since the latter requires a large quantity of water, stamp mills have been located where it is most readily available and where the enormous quantity of sand can be readily disposed of. The result is that the transportation of the rock from the mine to the mill becomes an additional problem.

"These conditions impose upon the Lake Superior copper companies a conservative policy, and rob them to some extent of the ability to quickly adapt themselves to rapid fluctuations in the demand and supply. They can not at short notice respond to calls for increased product, because preparations for an extension of operations involve the expenditure of large sums, extended underground development, and large additions to plant and equipment, with the long time which the execution of such plans requires. They are similarly hampered in any plans for an adjustment to the conditions which an overstocked market imposes. Low costs are based in operations involving the handling of large quantities of rock upon the full employment of equipment and force. Any curtailment means an undue burden of operating expenses and fixed charges upon a diminished product, while total suspension of operations presents the alternative of either providing for a steady outlay for the maintenance of mine and plant, or ultimately, upon resumption, of paying a far larger aggregate sum as a penalty for neglect. It is natural, therefore, that consciously or not, the managers of the Lake Superior copper companies have usually followed a [illegible]."

A table that is appended shows that the total cost of mining rock which finally yielded 87,455,675 pounds of ingot copper was at the rate of about 8½ cents per [illegible].

Electric Railways at Pittsburg.

[illegible] company is now building a new [illegible] street, Pittsburg, to Sharpsburg. The company purchased a site for [illegible]. The building will [illegible] equipped with dynamos and engines of the Westinghouse type as soon as the [illegible] that the new [illegible] to make [illegible] proof. Work on the [illegible] will be [illegible] equipped with [illegible]

[illegible]

Patent Litigation over Accumulators.

Judge Coxe has handed down an important decision in the litigation over the accumulator patents, awarding a substantial victory to the Brush company by declaring in favor of the patents of Charles F. Brush. The decision was handed down July 23d in the United States Circuit Court, southern district of New York. Following is the full text of the opinion:

This is an equity action founded upon three letters patent, granted to Charles F. Brush for improvements in secondary batteries, as follows: No. 337,299, granted March 6, 1886; No. 260,654, granted July 4, 1882, and No. 260,090, granted October 17, 1882.

These patents and one other, No. 337,298, granted March 2, 1886, were before this court in Brush company vs Julien company, 41 Fed. Rep., 679. The court there decided that No. 337,298 and No. 337,299 were for the same invention, and intimated, as the inventor and his expert apparently regarded the former as the broader patent, that the difficulty might be met by a surrender of the latter or by a disclaimer of similar claims therein. This solution of the difficulty was thrown out as a suggestion merely, the final disposition of the patents being left till the settlement of the decree.

It was not the intention of the court to decide that one of these patents was entitled to preference over the other. For the reason stated and for convenience of illustration No. 337,298 was given prominence in the discussion, but the conclusion would have been the same had the position of the patents been reversed.

Upon the settlement of the decree the complainant selected No. 337,299 as the patent upon which it chose to rely, and withdrew No. 337,298 from the consideration of the court. This was done without objection by the defendant in that case.

On the 15th of July, 1890, after the decree in the Brush-Julien case was entered, the complainant withdrew No. 337,298 from this cause, and an order was entered dismissing the bill as to that patent. The cause has since proceeded upon the three patents as stated.

In the prior litigations involving the subject matter of these patents the following propositions have been decided:

First.—That Mr. Brush was the first in this country to hold absorptive substance, in the form of dry powder, in place on the supports of a secondary battery by paper or equivalent material, and the first who rammed or pressed it into grooves or receptacles in the plates.

Second.—That No. 337,298 and No. 337,299 are for the same invention and that the complainant was not entitled to both patents, but was entitled to one.

Third.—The complainant having elected to hold No 337,299, it was decided, by the decree, that claims numbers one, two, three, six, seven, eleven, twelve and thirteen were valid, the word "perforations" in claims numbers six and seven being construed as synonymous with "cells or cavities."

Fourth.—That the claim of No. 260,654 was not infringed by the application of the absorptive substance to the grids by a trowel or spatula.

Fifth.—That the defendants, by the use of supports filled with rows of uniform square holes, did not infringe the "rib claims" of No. 266,090.

Sixth—That claims numbers seven and fourteen of No. 266,090, the latter claim being limited to the "perforations" described, were valid and infringed.

Seventh.—That No. 337,298 (and by implication No. 337,299) was not invalidated by patents Nos. 261,512 and 261,995, granted to Mr. Brush, July 18, and August 1, 1882, respectively.

Eighth.—That No. 337,298 (and by implication No. 337,299) was not invalidated by the expiration of the Brush Italian patent.[1]

All of these conclusions were reached after careful study and mature deliberation, and now, after having been reexamined in the light of the present record, arguments and briefs, except as to claims numbers eleven and thirteen of No. 337,299, are reaffirmed. No useful purpose would be subserved by again discussing them, as such a task would only involve a repetition of what has been said already in the other cases.

The proof of infringement is substantially the same as in the Brush-Julien case. It is more complete as to the manner in which the active material is applied to the plates, but in this respect it only emphasizes the former decision as to the non-infringement of the claim of No. 260,654. That claim is as follows:

> "The method of forming the plates of a secondary battery, consisting in forming receptacles for oxide of lead in its surface, then applying oxide of lead to the plate and within such receptacles and afterwards subjecting the oxide of lead to pressure."

The claim clearly contemplates not only the treatment adopted by the defendants, but afterwards subjecting the oxide to pressure. The defendants apply the oxide to the plates and within the receptacles with a wooden trowel in the hands of the workman, and there they stop. They do not subject the oxide to pressure afterwards.

The questions arising upon the expiration of the Italian patent and as to the validity of the "red lead claims" are, however, presented by this record in a new and different aspect and may, with entire propriety, be examined de [illegible] with the question, not heretofore considered, relating to the effect of the Brush patents Nos. 260,653 and 276,155 upon the broad patent in suit.

[illegible] that claims numbers eleven and [illegible] the red lead claims are void for lack of invention. The specification, after referring [illegible] material which is primarily and mechanically applied to the plates, proceeds:

[illegible]

> "[illegible] the best oxide of lead to use in the preparation of the plates; but as this is rather expensive to prepare red lead or minium may be used."

If the record contained nothing but this statement, the claims could not be upheld. After the invention of a support primarily coated with mechanically applied oxide of lead, merely coating the plate with the commonest, cheapest and best known form of lead oxide, did not require the exercise of the inventive faculties. Especially is this so when the patentee himself asserts that the best results can be obtained by using peroxide. It would seem that the use of red lead would at once occur to any one who had even a superficial knowledge of the art. There is no more novelty in using red lead for the coatings than there is in using cast lead for the plates. (Brush v. Julien, supra, p. 692.)

The following paragraph taken from defendant's brief states with clearness and precision the views of the court upon this subject:

> "The specification says that red lead is inferior to the peroxide, and we submit that no valid claim can be founded upon the use of an inferior article when it is shown that the use of the superior article is old."

Patent No. 337,299, at least as far as its broad claims are concerned, is not invalidated by anything contained in the Brush patents No. 260,653 and No. 276,155. The application for the former (No. 260,653) was filed June 15, 1882, a year and two days after the application of No. 337,299.

No one can read the specification of No. 260,653 without being impressed with the fact that the inventor intended to confine the patent to a single point, namely, the form of the electrodes. He expressly says so:

> "This application is a division of my application designated as 'Case I' [337,298-9] filed June 13, 1881, in which other features of my invention are claimed. For convenience in distinguishing this invention among others of mine in the class of secondary batteries I have denominated it 'Case I, Division A.'"

Again he says:

> "My invention consists essentially in a secondary battery element consisting of a structure of etagère-like form, containing in the spaces between its shelves lead in a finely divided state."

The claim is:

> "In a secondary battery, an element consisting of a structure of etagère-like form, containing in the spaces between its shelves lead in a finely divided state, substantially as set forth."

It is true that the broad invention is described, but it is equally true that it is not claimed. It was hardly possible for the patentee to describe the subsidiary invention without disclosing his main invention. Having disclosed it, had he permitted the patent to issue without warning or reservation, and, after the broad invention became public property, had filed an application covering what he had thus relinquished to others, it is probable that he would have been informed, either in the patent office or in the courts, that his application came too late. But that is not this case. Before his application for the subordinate invention he had applied for the superior one. In the former he expressly informed the public that it was but a division of the latter. He could do no more. The delay in the patent office cannot be charged to him. Even though the inventor were responsible for the issue of the divisional before the principal patent—and he was not—the fact of such prior issue in no way misled the public. They never for a moment acquired the right to use the broad invention. An infringer, with the statements on the face of No. 260,653 before him, would scarcely have the hardihood to assert that he supposed the broad invention was released. No court would listen to such a plea. The claims of that patent did not protect Mr. Brush in the use of the broad invention. A person who did not use an 'etagere shaped" plate, could, if no other patent prevented, use the broad invention with perfect impunity. No. 337,299 was intended to prevent such use.

The court has not been able to discover an authority holding a broad patent invalid in such circumstances. None has been cited by counsel.

What is true of No. 260,653 is also true of No 276,155.

Mr. Brush was the first in this country to make the broad invention as stated above. He is entitled to the fruits of his invention. It is the policy of the law to reward him.

Where the court can see that the patentee has produced an invention of real merit, it should not be unduly industrious in endeavoring to discover some statement or act of his by which, on technical grounds, his rights may be forfeited. It should rather be sedulous to protect him.

Whether or not the improvements patented by Nos. 260,653 and 276,155 are the same as the improvements covered by some of the claims of Nos. 337,299 and 266,090 it is, perhaps, unnecessary to decide, for none of the claims in issue and infringed are so affected.

It seems that in his anxiety to claim his invention in every conceivable form, the patentee has involved himself in a labyrinth of descriptions and claims in which electrician and lawyer alike are quite apt to become confused.

What Mr. Brush accomplished in 1879 and 1880 can be embraced in a brief, clear and concise statement. What he actually did is the test by which his patents must be judged. He is entitled to what he invented and only this. His patents can receive no broader construction, because he described his inventions with irksome prolixity and gives to the same structure a wearisome variety of names. The nomenclaturist should not seek the reward for his labors in the patent office. A person is not entitled to a patent because he has invented a new word. The danger and impropriety of holding a number of claims relating to the same structure, and which can be differentiated only by the most abstruse and metaphysical distinctions seem

apparent They are calculated to embarrass the inventor and mislead the public

Did patents Nos. 337,299 and 266,090 expire with the Italian patent?

The Italian patent was applied for July 28, 1882, sealed August [illegible], 1882, and was issued for a term of three years from September 30, 1882 It expired September 30, 1885, never having been prolonged, renewed or extended. No. 337,299 was granted March 2, 1886, No. 266,090, October 17, 1882, both were applied for in June, 1881.

Having stipulated that the patent was issued for an unextended term, from September 30, 1882, and that the translation appearing in the record is a correct one, the complainant is not in position to argue that the patent was either extended as to time or limited as to its terms

Especially is this so in the absence of the Italian patent law, which is not in evidence, and of all proof tending to establish either extension or limitation.

The difficulty with the complainant's argument in this regard is twofold; first, there is no law, and, second, there are no facts upon which to base it.

Section 4887 of the revised statutes is as follows:

> "No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. But every patent granted for an invention, which has been previously patented in a foreign country, shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years."

Under this section the test of identity between the foreign and the domestic patent, as established by the supreme court in two recent decisions, may be stated as follows:

Is the principal invention in each, is the thing patented abroad, the same in all essential particulars as the thing patented here; would the home patent be infringed by a structure made in accordance with the provisions of the foreign patent?

In cases where these questions are answered in the affirmative the United States patent falls, and it will not be saved by the fact that it contains improvements not found in the foreign patent.[1]

Whether the expiration of a foreign patent for an improvement only will operate to overthrow a domestic patent for a broad invention, which contains also a claim covering the improvement, has not apparently been decided by the Supreme Court. The language of the court in Siemens vs. Sellers, *supra*, is perhaps, comprehensive enough to cover such a contingency, but this is a question which need not now be considered.

In the Brush-Julien case the court commented upon the absence of expert testimony relating to the Italian patent. No similar observation can, with propriety, be made regarding the present record. It would indicate a lamentable want of appreciation on the part of the court to ask for additional instruction and advice. Eight experts of greater or less prominence and attainments have testified upon this subject. Three of these, called by the defendants, have expressed the opinion that the divisions of the Italian patent describe everything claimed in the United States patents granted to Mr. Brush and that the inventions covered by the two patents, No. 337,299 and No. 266,090, are literally described and substantially claimed in the Italian patent.

On the other hand five electricians, including the patentee himself, have testified that the Italian patent relates to inventions wholly different and proceeds upon totally dissimilar lines. In short, that it is but a progressive step in the Plante method, its object being to aid the process of electrical disintegration of the plates in the electrolyte, and not to supersede that process by placing the active material mechanically upon the plates prior to immersion in the battery fluid.

The mere fact that these gentlemen of conceded ability and learning, whose motive is to enlighten the court and who were all sworn to tell the truth, differ so radically regarding the meaning of the Italian patent is of itself suggestive.

The defendants plead the defense of forfeiture. They must prove it by a preponderance of evidence. And yet upon the question of the identity of the patents in question there is a sharp difference of opinion among those who are most entitled to speak upon the subject. Is there not room for the assertion that the defendants have failed to sustain the burden in this behalf?

When this question was presented in the Brush Julien case the mind of the court was in doubt, and now, having re-read the Italian patent in the light of the new testimony, it is still in doubt, but inclining more strongly to the opinion that the complainant's contention is correct. The court is not prepared to hold, therefore, that the Italian patent is for the same inventions as those covered by the two patents in question.

The principal reasons which led the court to adopt this view may be epitomized as follows:

First.—The language of the Italian patent is entirely different from that of the patent in suit. The drawings are different.

Some of the divisions of the Italian patent are unquestionably dissimilar and some concededly relate to the Plante process. The broad statement relating to the primary coating of the supports with active material is not found in the Italian patent.

Second.—The inventor's statement of his intent and purpose in taking the foreign patent and his reasons for not attempting to patent the invention of No. 337,299 abroad.

1. Siemens vs. Sellers, 123 U. S., 276; Com. Co. vs. Fairbanks Co., 135 U. S., 176.

This testimony is corroborated by his notes made at the time he was perfecting the inventions patented abroad. When these notes are placed side by side with corresponding portions of the Italian patent it will be seen that they are substantially similar. Mr. Brush testifies that the portion quoted describes the invention of Division D of the Italian patent.

[illegible]

"[illegible] * * * Now [illegible] very finely granulated or precipitated [illegible] superficially each particle, spontaneously [illegible] ing the metal, I will get a lead plate having minute seams throughout [illegible] 'forming' in the battery. It will [illegible] this peculiar fissured metal, so that the rapid oxidation in the battery will be [illegible] metal [illegible]

[illegible] condition, pressed or united together [illegible] coherent mass. [illegible] ized, granulated, precipitated, or other finely divided state, and [illegible] cess or application. * * * I now [illegible] and consolidated into a compact and firmly coherent mass. The [illegible] where ramifying and extending [illegible] lead oxide within and throughout the mass greatly facilitate the penetration of the electrical action in 'forming' the plates for operative use in secondary batteries."

The notes of March, 1882, seem to describe the invention of Division D; they certainly do not describe the invention of No. 337,299

Third.—United States patents, other than those in question, were issued to Mr Brush for the divisions of the Italian patent, evidently including Division D. At that time, therefore, neither the inventor nor the Patent Office officials thought these inventions, or any of them were the same as No. 337 299. Furthermore, the attention of the officials was particularly called to the foreign patents.

The opinion of the United States officials seems to have been entertained also by those of Italy, France and England.

Faure's invention was well known abroad and yet the patents issued to Brush with no objection apparently, from any source that they interfered with Faure.

Fourth—The fact that a sharp distinction is drawn in No 337,299 between the inventor's and Plante's method. Mr. Brush claims his secondary battery element "as contradistinguished from a plate or element having the active material produced by the disintegrating action of electricity as in the well-known Plante process."

There is nothing of this in the Italian patent. On the other hand the inventor clearly intimates that the plates of Division D are to be formed by the Plante process.

Fifth.—The vast superiority of the electrodes of the United States patents in question over those made in accordance with the directions of the Italian patent, as demonstrated by the experiments of the complainant's experts.

A careful reading of Division D in the light of the testimony has convinced the court that some, at least, of these experimental plates are made in conformity with the formula of that division. None of them are like the plates of No. 337,299.

Sixth.—The Italian patent is capable of a narrow construction which differentiates it from the patents in suit.

When to the statements of the patent itself is added the testimony of the inventor that he intended to limit the patent in all its branches to a coating formed by the action of the electric current and that he did not intend it to cover a coating placed on the plates mechanically before they are subjected to electrical action, there seems to be every reason why the narrower construction should be adopted.

Seventh—The fact that the element of the Italian patent is produced by heavy pressure, hydraulic or otherwise, whereby the particles of lead and lead oxide are compacted into a firmly coherent mass having minute veins of oxide of lead everywhere ramifying through it.

There is nothing resembling this in the United States patents in suit.

Eighth.—The "mass" described in the Italian patent is malleable and capable of being made into strips or wires and manipulated so as to form any style of element.

Neither the active material of No. 337,299 nor the completed plate of that patent is capable of such treatment.

Ninth.—No. 337,299 is designed to cover Mr. Brush's inventions made in the summer of 1879 and in the summer and autumn of 1880.[1]

Bearing this in mind, it is quite clear that the discoveries of these years alone are insufficient to support the Italian patent. Something more is required. What Mr. Brush did in 1879 and 1880 is not described in the Italian patent. What he did in 1882 is described there.

The foregoing are some of the reasons which have induced the court to overrule the defense of forfeiture; in fact, the more the Italian patent is studied the more settled becomes the conviction that it is not for the same invention as No. 337,299

Apply the test suggested in Commercial Manufacturing company vs. Fairbanks company, 135 U. S., 176, 194 If a person in this country, after the issue of No. 337,299, were to commence the manufacture of secondary batteries by the precise processes described in the Italian patent,

1. Brush vs. Julien, supra, 887; Accumulator vs. Julien, supra, [illegible] 131.

[illegible] ing the writ.

[illegible] statute creates it, and in all cases where the facts are clear the statute must be implicitly followed. But no one can examine the course of judicial dicision upon the subject [illegible] sought to construe it liberally, and have seldom, except in the plainest cases, permitted it to defeat a valuable patent.

[illegible] protection for a meritorious invention, the court should not, unless fully convinced that the facts warrant such a course, destroy his patents upon grounds which do not go to the merits of the invention, and which, for want of a more accurate word, may be termed *technical*.

[illegible] public [illegible] to protect them abroad is, on principle, not easy to comprehend.

It is said that the expiration of the Italian patent threw the invention into public domain. So it did into the domain of the Italian public, but if Mr. Brush had taken no patent in Italy the Italian public could have practiced the invention from the moment it became known there. Had he taken no foreign patents his invention would have been thrown into the public domain of every land but this. In this country his inventions would have been protected for seventeen years; outside of this country they could have been used with perfect impunity. The inventor applied for his patent here long before he applied abroad, but through the delay of the patent office the foreign patents were issued first.

Assuming the inventions to be similar, the inventor has been guilty of no fault, the American public has lost no rights, and yet, under the provisions of this statute, which it is thought was never intended to apply to a case like this, a valuable monopoly is destroyed.

These observations are, perhaps, only germane to the present inquiry as they tend to emphasize the suggestion already made that in dealing with a defense where, as in this case, the disaster following the inventor's acts is so out of proportion with the fault, if fault it be, the court should proceed with the utmost caution, and, where the evidence is not clear, give to the inventor the benefit of the doubt. If convinced that he did not intend to patent the invention abroad, the court should not by construction broaden the language of the foreign patent so as to destroy the domestic patent, when that language is capable of a construction which permits the domestic patent to live.

The question of how to dispose of No. 337,298 is, in view of complainant's position regarding it, more puzzling than ever. The rule which obtains in this Circuit, requiring a disclaimer of invalid claims as a condition of a decree, has always seemed an arbitrary one. It certainly seems inequitable that the court, at *nisi prius*, should compel the patentee to renounce forever a claim which may be held valid upon appeal. It is possible that this rule may be modified by the Circuit Court of Appeals.

In view of this contingency and of the extraordinary and distinguishing circumstances surrounding this case the court has concluded, if the complainant upon reflection still desires to assume the responsibility of retaining two patents for the same invention, not to require a surrender or disclaimer of No. 337,298 as a condition of a decree. It is thought, however, that pending an appeal it should be deposited with the clerk to await the further order of the court.

An accounting having been waived, it follows that on filing a disclaimer of claims eleven and thirteen of patent No. 337,299, the complainant is entitled to a decree upon claims one, two, three, six, seven and twelve of this patent, and upon claims seven and fourteen of No. 266,090, for an injunction, but without costs.

CORRESPONDENCE.

New York Notes.

NEW YORK, July 25.—The [illegible] State Naval Militia have been the heroes of the week in New York. As I wrote you last week the squadron of evolution has been anchored in the Hudson river, right off the western edge of New York city. Several preliminary drills have been organized for the benefit of the militia, and on each occasion the spectacle has been highly appreciated by tens of thousands of citizens who have crowded the docks and pier and all the river craft available for sight-seeing purposes. On Thursday [illegible] "distant service" was held, and at the same time the vessels of the squadron gave a mag[illegible] valuable services rendered by the electric projectors, the use of the Ardois system of [illegible] thrown in as a sort of side show. [illegible] has four search lights placed one at [illegible] ward and after bridges. The projectors are Mangin arc-lights of 23,700 candle power [illegible] amperes at 50 volts. [illegible] cruisers were in service at the same time [illegible] shafts of light now sweeping the banks of the river, then cast upward so as to form great [illegible] concentrated on a single vessel or portion of the [illegible]

formed a spectacle that was quite unique and fairly bewildered and delighted the crowds that occupied every available inch of space ashore and afloat from which the gigantic pyrotechnical display could be seen. The Ardois system of electric light signalling was used for communicating orders throughout the manœuvres. Ten incandescent lamps are strung in two vertical rows from the mizzen-top-mast head, the lamps being a considerable space apart to facilitate distinguishing the combinations from a distance. The lamps of one row show a red light and those of the others a white light. Only five lamps are lighted for each signal, the signals being made up to combinations of reds and whites. Five whites or five reds can be shown at once, or two reds and three whites, or one red and five whites, and so on in any combination of five, the total number of combinations possible being 62. The working of the lights is controlled by a circular switchboard provided with a revolving and depressing switch lever and connected with an automatic circuit closer. The signals are made instantaneously by turning the lever to the particular segment required among the 62 divisions of the switch and then depressing it; the proper lamp connections are then made automatically by the other devices of the system. This night drill, whatever it did to get the naval militia into training, certainly afforded a convincing demonstration of the value of the electric light in naval warfare. To-morrow the militia will leave for Fisher's Island, where their week's hard work will begin on Monday. Curiously enough, in spite of the very general interest shown in the proceedings, only $1,700 of the $5,000 needed for the expenses of the drill has yet been subscribed.

The rapid transit question is being discussed with a good deal of vigor just now. This week the commissioners screwed their courage up to the point of making public the route and style of road they have decided on for the east side of the city. It is to be a four-track underground line diverging from the proposed Broadway line at Fourteenth street; that is, nearly three miles from the down town terminus of the line, which was originally intended to serve the west side only. About two miles of the upper portion of the line is to be on a viaduct built over private property. The surveys, plans and specifications are left to the engineers, who are directed to have them ready "at the earliest practicable date." The road is to be operated by electricity or some other power not requiring combustion within the tunnel. It is not proposed to lay out a third line east of the one just decided on; the commissioners apparently intend to wait and see if capitalists will have the courage to face the situation. That the commissioners have their doubts on this score is pretty evident from the way they express themselves publicly, but unofficially. One of them says that "the commission has given to the public its best idea as to how rapid transit for New York should be realized. Capitalists must decide for themselves whether or not there is money in the project." The thing is that the "best idea" of the commission has been so overlaid with poor ideas that it is very doubtful whether capitalists will be tempted to put money into the project. The original idea of an electric underground road, or rather two roads, one for each side of the city, was excellent, certainly the best idea the commission has had. If capitalists had been allowed to work on that idea and build the road according to the best system obtainable the franchise would probably have been in great demand. The plan now given out of having the east side route branch off from the line from the west side at a point about two miles above the center of the business district is a fatal mistake. Anybody with an atom of common sense who has seen the evening and morning jams on the four elevated roads during the busy hours must see in a moment that it would be impossible to properly handle the traffic if the trains of both [illegible] have to run over a common track [illegible] of the city. Such a scheme is [illegible] even if it were intended merely [illegible] a system intended to permanently solve the difficulty of rapid transit in New York it [illegible] has put aside the simple and economical Greathead system of tun- [illegible] to deep [illegible] near the surface as [illegible] of the commission are [illegible]

opinion is that the commissioners incline more to the former plan. If they decide to adopt it, capitalists will probably not be very long in deciding whether there is money in the project or not, but their decision is pretty sure to be that there is not.

In addition to the vexation caused by the hopeless muddle in which the commission has involved the transit question, the souls and bodies of New Yorkers are further vexed by the blockade on Broadway caused by the construction work for the cable railroad. The work has been far more tedious and more expensive than had been estimated, and the preliminary job of re-arranging the gas and water mains, subways and other underground obstructions, has been—and will be, for a considerable length of the street has not been touched yet—a piece of work occupying an immense amount of time and costing an immense amount of money. The railroad company has bought the franchise of the steam company for the lower part of Broadway and will remove the mains altogether, as this was found to be the only way of disposing of them. The consideration was $100,000. The electrical companies will profit by this move, as the steam pipes kept the subways very hot, lowering the insulation of the cables. It is stated on the best authority that the cable road will not be in operation for at least a year yet. After the tracks have been laid the construction of the wheel-pits, power stations and machinery will occupy several months, so that the horse cars will run on Broadway for a long time yet. Perhaps after all the cable will never be set to work, as the road might yet be equipped electrically, as several other cable roads in various parts of the country have been.

The decision in the incandescent lamp suit has been pretty freely discussed during the past week. The fact that the Westinghouse company publicly announced the completion of its plans for reorganization after the decision was given out is taken as indicating that the interests opposed to the Edison company do not expect to suffer very much by reason of the decision. Judge Wallace granted the Edison company an injunction against the United States company, and later granted a stay until the appeal should have been decided, on the ground that it would be unfair to stop the company's business until the case had been finally decided, as it has been manufacturing lamps for the past five years. Commissioner Shields has been appointed master in chancery to take testimony in the accounting, and the United States company has filed a bond of $50,000 for the payment of profits. Edison stock has been very quiet; one day this week 100 shares were sold at $101\frac{3}{4}$.

Another important electrical decision was handed down by Judge Coxe on Wednesday in the case of the Brush Electric company against the Accumulator company. The Brush storage battery patent is upheld in all its bearings, and storage battery litigation is apparently at an end after having been bitterly waged for the past five years. In his decision Judge Coxe says: "Mr. Brush was the first in this country to make the broad invention. He is entitled to the fruits of his invention. It is the policy of the law to reward him." The Consolidated Electric Storage company, which is the successor of the Julien company and owns the Julien system, is the gainer by the decision, as after the decision in the case of the Brush company against the Julien in favor of the former it bought the Brush patents and then proceeded to push vigorously the suit of Brush against the Accumulator company, which it has just won. The storage battery cars belonging to the Fourth avenue line which were taken off on account of the injunction obtained against the Julien system, will be put in service again immediately, and it is said that a more extensive equipment of storage battery cars will be added with a view to the permanent working of the line by electricity. The engineers in charge of the system claim that with a large number of cars they can carry on the service much more economically than on a very small scale.

The state authorities have decided to test the constitutionality of the section of the new execution law, which prohibits the publication of details of executions. The city editor of the *Daily News* has been indicted for a misdemeanor for having published an account of the executions at Sing Sing. The district attorney says that the indictment was found merely to test the constitutionality of the law; he adds that he thinks the law is a bad one and that the public is entitled to know all it wants to know about executions. The other newspapers are rather envious of the *Daily News* and any one of them would have been glad of the distinction conferred on that journal—to say nothing of the "ad." The *Sun* says "the counsel for the defendant in the great and important test case is the united newspaper press of New York. No man charged with the violation of the law ever had more powerful backing."

The cable steamer Relay, belonging to the Central and South American Telegraph company, an American company which owns a system of cables skirting the west coast of the American continent, all the way from Tehuantepec, Mexico, to Valparaiso, Chili, succeeded the other day in splicing one of the main cables at sea off Iquique, thus re establishing telegraphic communication between Lima and Valparaiso. The Relay, although she sails under the British flag, having been built and equipped in England, saw under the protection of the United States war vessel Baltimore while executing this work. The southern sections of the central and South American company's system, from Lima to Iquique and Iquique to Valparaiso, were laid by the cable ship Silvertown early this year, but owing to the revolution the Silvertown was prevented from completing the connections. The Relay has now been enabled to finish the work under the very noses of the fleet of the Congressional party.

The New England Telephone & Telegraph company has just inaugurated a new exchange at Boston in the magnificent building put up by the American Bell Telephone company. The headquarters of the telephone industry in the United States have very appropriately been arranged on the plan of a model telephone building. It is ten stories high; five stories are to be let out as offices, two are occupied by the extensive organization of the American Bell company and the remaining three by the New England Telephone company, the executive offices being on the eighth story and the various departments of the telephone exchange. In the basement is a very complete electric lighting plant, and the machinery for heating and ventilating the building and for working the elevators. The underground cables of the telephone system enter at the basement and are carried up a shaft to the ninth floor, where they terminate in the distributing room. In this department the cross connections between the subscribers' lines and the switchboard wires are made, foreign current protectors being inserted in all the lines. Adjoining the distributing room is the operating room, which contains a multiple board of the latest Western Electric pattern, built for an ultimate capacity of 6,000 metallic circuit subscribers' lines and 600 trunk lines. Besides the multiple board there are several other switchboards for various purposes, such as testing and handling combination loops, long distance, extra territorial and suburban trunk lines, and the express service, which consists wholly of transmitting messages between the various express companies and their customers. On the tenth floor are the batteries and generators used in connection with the switchboards. An interesting fact in connection with this new electrical building is that the whole of the equipment of the exchange, the electric lighting plant and all the various accessory electrical apparatus was constructed and installed by the Western Electric company.

W. L. H.

Toledo, O.

TOLEDO, July 25.—The largest electric railway strike ever known in the United States has just been settled in this city. It began on July 15th, and every electric and horse car in the city was tied up. Public sentiment was generally in sympathy with the strikers. The employes of the Toledo Electric Street Railway company (Robison's) claim that they were promised $2 per day as soon as the cars were allowed to run on Summit street. The company, having obtained the privilege, was waited upon by a committee of the men and requested to keep its promise. This was refused, the company claiming that no such promise had been made. The employes of both companies were united and threatened to strike, which they did, completely blocking street car traffic. The motor men were receiving $1.50 and the conductors $1.65 per day of 12 hours. An attempt was made on the 16th to run cars, but when only a few rods from the barn the strikers lifted the cars from the track and informed the officials of the company that they could not run a car until the demand of $2 was conceded.

Numerous propositions were made by both sides, but no agreement was reached until Saturday night, when through the efforts of the mayor the matter was adjusted by the company agreeing to pay the motor men and conductors of both electric and horse cars $1.80 and the horse car drivers $1.70 per day of 12 hours and equal rates for overtime. The strikers were very quiet and not a drunken man was seen among them. They were, however, firm in their demand, and said that any attempt to run cars with non-union men would cause a riot and bloodshed.

The different labor organizations and the Central Labor Union passed resolutions indorsing the action taken by the strikers and offering them aid. The strikers ran wagons as a means of transportation, but the service was very irregular and accomplished little.

On July 11th the demurrer of the Consolidated Street Railway company to the petition by the Toledo Electric

Street Railway company asking that the former be enjoined from stringing new wires where the latter's wires are now, or from using these wires, was overruled. The temporary injunction was also made perpetual, and all that the Consolidated can now do is to appeal. This will prevent the Consolidated company from changing some of its horse car lines to electricity for some time

The latest move in the litigation between the two companies comes from the camp of the Consolidated people, and is in the nature of a petition in quo warranto proceedings brought in the name of the attorney general of the state. The claim is set up that the Toledo Electric Street Railroad company has abused its corporate authority. The company was organized April 11, 1890, and the legislature gave it authority to appropriate property necessary for the use of existing street railway track for not more than one-eighth of the entire distance between the termini of the route as actually constructed. The attorney-general claims that this act is unconstitutional on the grounds that it conflicts with section 26, article 2, in that it relates to the exercise of the sovereign power of eminent domain, is general, and does not have uniform operation throughout the state; that it conflicts with section 1, article 2, in that it purports to confer by special act the power of appropriating; that it is a special act conferring corporate powers; that it conflicts with section 19, article 1, in that it authorizes the appropriation of property already devoted to and in public use for street railway purposes to the use of another corporation for the same public purpose. The questions involved are similar to those in the case of the Cleveland roads, affecting the change from horse to electric power.

The Postal Telegraph, Consolidated Street Railroad, Toledo Electric and Western Electric companies of Toledo have joined in erecting a new line of poles on Superior street. Some of the poles are sixty and seventy feet high.

Pittsburg, Pa.

PITTSBURG, July 25.—The Braddock & Turtle Creek Electric Railway company has now commenced operations. The line was finished last week, and on Sunday, the opening day, the capacity of the road was fully tested. Three cars carried 4,000 passengers. The people of Braddock have for a long time been clamoring for a rapid transit railroad and the electric system meets with general approval. The line is now a little over two miles long, but the company is already contemplating an extension, and when the entire road is completed the company will operate about five miles.

Another progressive step toward the removal of the overhead wires in large cities took place yesterday by the organization of the Pittsburg Underground Electric Construction company, to equip electric and cable street railways with the underground systems under the patents of John J. Miller of this city. The gentlemen composing this organization are cautious and conservative, and it is believed the project is a good one, and from the position the gentlemen hold in the business world the combination is of great financial strength.

The officers and directors elected were C. D. Robbins, a successful oil producer of Washington county, as president, and D. J. Rex, manufacturer, as secretary and treasurer. C. F. Shoemaker, superintendent of Liggett Spring and Axle company, F. A. Mann, nut and bolt manufacturer of Cleveland, O.; F. J. Osterling, architect, and John J. Miller of the Robbins Electric company, the inventor of the system, comprise the directory. The company is organized with a capital stock of $300,000, of which $96,000 was paid in yesterday.

The inventions consist of a complete system of street railway appliances, motors, underground trolley, rail and road bed.

Sterling, Ill.

STERLING, July 25.—About two years ago the Union Street Railroad company obtained a franchise for a road in Sterling and Rock Falls and at once commenced construction. The Sprague company constructed about six miles of trolley wire and feeders; car barns were built and a power house added. Work was then discontinued, and the time allowed in the franchise expired. Last Monday evening Charles D. Jameson of Iowa City, Ia., applied for a franchise over the right of way of the Union company and agreed to file bonds to carry out the work. It being necessary to advertise the application for ten days, and form a stock company; the matter will be again brought up Monday evening, Aug. 3, when it is probable the franchise asked for will be granted.

The Sterling Gas and Electric Light company has commenced work on the head race tunnel which, when completed will be three times the present dimensions.

B. W. F.

PERSONAL.

Egbert G. Handy, president of the Columbia Electric company, St. Paul, has been in Boston and New York for the past three weeks.

J. H. Stahley, formerly with the North American Construction company is now in charge of the construction department of Kohler Bros. & Grier.

G. A. Edward Kohler, of Kohler Bros. & Grier, has just returned from an extended business trip through the east, visiting Philadelphia, New York and Boston.

C. A. Daigh, manager of the Electric Engineering & Supply company, St. Paul, has been in Chicago the last week getting the fine new office in order that has recently been opened by his company in the Rookery. The St. Paul office is managed by Morgan Brooks, the company's treasurer.

Dr. D. C. Jackson of Madison, it is reported, has been tendered the professorship of electrical engineering at the state university of Wisconsin. At present he holds the position of electrical engineer of the Consolidated Edison company of Madison, Wis. It is thought that he will accept the appointment.

W. J. Heald has been appointed superintendent of the operating department of the Minneapolis electric street railway system. Until recently Mr. Heald has had charge of the work connected with the overhead construction for the same company, the appointment coming in the line of promotion. Mr. Heald is a young man but he has won his spurs in active service and his appointment meets with approval in the Flour City.

C. C. Smith of the firm of Carr & Smith, electrical engineers, Minneapolis, has been engaged by the Villard company to take charge of the practical work connected with the rebuilding of the Milwaukee street railway system under Chief Engineer Julius Myers. Mr. Smith has been with the Minneapolis company nearly two years, having had entire charge of the installation of its magnificent plant, after plans and specifications prepared by Mr. Carr. As a reward for meritorious work he has been sent to Milwaukee, where his position will entail greater responsibilities.

NEW INCORPORATIONS.

Carpenter Electric Light & Motor company, Washington, D. C.; capital stock, $100,000; dealing generally in all kinds of electrical appliances

Merchants' Electric Light company. Leavensworth, Kan., capital stock, $50,000; to manufacture and supply light to the public by means of electricity.

Wisconsin Gas company, Chicago, Ill.; capital stock, $2,000,000; to build and operate gas and electric plants for all purposes to which the use of same may be adapted.

Cutter Electrical and Manufacturing company, Camden, N. J.; capital stock, $100,000; to manufacture chemical, electrical and mechanical devices, novelties and appliances.

Beatrice Light & Power company, Beatrice, Neb.; capital stock $250 000; to construct and maintain gas and electric light works for light, heat, power, etc., in Beatrice and other places.

Harvey Transit company, Chicago, Ill.; capital stock, $150,000; to construct a railroad in Harvey, Ill., and contiguous territory to be operated by animal, steam, electric or other power.

Youngstown Street Railway company, Youngstown, O.; capital stock, $500,000; building and operating street railroads to be operated by horses cable, electric or other power, and to furnish power and light, etc.

Light, Heat & Power company, New Albany, Ind.; capital stock, $50,000; to purchase, establish, erect and maintain an electric light station with all proper attachments for the purpose of furnishing electric light, heat and power to all persons desiring to use the same in Floyd and Clark counties, Ind.

United States Bulletin company (incorporated in West Virginia), New York, N. Y.; capital stock, $200,000; manufacturing, selling and renting, using or licensing electrical and mechanical bulletins, appliances or apparatus to report base ball games, and other amusements, sporting or public events.

ELECTRIC LIGHT.

The people of Leroy, Fla., are talking of introducing electric lights.

The erection of an electric lighting plant in St. Bernard, La., is talked of.

It is reported that an electric light plant will be erected at Riverside, Texas.

The Tampa, Fla., Illuminating company will, it is stated, change its incandescent plant to an arc light system.

It is reported that the big Alcazar hotel in St. Augustine, Fla., will be fitted with a new electric light plant.

At a recent meeting of the city council of High Point, N. C., E. A. Snow and J. E. Cox were appointed a committee to purchase an electric light plant for the city.

A paper on "Incandescent Electric Lighting" was recently read before the Illinois Chapter of the American Institute of Architects by Thomas G. Grier of Chicago.

The Edison Electric Illuminating company of Rochester, N. Y., has taken possession of its new property. The site cost $91,000. The company has issued bonds aggregating $300,000.

[illegible] Duluth high school for 581 incandescent lights. The company is [illegible] plant at Anderson [illegible] some time since.

The Edison Electric Illuminating company of Brooklyn, N. Y., has [illegible] ing station at [illegible] feet front and [illegible] deep. [illegible] teen No. 32 dynamos, [illegible] horse power Ball compound engines

ELECTRIC RAILWAYS.

An electric road from Chattanooga [illegible] Park is contemplated.

At Norfolk, Va., the Norfolk & Atlantic Terminal company intends building an electric line.

The St. Catherines, Ont., electric street railway, owing to financial embarrassment, has passed under the control of the Bank of Toronto.

The San Antonio, Tex., Rapid Transit Street Railroad company has contracted with the Thomson-Houston Electric company for the equipment of its electrical railroad.

Twenty new cars have just been added to the rolling stock of the Minneapolis Street Railway company. They are from the shops of the Northern Car company of Minneapolis and are highly commended.

Work on the electric railway at New Westminster, B. C., is steadily progressing. The foundations of the power house are finished and the work of its completion and fitting up will go forward without delay.

A new electric street railway company has been incorporated in Columbus, O. It will be operated in the extreme northeastern and northwestern sections of the city named and will also extend to Green Lawn cemetery.

The Galveston City Railroad company of Galveston, Tex., has let the contract to Noah Hamlet and W. D. Holtzman at $50,000 for the erection of its electric power house. The building will be 99x280 feet in size, and four stories high.

S. D. Loring, representing bondholders, has purchased the Houston, Tex., street railway property of the Fort Worth Land & Railway company. The property includes 10 miles of street railway, electric plant and equipment and real estate. The purchasers will, it is stated, make a number of improvements.

An application has been made to the Jamaica, N. Y., town board by the Brooklyn City Railroad company for permission to extend its Myrtle avenue line to Richmond Hill. Many property holders along the proposed extension were present at the meeting. They all favored the proposed extension. President Lewis of the railroad company said that the company intended to operate the whole road eventually by electricity. The next hearing will be on Sept. 14th.

ELECTRIC MOTOR.

Floyd, Gallagher & Co. have organized the Edison Electric Power company at Meridian, Miss., and are, it is tated, erecting an electric power plant.

The *Chicago Herald* is authority for the following item: "A queer suit in equity has been brought against a Philadelphia dentist. He has on his premises an electric plant with which he pulls teeth. The engine, dynamo and machinery make too much noise for the neighbors, and they have petitioned the court to have the nuisance abated."

TELEPHONE.

The telephone line between the German cities of Munich and Stuttgart, 125 miles in length, was started working on July 1st. Twenty-four cents is charged for five minutes' conversation.

The *Manufacturer's Record* is authority for the statement that the South Florida Telephone company will erect a factory for the manufacture of C. J. Seeger's patent telephone instrument at Bartow, Fla.

MISCELLANEOUS.

One of the best schools of electrical engineering in the country is that connected with Columbia college, New York, and at which Prof. F. B. Crocker is instructor. Full information regarding it is given in the recent [illegible] "circular" issued by the School of Mines of that institution.

O. W. McKinney of Rochester, N. Y., writes to the New York *Sun* to cite the case of John [illegible] Mass., who is alleged to have received a current [illegible] volts for over a minute with no more dangerous injuries than severe burns on his left hand and a large [illegible] left side, extending from shoulder to toe.

A beneficent product of ingenuity in [illegible] tion is an invalid chair which can be [illegible] ease that an attendant can be dispense[illegible] valid can, if desired, take his constitutional [illegible] eight miles on hour. Underneath the chair are placed the motor and the storage cells, and the guiding apparatus and that for controlling the motor are conveniently arranged. At a moderate speed he [illegible] miles of travel.

ELECTRIC MINING.

[illegible] the Hub Mining company of Neihart, [illegible] contract to the Thomson Houston Electric company for a complete mining plant. C. L. Parker superintendent of the works, says: "This plant will be the first complete electrical machinery equipment and the [illegible]. It will consist of electrical pumps, drills and hoists The hoists are for use in a 2,000-foot shaft, but for the present will only be used 1,000 feet. The machinery will be completed and ready for shipment as soon as the railroad is finished to Neihart, which will be in about sixty days, and inside of ninety days will be in operation. The drills can be operated in any part of the mine—three will be operated at once and within six months, or, as development goes on, six will be in use. The introduction of this electrical machinery will work a revolution in the manner of taking ores from the ground and its operation is being watched with interest all over the state; and when the electricity is once applied, there will be hundreds of mining men present to watch it, for upon the success of the plant hangs the fate of the application of electricity to working other mines in the Neihart district. The new process, it is claimed, simplifies mining and reduces mining operations to the minimum of cost."

TRADE NEWS.

[illegible] & Co., New York, have begun an action against the Manhattan Electric Supply company for alleged infringement of patent on the Burmley dry battery.

The Great Western Electric Supply company at a meeting of its directors, July 1st, declared a 2 per cent. quarterly dividend on $350,000 of preferred stock. It is announced that the company will soon pay 6 per cent. on common stock.

At the fourth annual exhibition of the Amateur Photographer's society of New Yo k the Clark Electric company was awarded a silver medal of excellence for its arc lamp for electric optical lantern apparatus. This is the first and highest medal ever issued by the society for electric light for optical purposes in photography.

Hewlings' Directory of Steam Specialties and Engineering Appliances is out. It contains classified lists, with an index of the names of manufacturers of the articles mentioned in the title. The compilation will undoubtedly prove of value to users of machinery of this class. A. J. Hewlings, 218 Lake street, Chicago, is the publisher.

The Electric Merchandise company reports large sales of the Pratt portable register for street car use. The company claims that this device is superior in many ways to other standard makes. Large orders have already been filled, and claims made by the company seem to be supported by the experience of those who have adopted the device.

"The Transmission of Electric Power" is the title of a handsome pamphlet just issued by the C. & C. Electric Motor company, New York. Besides a brief general article on the subject the little book contains the rates charged for electric power in many cities, forms of contracts for power and an essay on "A Proper Basis for Determining Electric Motor Rates."

The Pond Engineering company reports encouraging business from the Southwest. It is building the complete power plant for an Edison central station at El Paso, Tex; also a complete plant at Paris, Tex., for lighting and railway service. The company is furnishing Armington & Sims engines for Texarkana, Ark., and Austin, [illegible] the [illegible] for the new capitol building the second engine of this make now in the capitol.

[illegible] Lamp company, 2[illegible] S Canal street, Chicago, Ill., has greatly enlarged its manufacturing facilities, and is now prepared to fill all orders for the Sun arc lamp promptly, either for incandescent or arc circuits. The Great Western Electric Supply company has secured the general agency for the west; this lamp has been upon the [illegible] and it has received a phenomenal success, especially among the isolated plants and central stations that have the direct incandescent system. This [illegible] gives a bright, steady, white [illegible] also engage extensively in the manufacture and introduction of several new articles, upon [illegible]

BUSINESS.

[illegible] are issuing a circular describing the boilers they are installing for electric light [illegible]

[illegible]

commodious rooms at 203 and 205 South Canal street, and in a very few days will be settled. This company is having a fine trade in the leading lines, but particularly so in the Sun arc lamp which is made a specialty. In its new location it with offices, salesroom and factory in the same building, they will be prepared to fill orders speedily and with satisfaction.

The Coolridge Fuel & Supply company of Minneapolis has just closed an important contract with the Milwaukee Street Railway company to supply a large number of the Clark octagonal pole to be used in the rebuilding of the present lines and in future extensions in Milwaukee. While the pole was not put on the market until the season was well advanced, still it has met with a flattering reception, and another year will undoubtedly witness its almost universal adoption The pole is very handsome and could be used to advantage in supporting arc lights at street intersections and with but little additional cost. The pole is made by the J. R. Clark company of Minneapolis.

F. W. Weir, the general western agent of the Falls Rivet & Machine company of Cuyahoga Falls, Ohio, has just fitted up a very handsome office at 8 South Canal street, in anticipation of a very heavy business with lighting companies during the coming fall and winter. The name of the company is a misnomer, but while it manufacture rivets that have a wide reputation it also manufactures a line of specialties that are rapidly becoming popular with users of steam. As well as clutch pulleys, they manufacture all the intermediate appliances such as shafting, hangers, etc., necessary in power transmitting machinery. Several large contracts have been secured by Mr. Weir, among others that of the new Masonic temple, which is to have one of the largest isolated lighting plants in the world.

The extent to which electricity is being applied to the running of passenger and freight elevators is something remarkable. The Hale Elevator company of Chicago is the pioneer in this great undertaking and as such is reaping the benefits that come from well directed efforts. Six months since there were no elevators operated by electricity in this country, at least, none considered commercial, successfully, while to day this wide-awake company has a large number in the East, and in Chicago they have the following in some of the leading establishments: The Atheneum, two;' the Williams Building, 200 Monroe street, one; the Bijou Apartment House, Twelfth and Michigan avenue, two; and The Hub one. These elevators are giving most complete satisfaction, and it is predicted that this power will rapidly supplant all other means of operating this class of machinery.

The Union Electric works, 506 Springer building, have received some very flattering recommendation, regarding a new bell that they are putting in the market. The bell is a handsome one and besides is built for service, every part receiving the highest finish. The connections all have platina points, and the greatest care is used in winding so that every one may be up to standard. This company has a very commodious workshop and is prepared to manufacture on a scale as large as may be required any electric appliance or invention that may be offered them, It is specially desirous of securing the right to manufacture, on a royalty, a line of new appliances, or if meritorious, they will purchase outright from the inventor. The repair of electrical apparatus is also given careful attention, no pains having been spared in securing first-class workmen and the necessary machinery.

Jas. McLaughlin, 5[illegible] North Clinton street, has just rewound a 40 arc generator armature for a lighting company at Greenville, Miss., the second of the kind that has been sent him from that remote point within the past few months Mr. McLaughlin has every facility for doing this class of work, making a specialty of rewinding Sprague railway armatures. Besides having a shop particularly will fitted for heavy work, Mr. McLaughlin gives personal attention to every order of this kind that reaches him thus insuring its completion in a painstaking manner. Mr. McLaughlin can safely be classed as a pioneer in the building and repairing of electric light apparatus having been engaged almost constantly in this line of work for the last fifteen years. He was also among the earliest experimental workers in electric street railway apparatus, having held an important position with the Van De Poele company before there was a road in operation in the world. It will readily be seen that Mr. McLaughlin has had an experience in electric work that ought to be valuable to him in his present workshop.

Recent shipments of the Ball Engine company, Erie, Pa., were as follows: Temple Beth El, New York City; Johnson company, Johnstown, Pa.; Frishmuth Bros. & Co., Philadelphia, Pa.; Gambrinus Stock company, Cincinnati, O.; Bennett, Sloan & Co., New York City; Allentown Rapid Transit company, Allentown, Pa.; Lebanon Street Railway company, Lebanon, Pa.; Edison General Electric company, New York City; E. T. Copeland & Co., New York City; Schuylkill Electric Railway company, Pottsville, Pa.; Durham Electric Light company, Durham, N. C.; Amsterdam, [illegible] Street Railway company, Amsterdam, N. Y.; Corvallis Electric Railway company, Corvallis, Wash.; Olean Electric Light company, Olean, N. Y.; [illegible] Great Falls Electric Light and Power company, Great Falls, Mont.; [illegible] Horner & Co., [illegible] Northwestern Electrical Supply company, [illegible] Meyer, New York city; Reading & [illegible] Street Railway company, Reading, Pa.; Key West Gas and Electric Light company, Key West, Fla.; [illegible] company, Trenton, N. J.

[illegible] at present engaged in [illegible] incandescent and arc [illegible] of [illegible] reversible motors for elevator use. His present contracts for [illegible] apartment house, 600 incan[illegible] current to be gotten from

some one of the central station systems; the Pfieffer block, which is to be supplied with a large number of both incandescent and arc lights and two Detroit motors for a freight and passenger elevator, in connection with a large dry goods establishment; the McQuillan building, which is to have a Graves elevator operated by a slow speed 5 horse power motor running at 600 revolutions and the necessary lights, and the William Pitt Murray "department" store building, which is to have a large number of lights and two motors for freight and passenger elevators of 5 and 8-horse power capacity. The latter to be slow speed and reversible. Mr. Thomsen has recently fitted up a very commodious repair shop, enlarged his salesroom and office, and withal reports a very flattering outlook for the approaching season.

The Consolidated Temperature Controlling company of Minneapolis has arranged for an active business for the approaching fall and winter, and from the present indications its expectations will be more than realized. As the name of the company indicates it has a device to regulate the temperature of a single room, or an entire building can be controlled by a separate appliance. A new valve has just been brought out, designed particularly for large buildings, that is much simpler and in consequence much cheaper than anything that has heretofore been used. Another special advantage claimed for this new valve is that it can be placed in any room independent of the balance of the building. This invention is entirely distinct from the furnace regulator, which is attached to the furnace itself, and controls the entire volume of heat sent out. Owners of large buildings have come to better understand the saving in fuel possible by means of this appliance, and the owners of fine homes now know not only the economy, but the comfort that follows the maintenance of an even temperature throughout the entire building. The inquiry for particulars regarding these appliances has commenced much earlier in the season than heretofore and to meet the demand Mr. Paul is in the east arranging for the manufacture and sale of the apparatus on a large scale.

ELECTRICAL PATENTS.

Issued July 21, 1891.

456,172. Method of Measuring Electric Currents. Elihu Thomson, Lynn, Mass.

The current is passed through an electric conductor, which resists its passage. The heat thus evolved is caused to evaporate any suitable liquid, preferably alcohol. The vapor is then condensed and the amount of current is calculated therefrom.

456,182. Electric Lock. Abraham S. Wiley, Detroit, Mich.

456,219. Electro Therapeutic Apparatus. Edgar Grauert, New York, N. Y.

456,250 Insulated Contact for Electric Switches. Ocron S. Platt, Bridgeport, Conn.

456,252. Connector and Support for Trolley Wires. Sidney H. Short, Cleveland, O.

456,253. Operating Mechanism for Current Regulators. Sidney H Short, Cleveland, O.

456,254. Switch for Electric Car Motors. Sidney H. Short, Cleveland, O.

456,271. Flexible Conduit for Electric Conductors. Charles H. Herrick, Winchester, Mass.

There are three component parts to this conduit,—a lining or inner part made of any suitable material, formed as a spiral, with the turns thereof slightly separated; a tape or protective strip so applied to the aforesaid lining as to cover the spaces between its windings; and an envelope of plastic and water-proof substance over all.

456,280. Rheostat. John Van Vleck, New York, N. Y.

456 325. Secondary Electric Clock Movement. Benedikt Haberthur, Breitenbach, Switzerland.

456,327. Cut-out for Electric Lamps. Walter F. Smith, Philadelphia, Pa.

456,376. Conduit for Electric Cables. Maurice Delafor, Paris, France.

456,466. Color Printing Apparatus. Thomas Bickford, Branford, Conn.

456 493. Double Contact Switch. Thomas H. Lovell, Cleveland, O.

456,507. Magnetic Separator Henry G. Fiske, New York, N. Y.

We quote claim three:

"3. The combination of a water tight casing provided with an inlet, a series of magnets of alternately opposite polarity arranged radially on a rotary shaft within said case, a shield rotatable around said magnets, and a hopper having a discharge opening in proximity to said shield."

456,513 Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

456,514. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

456,540. Method of Welding by Electricity. John H. Bassler, Myerstown, Pa.

The meeting edges of the metal are first coated with carbon. Then two currents are sent simultaneously, one transversely through the joint from the upper surfaces of the meeting plates, and the other in the same manner from the lower surfaces of the plates.

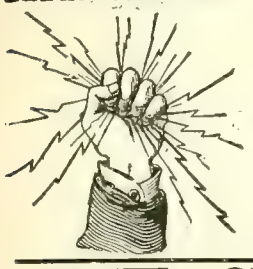
456,541. Method of and Apparatus for Electric Welding S. Lloyd Wiegand, Philadelphia, Pa.

A metal strip is inserted between the parts, and the current and heat resulting therefrom is concentrated on said strip and [illegible] portion in the seam In this manner an intimate contact is insured, the strip being kneaded in complete union with the plate metal.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 20, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and **is guaranteed to be waterproof, and will not deteriorate, oxidize or crack,** and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS FANS

FOR ELECTRIC MOTORS.

MANUFACTURED BY

THE TURNER BRASS WORKS,

4 LaSalle Ave., Chicago.

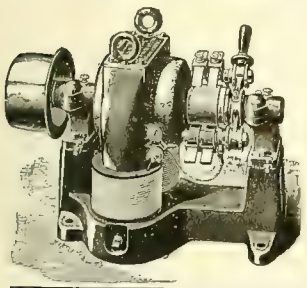
Write us for prices.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. **Telephone, 1718.**

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

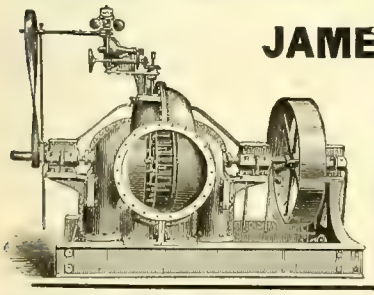
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS



BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

WANTED.

Position wanted by a man to take charge of an Electric Plant, Lighting or Street Railway; is a machinist by trade, and has four years' experience in Central Station work. Best of references furnished.

Address **"Machinist,"**

Care WESTERN ELECTRICIAN.

MICA.

For all Electric Insulating Purposes East India Mica is the best on the market.

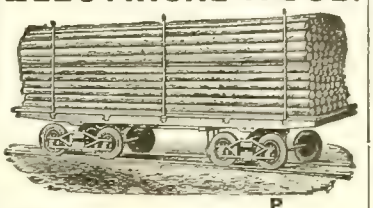
I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

ELECTRICAL WOOD.



Telegraph
Telephone } **CROSS ARMS**
Electric Light

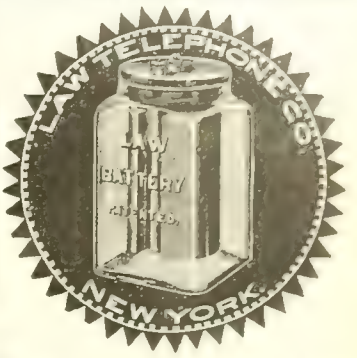
POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

AN ELECTRICAL ENGINEER

[illegible] ENERGY



The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N. Y.**

MEASURE YOUR INCANDESCENT LAMPS WITH

Queen's Portable Bunsen Photometer.

In every Central Station there is constant occasion to measure the candle power of Incandescent Lamps, and to meet these requirements we have designed our **Portable Bunsen Photometer.** It is **compact,** gives **accurate results,** is **simple in operation,** and the **price is low.** Dimensions, 37½ inches long and 5½ inches square. Total weight, 13 pounds.

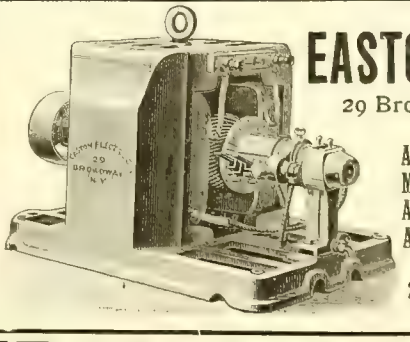
PRICE, $30.00.

Indispensable to the Economical Operation of Every Central Station.

CORRESPONDENCE SOLICITED.

Send for Illustrated Catalogue of Electrical Test Instruments No. 1-63.

QUEEN & CO., PHILADELPHIA.



THE

EASTON ELECTRIC CO.,

29 Broadway, New York City,

MANUFACTURERS OF

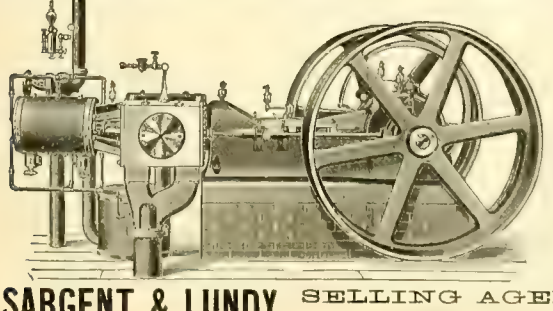
Arc and Incandescent Dynamos, Motors, Generators and Separators, And Arc Lamps adapted for use on Arc or Incandescent Circuits.

ADDRESS:

29 Broadway, - New York City,

For Circulars, Prices and Information.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

SIZE.	H. P. OF EACH ENGINE.	DESTINATION.
One 12½x12	80	Edison General Electric Co., Groton, N. Y.
Two 18½x17	500	Gloucester Street Railway Co., Gloucester, Mass.
One 13 and 23x17	240	T. H. International Electric Co., Rio Janeiro, Brazil.
One 11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One 18 and 19x15	150	Portland Street Railway Co., Portland, Me.
One 11 and 19x15	150	Lawrence, Mass.
Two 13 and 23x17	240	Lawrence, Mass.
One 13 and 23x17	240	Fall River, Mass.
One 8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One 13 and 19x15	150	G. A. Rollins & Co., Chicago, Ill.
One 15 and 23x17	325	Somerville Electric Light Co., Somerville, Mass.
One 13x15	100	A. G. Weeks, Boston, Mass.
One 14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One 18½x18	200	T.-H. Int. Elec. Co., Leeds, England.
One 8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two 9½x10½	45	Presbyterian Hospital, New York City.
One 23x19	500	Chicago Edison Co., Chicago, Ill.
One 11 and 19x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One 11 and 19x15	150	Fritz Wilen, Helsingfors, Finland.
One 16x15	150	T.-H. Electric Co., Boston, Mass.
Two 14½x15	125	Cortland Forging Co., Cortland, N. Y.
One 13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One 15 and 26x17	400	Baltimore Electric Refining Co., Baltimore, Md.
One 14½ and 23x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, **339 Rookery Bldg., CHICAGO.**

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.
№180 MAIN ST.
FITCHBURG, MASS, U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

COMPLETED TO DEADWOOD.

The Burlington Route, C., B. & Q. R. R., from Chicago, Peoria and St. Louis, is now completed and daily passenger trains are running through Lincoln, Neb., and Custer, S. D., to Deadwood. Also to Newcastle, Wyoming. Sleeping cars to Deadwood.

EXCURSION TO CHAUTAUQUA
VIA THE ERIE LINES.

On August 4 the Chicago & Erie R. R. will run an excursion to Chautauqua Lake, for which tickets good to return within fifteen days will be sold at **One Fare for the Round Trip.** This will positively be the only opportunity this season to visit Chautauqua Lake and the famous Chautauqua Assembly at reduced rates.

As the through trains of the Erie Lines between **Chicago** and **New York** all run via the Lake, no change of cars is required via this route.

For details of the excursion, sleeping car reservations, etc., call on, or address,

D. I. ROBERTS, Ass't Gen. Pass. Agt., Erie Lines, 802 Phenix Building, Chicago.

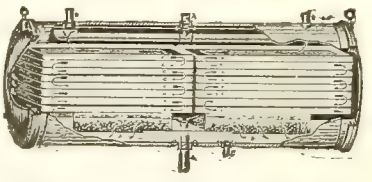
INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 12, 1889 THE OLD STYLE.

THE ACME LINK BELT
IS MADE ONLY BY THE
Page Belting Company, Concord, N. H.
BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the standard grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

WANTED.

A mechanical engineer now holding responsible position in a large manufacturing concern desires to make a change; experienced in modern economical methods of manufacture, especially so in producing machinery and its products in quantities where jigs and duplicating machinery are required, also in the erection and testing of steam plants and in operating them to their highest economy, and in the manufacture of wire and wire working machinery; will be pleased to correspond with any party having a responsible position open, who requires the services of a competent, energetic man. Address **A. S. M. E.,** care of The WESTERN ELECTRICIAN.

FOR SALE. WEST END ST. RAILWAY COMPANY, 81 Milk St., Boston. This company having adopted the long car for traffic on its most populous lines, is now able to dispose of a portion of its box and open cars. Roads in want can be promptly supplied at advantageous prices. We invite correspondence, but believe an examination of our stock by a representative of parties in want would be to their advantage. HENRY F. WOODS,
JUNE 19, 1891. Purchasing Agent.

STAR GAUGE GLASS CUTTER.

A necessary tool in every engine room. Sent by mail on receipt of price.

No. 1. Cuts over 5 inches $1 50
" 2. " " 8 " 2 00

S. TAUSSIG, 45 River St., Chicago. WESTERN AGENT

FOR SALE.

Two forty-eight inch Boilers twenty feet long, with twelve six-inch flues. In use about eight years. In fair condition. Will sell cheap. Address,

Parlin & Orendorff Co., Canton, Ill.

FOR SALE.
New 10 and 25 Light
Arc Dynamos and Lamps.
HIGH TENSION. CHEAP.
JAS. McLAUGHLIN, Mfg. Electrician,
50 N. Clinton St., Chicago.

SLATE.

Six samples showing all finishes for $1.50.

T. J. MURPHY,
96 Columbus Ave., NEW YORK.

George P. Barton. Charles A. Brown.

Barton & Brown,
ATTORNEYS AND COUNSELORS
Rooms 601-607 Temple Court Bldg.,
225 Dearborn Street, CHICAGO.
Patent, Trademark and Copyright Cases.

73-75 W. Jackson St.
RELIABLE

WE ARE FITTED WITH
RELIABLE Machinery and Tools,
And Employ RELIABLE Workmen.
All Kinds of Electrical Apparatus to Order.
CHICAGO ELECTRIC MFG. CO.

SPEAKING TUBES AND WHISTLES.
Oral, Electric, Pneumatic and Mechanical
ANNUNCIATORS AND BELLS.
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE. Out August 1st.

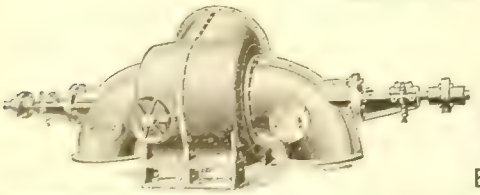
TURBINE WATER WHEELS,

Horizontal AND Vertical.

MANUFACTURED BY

RODNEY HUNT MACHINE COMPANY,

SPECIALTIES FOR ELECTRIC LIGHT AND POWER.



Double the power of most wheels. **High speed. Belting** directly to dynamo. **Efficiency,** .9050. Holyoke Testing Flume. **Easy working gate. Even speed.** Excellent workmanship, great durability. **Moderate prices** and satisfaction in every respect guaranteed. 1,800 wheels sold in New England. One party has 87 of these wheels in use; another 6,800 h. p.; another 7,330 h. p., etc., etc. Large number of wheels furnished for Electric Lighting. All giving perfect satisfaction. Write for catalogue and estimates on proposed plants.

Boston Office, 70 Kilby St. Main Office and Works, ORANGE, MASS., U. S. A.

PURDUE SCHOOL —OF— ELECTRICITY.

New Laboratory, fitted with best appliances, dynamos, alternating current plant storage batteries and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue.

PURDUE UNIVERSITY,
La Fayette, Ind.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

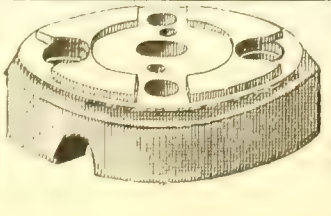
A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,
WILMINGTON, DEL.

Experimental Work in Anything Electrical.

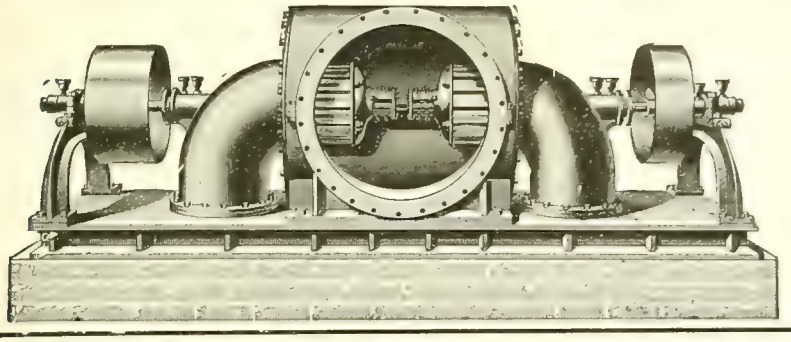
FREEMAN, COLEMAN & CO.,
53 and 55 South Jefferson Street, - - CHICAGO, ILL.



EMPIRE CHINA WORKS,
134 to 156 Green St., Green Point, BROOKLYN, N. Y.
MANUFACTORY OF
Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our wares are of same composition, and are baked alike, which are the features of
TRUE HARD PORCELAIN.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC CO[illegible] CELE-BRATED WATER WHEEL on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** [illegible] diameter, being **double** the **Power** of [illegible] number of the leading [illegible] ical use of water it is without an equal, [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents a pair of [illegible] **VICTOR TURBINES** arranged on a horizontal shaft with [illegible] Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The [illegible] strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ALUMINUM

IN ALLOYS 75c. PER POUND.

Aluminum in alloys equal in purity to any on the market, 75c. per pound for the contained Aluminum.

Cowles' Pure Aluminum in ingots is offered as low as that of any American concern; quality guaranteed.

THE COWLES

Electric Smelting & Aluminum Co.

LOCKPORT, N. Y.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),

DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

FOR HANDLING

GRAIN, COAL, TAN BARK, SEEDS, ETC.

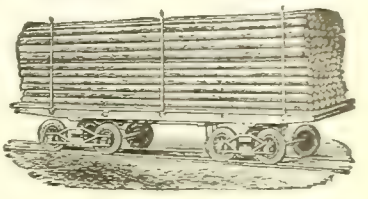
Will convey all kinds of grain without mixing.

Will carry two different kinds of material in opposite directions at the same time.

Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

ESTABLISHED 1873.

SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

OTHER PEOPLE May Imitate Our Methods of Advertising But They CANNOT Duplicate THE SUNBEAM LAMP, STICK A PIN RIGHT HERE!

THE SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

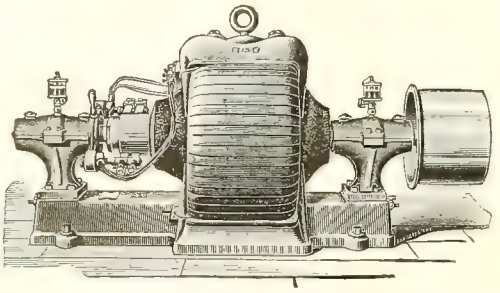
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



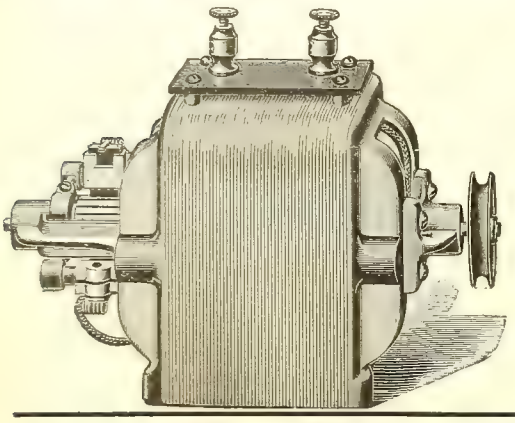
Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer.

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

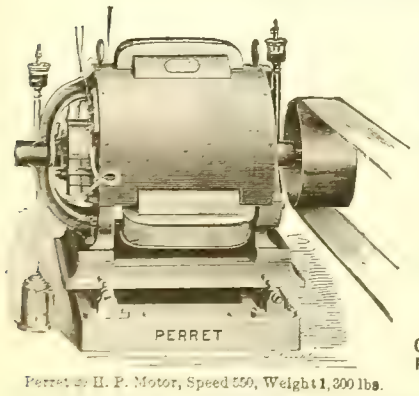
Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

—MANUFACTURERS OF—



Perret 25 H. P. Motor, Speed 550, Weight 1,200 lbs.

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power. Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.

JOHN STEPHENSON CO.,

LIMITED,

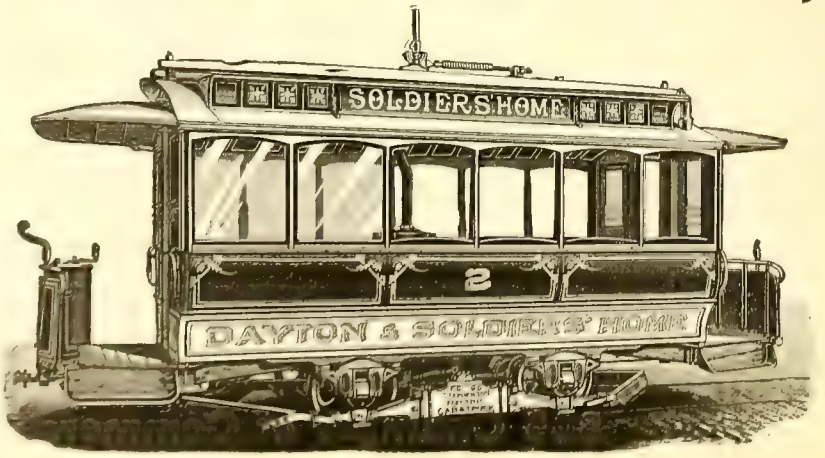
NEW YORK.

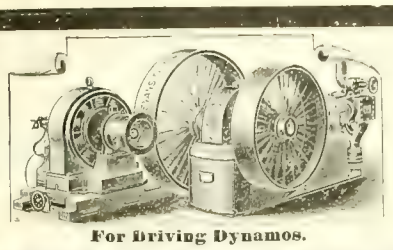
STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.





For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.

Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

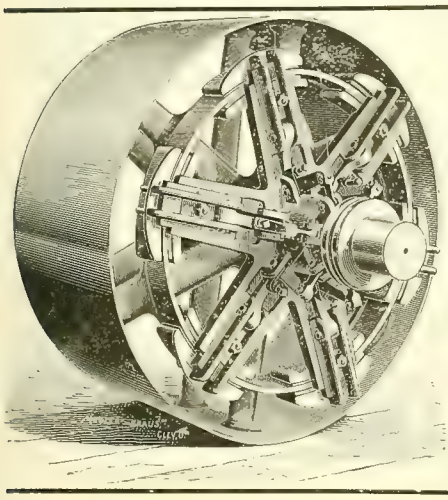
OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.



HILL
Clutch Works,
CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: MINNEAPOLIS:
28 So. Canal St. 305 Kasota Building.

KANSAS CITY:
1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

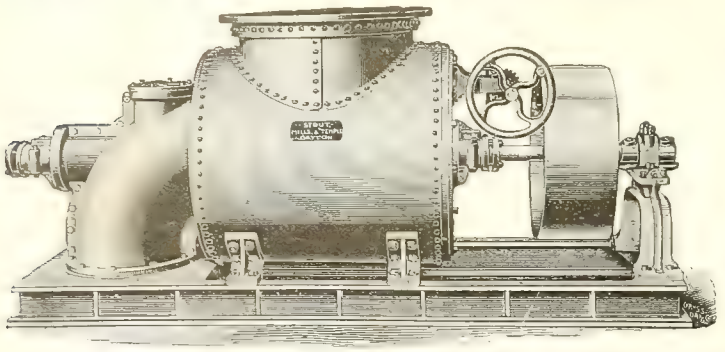
Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,
CLEVELAND, OHIO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

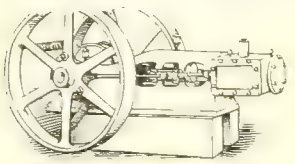
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS, No. 417 North Street, BALTIMORE, MD.

Binders FOR THE Western Electrician **$1.00.**

TRIPOD BOILER

Three Points of Superiority Guaranteed: **Safety, Economy, Low First Cost**

Repeated tests prove that it is absolutely **Non-Explosive** and the most **Durable** ever made.
Strong testimonials from hundreds of users, in all parts of the country.
Sizes 10 to 1,000 H. P.
For full information address,
HAZELTON TRIPOD BOILER CO.
809 Monon Block., CHICAGO, ILL.

FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST.
HALF TONE PLATE SPECIALTY
CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

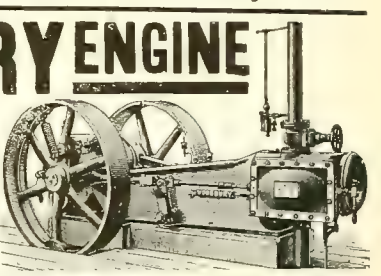
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,
ST. LOUIS. CHICAGO. KANSAS CITY.
OMAHA DALLAS. SEATTLE.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
Catalogue sent on application.
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES: Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



WESTINGHOUSE ENGINES

A FEW RAILROAD USERS:

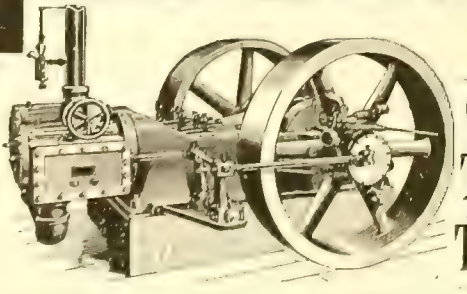
	Engines.	Horse-powers.
Ashland Coal & Iron Railroad Co	1	60
Baltimore & Ohio Railroad Co	6	190
Boston & Albany Railroad Co	2	130
Camden & Atlantic Railway Co	3	75
Central Railway of New Jersey	4	275
Chicago & Erie Railway Co	2	30
Chicago, Burlington & Quincy Railroad Co	3	175
Chicago, Milwaukee & St. Paul Railroad Co	5	100
Chicago, Rock Island & Pacific Railroad Co	4	170
Colorado Midland Railway Co	1	25
Denver & Rio Grande Western Railroad Co	3	75
East Tennessee, Virginia & Georgia Railroad Co	3	325
George's Creek & Cumberland Railroad Co	2	50
Grand Trunk Railway Co. of Canada	12	500
Gulf, Colorado & Santa Fe Railway Co	3	135
Kansas City, Wyandotte & Northwestern Railway Co	2	55
Newport News & Mississippi Valley Co	2	200
New York Central & Hudson River Railroad Co	4	125
New York, Lake Erie & Western Railroad Co	2	140
New York, West Shore & Buffalo Railroad Co	6	340
Northern Pacific Railroad Co	2	45
Pennsylvania & Northwestern Railroad Co	1	25
Pennsylvania Railroad Co	51	2330
Peoria & Pekin Union Railroad Co	1	55
Philadelphia & Reading Railroad Co	7	615
Pittsburgh, Cincinnati, Chicago & St. Louis Railway Co	2	20
St. Louis & San Francisco Railway Co	3	260
Southern Railway Co	1	10
Wabash, St. Louis & Pacific Railroad Co	4	60
Washington & Georgetown Railway Co	1	15

Many foreign railroads unreported.

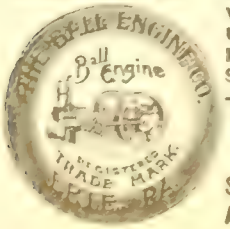
THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound



With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS (E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER, 38 South Fourth St., Philadelphia, Pa.; COOLEY & VATER, 224 Washington Ave. So., Minneapolis, Minn.; W. B. PEARSON, Room 403 Home Insurance Bldg., Chicago, Ill.; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; CHAS. K. SHERMAN, New England Bldg., Kansas City, Mo.; NORTH-WESTERN SUPPLY CO., Tacoma, Wash.

STANLEY ELECTRIC MFG. CO.

TRANSFORMERS.

Compare these weights with weights of other transformers:

5 light,	48 lbs.
10 light,	65 lbs.
20 light,	85 lbs.
30 light,	101 lbs.
40 light,	130 lbs.
100 light,	300 lbs.

A. C. FAN MOTORS.

SMALL,
NOISELESS,
RELIABLE.

Less than 1½ Amperes required to drive it.

Price, $20.00.

PITTSFIELD, MASS.

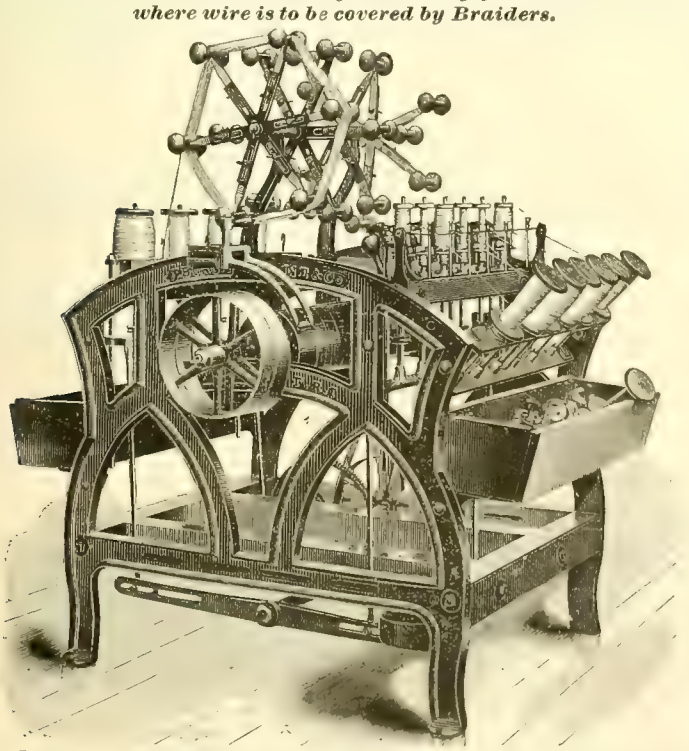
Chicago Agents: THE ELECTRICAL SUPPLY CO., 102 Michigan Ave.

GEORGE W. PAYNE & CO.,

MANUFACTURERS OF

BRAIDER SPOOLERS,

Used in connection with Braiding Machinery for Electrical Work where wire is to be covered by Braiders.



Machines built when required to double two or more ends, with drop motions to stop spindle when end breaks, also when bobbin is full.

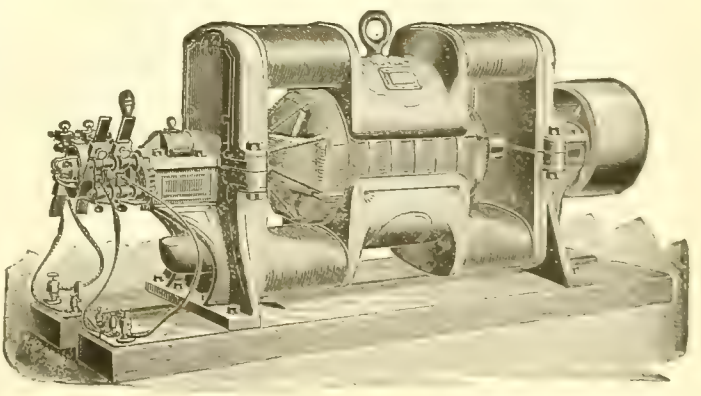
Works 102 Broad St., PAWTUCKET, R. I.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

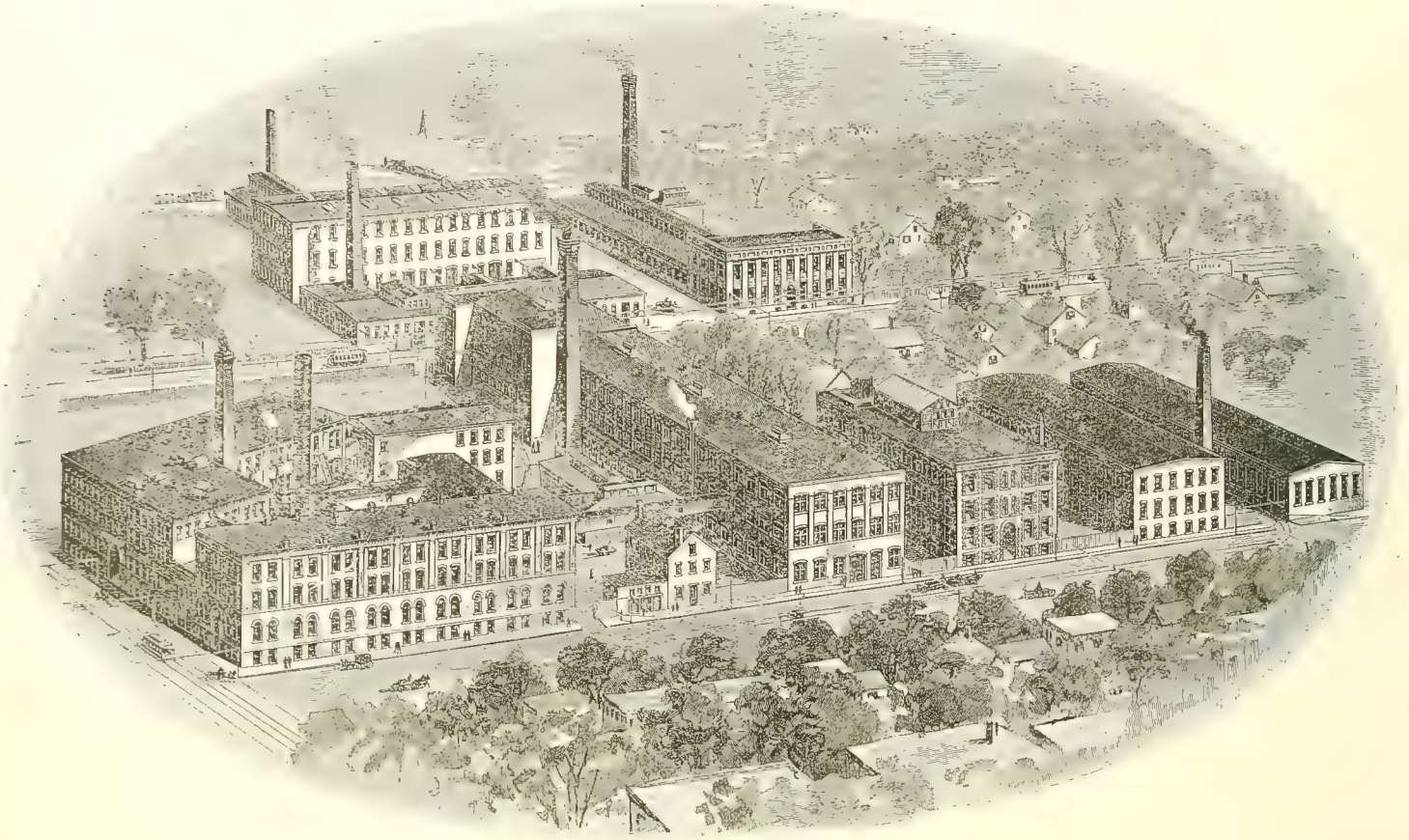
Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.

The KNAPP ELECTRICAL WORKS,

GENERAL AGENTS FOR

"SAFETY"

WIRES, CABLES AND CORDS

For Inside, Underground and Submarine Use.

"SAFETY" Fire-Proof House Wire. "ATLAS" Line Wire.

R. B. WATSON & CO., Agts., DETROIT, MICH.

J. W. MASON, Agt., 527 Delaware Street, KANSAS CITY, MO

POST & CO., Agts., CINCINNATI, O.

THE PERKINS ELECTRIC LAMP CO.

LAMPS

TO FIT ANY SOCKET.
ANY CANDLE POWER.
ANY VOLTAGE.
LONGEST LIFE.
HIGH EFFICIENCY.

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

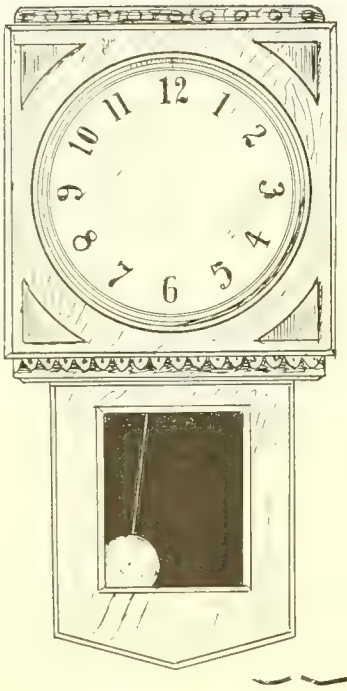
54 and 56 Franklin Street, CHICAGO.

SEND FOR CATALOGUE.

The Electrical Supply Co.,

Corner **MICHIGAN AVENUE** and **RANDOLPH STREET,**

CHICAGO.



"What time is it?"

Who can tell?

The mechanism is all right; the Clock ticks, the wheels go round with their accustomed regularity—but to what purpose? There is not much lacking, only the Hands gone.

The Central Station is all right; the wheels spin around with cheerful humming. The Dynamo sings a busy song; the Fuel burns with a gleeful sputter; the trembling Meters tell of outgoing Energy.

"Going where?"

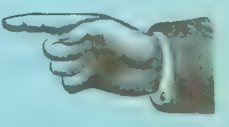
It will go down your poles, into trees, over awnings, along crossed lines, wherever it wills, a Fugitive Force, unless the Insulation is there.

Do you use Shield Brand Wire?

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.



Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE, $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

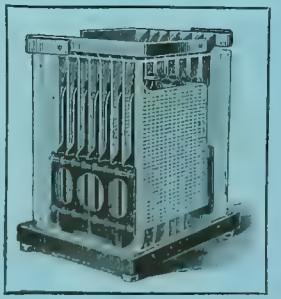
SLOW SPEED **STATIONARY MOTORS** For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

WORKS AND GENERAL OFFICES. BALTIMORE, MD.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
Central Station and Isolated Lighting.
Portable Lighting or Power.
Portable Electric Lanterns.
Electric Power for Motors.
Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR COMPANY,

224 and 226 Chestnut Street, Philadelphia, Pa.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 and 226 Chestnut St.
NEW YORK: TRUEX & VAIL, 44 Broadway. CHICAGO: WM. HOOD, 239 La Salle St.
SAN FRANCISCO:—THE PACIFIC ELECTRICAL STORAGE CO., 118 and 120 Pine St.
BOSTON:—THE HOLTZER-CABOT ELECTRIC CO., 111 Arch St.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, AUGUST 8, 1891. No. 6

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building, - - CHICAGO.

THE HOLTZER-CABOT ELECTRIC CO.,

MANUFACTURERS OF AND DEALERS IN
EVERYTHING ELECTRICAL.
SEND FOR 256-PAGE CATALOGUE,
111 Arch Street, BOSTON, MASS.
SPECIAL AGENCIES: CLOWER & HARRIS, Dallas, Texas. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.
A full line of our manufacture can be found at our Agencies.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes
Telephonic transmission through Our Cable an easy
GAME.

An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices. Standard Underground Cable Co., New York, Pittsburgh, Chicago.

Nuttall Trolley. Patents Pending.

THE BEST!

$30.00
WRITE US.
Electric Railway Specialty COMPANY,
29 Broadway,
NEW YORK.

DO YOU WANT

A THOROUGH INSULATING PIPE?
AN INDESTRUCTIBLE PIPE?
PIPE TESTED SUCCESSFULLY?
THE PATENT INDURATED FIBRE PIPE
Costs less than iron and does better work in electrical subways and elsewhere.
SOLE AGENTS:
Engineering Equipment Co.,
143 Liberty St., NEW YORK.
126 Pearl St., BOSTON.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.

The International OKONITE COMPANY, LIMITED.

OKONITE TRADE MARK
13 Park Row, New York.
INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.
BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

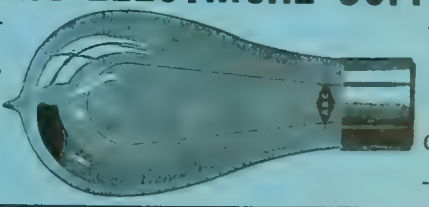
New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP
AGENTS
J. W. PEALE, 1 BROADWAY, NEW YORK
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.

DAY'S KERITE
The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.
Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.
GEORGE B. PRESCOTT, JR., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,

20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.
THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."



WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

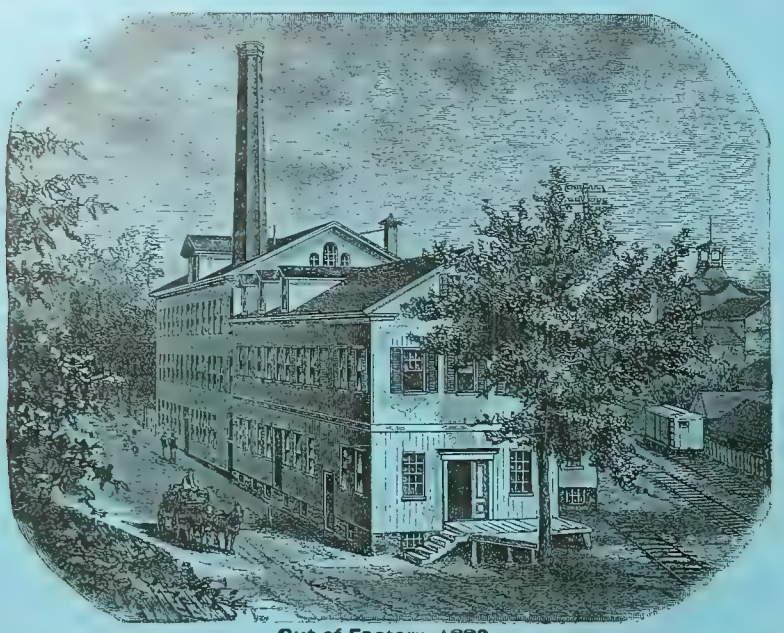
Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.
Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.
STANDARD ELECTRICAL MEASUREMENT APPARATUS.

73-75 W. Jackson St. RELIABLE
WE ARE FITTED WITH RELIABLE Machinery and Tools,
And Employ RELIABLE Workmen.
All Kinds of Electrical Apparatus to Order.
CHICAGO ELECTRIC MFG. CO.

WM. ROTCH, Prest. CHAS. E. BIBBER, Mgr.
DO NOT
Equip your Switchboard with Cheap Switches
BUY THE
C. E. M. Jack-Knife Switch.
The Consolidated Electric Mfg. Company,
196 Summer St., BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS

IS THE THOMSON-HOUSTON ELECTRIC CO.'S SYSTEM OF LIGHTING A SUCCESS?



Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, 1,653 Lamps.	None.	None.

Cut of Factory, 1886.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, 21,840 Lamps.	29 Companies, 11,275 Lamps.	None.

Read the Answer on Page xx.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The........——
Abendroth & Root Mfg. Co.... xiii
Alexander, Barney & Chapin.....i
American Electrical Works.....xiii
Andrews & Co., A. H..........xiv
Automatic Switch Co........... x
Baggot, E....................xiv
Bain Electric Mfg. Co.........xvi
Ball Engine Co...............xviii
Ball & Wood Co., The........ xii
Barton & Brown.............. xiv
Baxter Electric Motor Co.......xxiv
Beardsley, Chas. S., Receiver..——
Bernstein Electric Co...........xiv
Blatz, L......................xiii
Borden & Selleck Co............xv
Braun Illustrating Co.........xviii
Brownlee & Co.................xii
Brookfield, Wm................xii
Brush Electric Co............ xvii
Butler Hard Rubber Co........viii
C. B. & Q. R. R.......... xiv, xviii
C. & C. Electric Motor Co. ... xvi
Card Electric Motor & Dynamo Co.......................... xiv
Central Electric Co........... v
Chicago Electric Mfg. Co........ i
Chicago Insulated Wire Co.... xvii
Cleverly Electrical Works... .——
Colburn & Co., I. W......... xiv
Coolidge, Fuel & Supply Co..... iv
Consolidated Elec. Mfg. Co., The i
Cowles Electric Smelting and Aluminum Co...............xv
Crocker-Wheeler Electric Motor Co......................... xiii
Day's Kerite Insulation...........i
Dayton Globe Iron Works Co.xviii
Eastern Electric Cable Co.......xiii
Edison General Electric Co.,—Motor Dept...............vi
Edison General Electric Co., Wire Department................vii
Electric Construction & Sup. Co.xxiii
Electric Merchandise Co.......... iv
Electric Secret Service Co......xvii
Electric Railway Specialty Co.....i
Electrician Pub. Co. vii, viii, x, xxiii
Elec. Construction Co., The.....xiii
Electrical Engineering Co.......xiii
Elec. Eng. & Supply Co., The..xiii
Electrical Supply Co., The....xxii
Elektron Mfg. Co..............xvi
Empire China Works......... .xiv
Engineering Equipment Co.......i
Evans Friction Cone Co....... xvii
For Sale..............xii, xiii, xiv
Fort Wayne Electric Co........ xxiv
Freeman, Coleman & Co........——
Globe Carbon Co.............. xv
Great Western Electric Supply Co.......................——
Greeley & Co., The E. S...........i
Hale Elevator Co............. vii
Hazelton Tripod Boiler Co...... xiv
Heisler Electric Light Co......xviii
Hill Clutch Works.............——
Hine Eliminator Co............xii
Holmes, C. H..................xiii
Holmes, Booth & Haydens........iv
Holtzer-Cabot Electric Co.........i
Hood, Wm....................... x
India Rubber & Gutta Percha Insulating Co.................——
Interior Conduit & Insulation Co...iv
International Okonite Co...........i
Kartavert Mfg. Co...............iv
Knapp Electrical Works....... xxi
Law Telephone Co............ xiii
Leffel & Co., Jas.............. xiii
Loud, H. M. & Sons Lumber Co............................. xiv
McLaughlin, James xiii
Mason, James H...............xiii
Milliken Bros....................iv
Minneapolis Street Railway Co... xix
Monitor Electric Co x
Munsell & Co., Eugene..........xiii
Murphy, T. J..................xiv
National Carbon Co...............iv
National Electric Mfg. Co........ix
N. Y. Belting & Packing Co...... xii
New York Insulated Wire Co.. viii
New York & Ohio Co..............i
Northwestern Electrical Specialty Co.....................xxiii
Ohio State University........ ——
Ostrander & Co., W. R..........xiv
Paiste, H. T.....................xii
Page Belting Co................——
Partrick & Carter Co............ x
Payne & Co., Geo. W............——
Pearson & Co., W. B..........xviii
Phoenix Glass Co.................——
Pond Engineering Co.......... xviii
Powell Co., The Wm........... xiv
Purdue University.............. xii
Queen & Co.................. xiii
Rochester Railway Co........... xii
Rockford Electric Mfg. Co.... ——
Sargent & Lundy..................i
Sawyer-Man Electric Co.........xi
Schieren & Co. Chas. A........ xii
Schoonmaker, A. O............ xii
Schuyler Electric Co......... xxiv
Short Electric Railway Co. xii
Shultz Belting Co................x
Standard Underground Cable Co....i
Standard Paint Co...............xii
Stanley Electric Mfg. Co.... .——
Star Iron Tower Co............. iv
Stearns Mfg. Co...............xviii
Stephenson Co., Jno...........xvi
Sterling, W. C................. xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co xv
Taussig, S..................xiii, xiv
Temple, J. C.................. xv
Thomson-Houston Electric Co. Lighting Department ..... ii, xx
Turner Brass Works.......... .xiii
Union Electric Mfg. Co., The... vii
Union Electric Works...........——
Union Hardware Co.............xii
United States Electric Lighting Co...........................——
Van Nuis C. S...................——
Vulcanized Fibre Co............ xv
Wanted ....xiii, xiv
Wenstrom Consolidated Dynamo & Motor Co., The x
West End Street Railway Co.. xiv
Western Electric Co viii
Westinghouse Electric and Mfg. Co.................................xi
Westinghouse Machine Co.... xviii
Weston Electrical Instrument Co..............................——
Williams Engine Works.......xviii
Woodbridge & Turner Engineering Co xv
Woodhouse & Rawson, Ltd.... xiv
Worthington, Henry R........——

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
McLaughlin, Jas.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Butler Hard Rubber Co.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Beardsley, Chas. S.
Central Electric Co.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Elect. Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Rochester Railway Co.
Stephenson Co., John.
West End Street Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Edison General Electric Co.
Electrical Engineering Co., The
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Engineering Equipment Co.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Beardsley, Chas. S.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Monitor Electric Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Colburn & Co., I. W.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Consolidated Elec. Mfg. Co., The
Central Electric Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.
Union Electric Works.

Electric Railways.
Edison General Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Sawyer-Man Electric Co.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn & Co., I. W.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Engineering Equipment Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Cleverly Electrical Works.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Brush Electric Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Cleverly Electrical Works.
Consolidated Elec. Mfg. Co., The.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Greeley & Co., The E. S.
Holmes, Booth & Haydens.
Holtzer-Cabot Electric Co.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Union Hardware Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hard Rubber for Electrical Purposes.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Beardsley, Chas. S.
Brookfield, Wm.
Butler Hard Rubber Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Electric Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
Monitor Electric Co.
New York and Ohio Co.
Northwestern Electrical Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica
Munsell & Co., Eugene
[illegible]

Mining Apparatus, Electric
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Electrical Engineering Co., The
Electrical Eng. & Supply Co.
Elektron Manufacturing Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Barton & Brown.
Woodhouse & Rawson, Ltd.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Beardsley, Chas. S.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
Rochester Railway Co.
West End Street Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Electric Railway Specialty Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Universities.
Ohio State University.
Purdue University.

Wire, Bare.
American Electrical Works.
Beardsley, Chas. S.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Partrick & Carter Co.

CLEVELAND, OHIO. **THE NATIONAL CARBON CO.** CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY **MILLIKEN BROS.**

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

BEST MAST ARM IN USE.

More Lamps Trimmed. No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRON TOWER CO., FORT WAYNE, IND.

SEND FOR New American Electrical Directory, just published; very complete lists. Invaluable for its information of Lighting and Railway Plants.

COOLIDGE FUEL & SUPPLY CO.,

RAILROAD CROSS TIES AND PILING.

CEDAR AND OCTAGONAL PINE POLES.

CROSS ARMS, PINS AND BRACKETS.

—MANUFACTURED BY—

J. R. CLARK CO., Minneapolis, Minn.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

THE NEW CATALOGUE

—OF THE—

UNDERGROUND CONDUIT SYSTEM

Of the Interior Conduit & Insulation Company

IS NOW READY.

COPIES MAILED UPON APPLICATION TO

Interior Conduit & Insulation Company,

EDWARD H. JOHNSON, President.

GENERAL OFFICES, 42 & 44 BROAD ST., NEW YORK.
WORKS, 527 to 531 W. 34th St. and 526 to 528 W. 35th St.

H. M. UNDERWOOD, Gen. Western Agent, Rookery Building, Chicago.
B. FRANK JOHNSON, Gen. Agt. for Pa., Provident Bldg., Philadelphia, Pa.
THOS. DAY & CO., Gen. Agents for California, San Francisco, Cal.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 LOCUST ST., ST. LOUIS, MO.

BANNER WIRE.

OKONITE
TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 DELAWARE ST., KANSAS CITY, MO.

A NEW WEATHER-PROOF WIRE.

Double, Triple and Quadruple Braid.

This is the best finished, best insulated, most durable and generally the most satisfactory of all the ordinary weather-proof Wires. Send for samples before placing your construction orders.

PRICES LOW. SHIPMENTS PROMPT.

Also GENERAL WESTERN AGENTS for

OKONITE
TRADE MARK

AND

IMPROVED CANDEE WEATHERPROOF WIRES.

These Wires are positively the best of their respective classes.

BRANCH BLOCKS, SOCKETS,
MAIN CUT-OUTS, PAISTE SWITCHES
AND GENERAL ELECTRICAL SUPPLIES.

CENTRAL ELECTRIC COMPANY,

116 & 118 FRANKLIN ST.,
CHICAGO.

OKONITE
TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., OMAHA, NEB.

Connected by private wire with Postal Telegraph-Cable Company's System.

OKONITE
TRADE MARK.

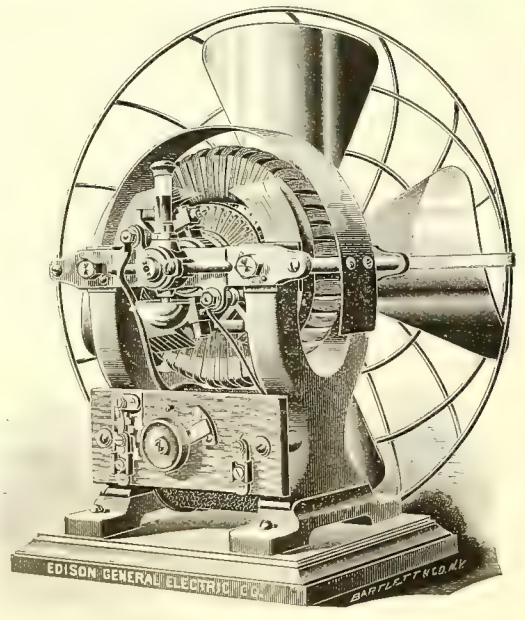
ELECTRIC POWER AND TRANSMISSION CO.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.

ELECTRIC FANS.

These Fans are operated by new Edison Slow Speed Motors, requiring Minimum amount of attention and lubrication.



They are compact and especially suitable for office desks and similar places.

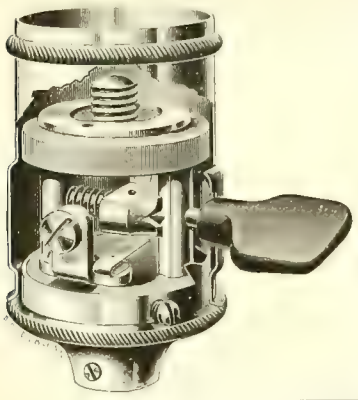
Will operate on any ordinary Lighting Circuit without Wasteful Resistance.

List Price, Motor and Fan, $42.50, less 45 per cent. to Users. Net, $23.36.

For Particulars Address Nearest District Office.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, 173 and 175 Adams St., Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.



CUT THIS OUT and send to us for SAMPLE of the

BEST SOCKET MADE.

Name

Address

THE UNION ELECTRIC MFG. CO., BRIDGEPORT, CONN.

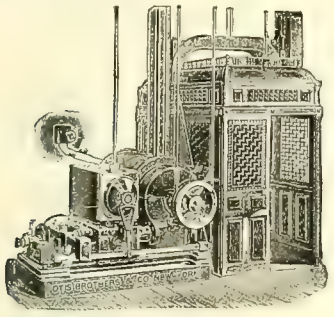
WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

PASSENGER AND FREIGHT

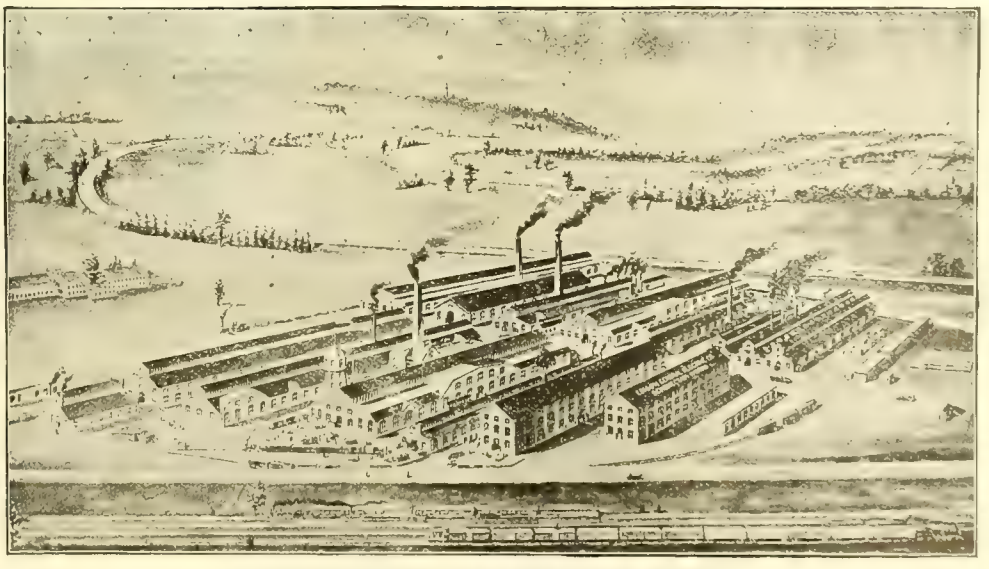
Hydraulic and Electric ELEVATORS.

SIEMENS CABLES.

Submarine,

Telegraph,

Underground,



Telephone,

Interior,

Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Wire Department, Edison General Electric Company,

EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

WESTERN ELECTRIC COMPANY, CHICAGO, NEW YORK, LONDON, ANTWERP, BERLIN, PARIS.

MANUFACTURERS AND DEALERS IN

Arc and Incandescent Electric Light Apparatus, Patterson Underground and Overhead Cables, I. C. Weather-proof Wire, Washburn & Moen's Hard Drawn Copper Trolley and Galvanized Iron Wires, House Goods, Testing Apparatus, District Telegraph Apparatus, Line Supplies, Tools and all other Electrical Appliances.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS. **WIRES.** You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK. G. H. MEEKER, Western Manager.

A NEW BOOK.

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

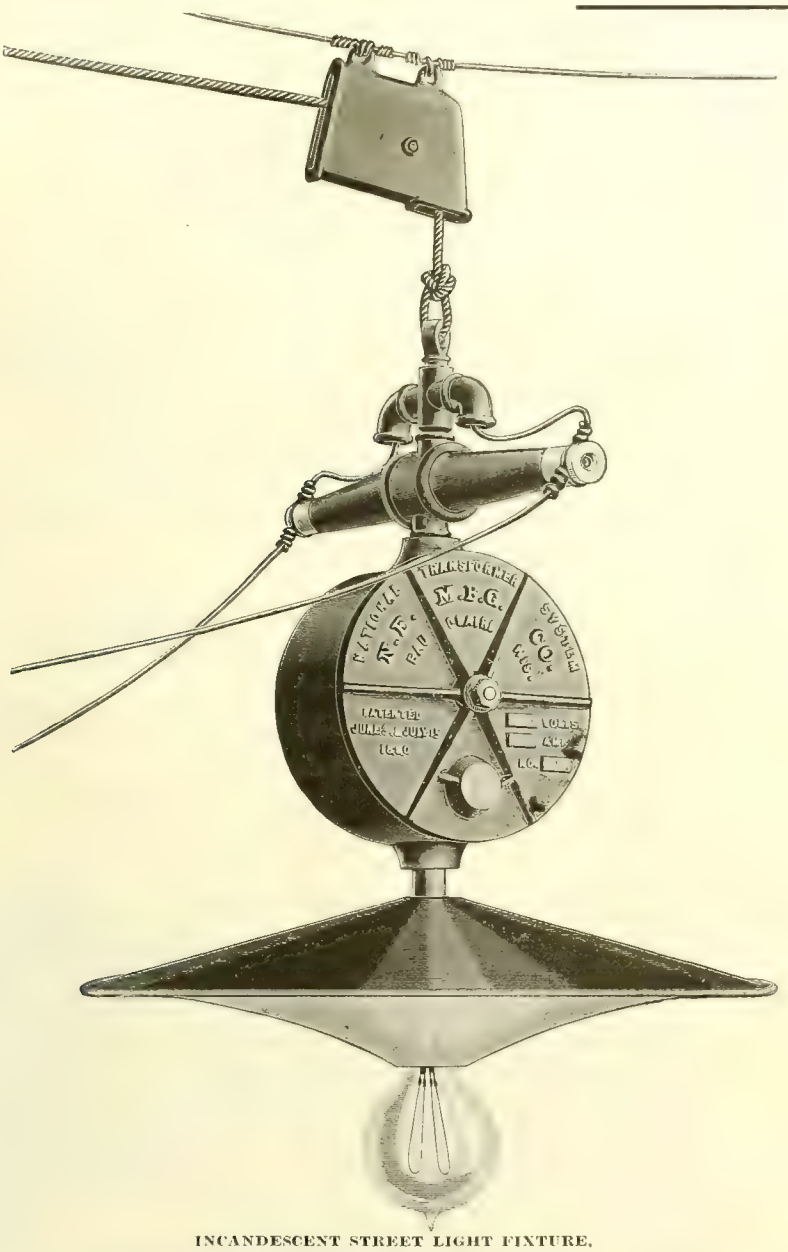
Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



INCANDESCENT STREET LIGHT FIXTURE,
SERIES TRANSFORMER, REFLECTOR CANOPY AND 32 C. P. LAMP.

WHY

USE ARC LAMPS

WHEN THE

NATIONAL

SERIES TRANSFORMER

ENABLES YOU TO DO

STREET LIGHTING

ECONOMICALLY
EFFICIENTLY
SATISFACTORILY ???

Send for Circulars and Prices.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

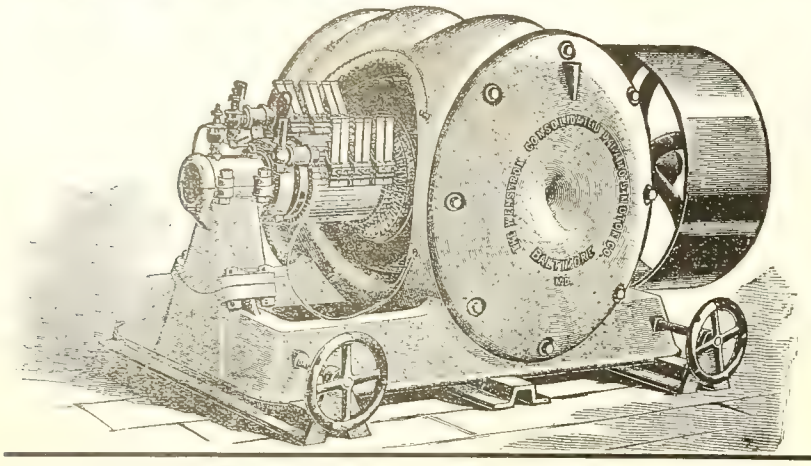
AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	**ST. PAUL, MINN.,**	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	**DETROIT, MICH.,**	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	**DENVER, COLO.,**	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	**WINNIPEG, MAN.,**	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	**SAN FRANCISCO, CAL.,**	National Electric Development Co.
LINCOLN, NEB.,	Lincoln Electrical Mfg & Supply Co.	**KANSAS CITY, MO.,**	Thomas Wolfe, 515 Main St.
SEATTLE, WASH.,	Chas. H. Baker & Co.	**DULUTH, MINN.,**	The Electrical Eng. & Supply Co.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES!

16 C. P Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

G. A. HARMOUNT,

MANAGER.

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

ESTABLISHED 1820.

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

MOONLIGHT SCHEDULE FOR 1891

IN THE NEW EDITION OF THE

Dynamo-Tenders' Hand-Book.

NOW READY. PRICE $1. SEND FOR IT.

ELECTRICIAN PUBLISHING COMPANY,

6 LAKESIDE BLDG.,

CHICAGO.

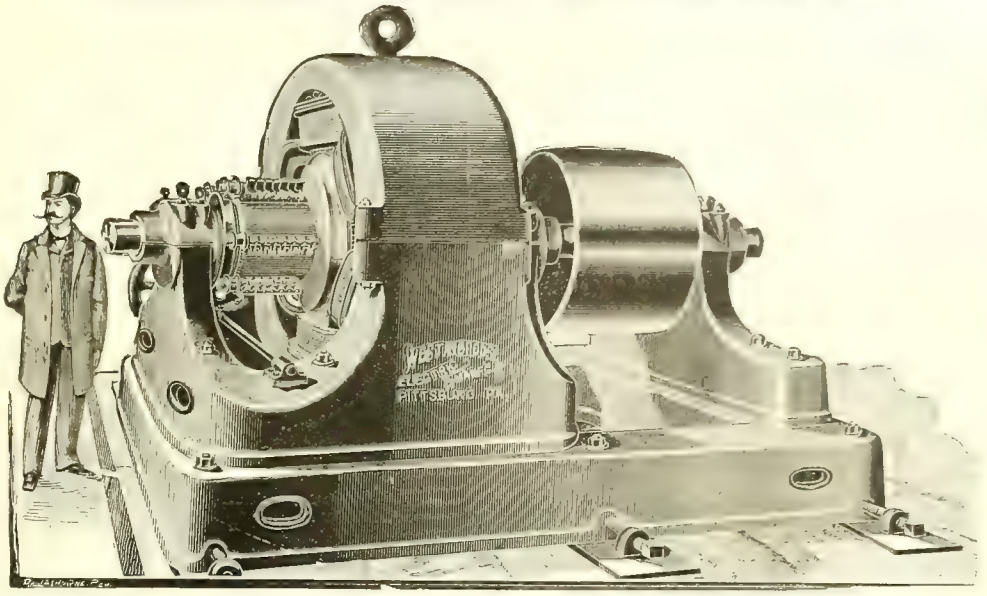
BRANCHES: 164 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 90 W. Monroe St. Chicago. | St. Louis, Mo.

WESTINGHOUSE
MULTIPOLAR STREET RAILWAY GENERATORS.

COMPOUND-WOUND. SELF-EXCITING.

Perfect Self-Regulation.

High Electrical Efficiency.



Slow Armature Speed.

No External Magnetism.

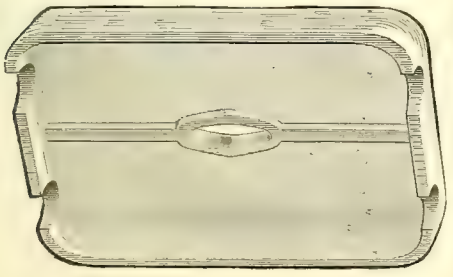
Self-Oiling Bearings.

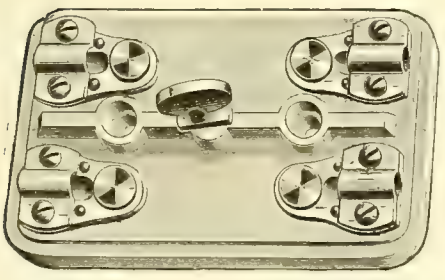
Descriptive Catalogues of Generators, Single-Reduction and Gearless Motors. and Power Station Appliances furnished upon application. Correspondence on all subjects connected with Electric Railways is solicited.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,

RAILWAY DEPARTMENT,

PULLMAN BUILDING, CHICAGO. PITTSBURGH, PA. 120 BROADWAY, NEW YORK





CUT-OUTS,

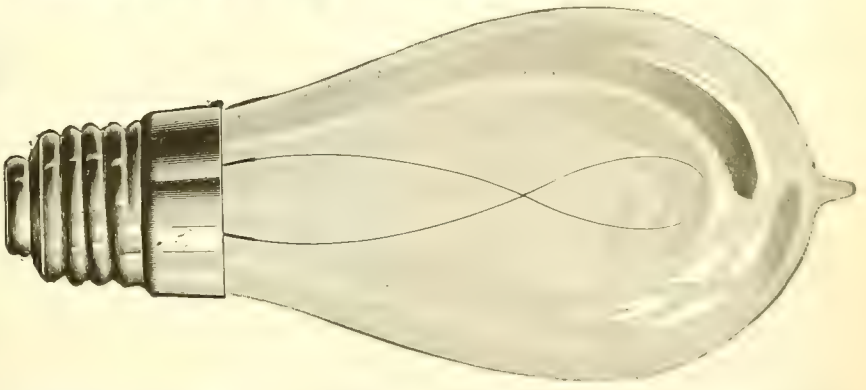
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

FOR SALE.

A 112-CALL

Western Electric Annunciator,

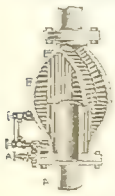
In good condition, and as good as new.

Address PRICE, $85.00.

SCHULMAN & REYNOLDS,

250 Walnut St., CINCINNATI, OHIO.

KNOW WHAT YOU'RE GETTING!



HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

A test of six of the best known "Separators" has recently been made at Cornell University. **Hine's Eliminator stands at the head.** The full report with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street, NEW YORK.

FOR SALE.

STREET CARS.

ONE HUNDRED 12-FOOT CARS,

Built by the John Stephenson Co. and Jones. One end type, with fare box in good order, gauge 4 ft. 8½ in.

Six Hundred Tons 38 lb. Tram Steel Rails and One Hundred 30 ft. Steel Poles.

ROCHESTER RAILWAY CO.,

ROCHESTER, N. Y.

PURDUE SCHOOL

—OF—

ELECTRICITY,

New Laboratory, fitted with best appliances, dynamos, alternating current plant, storage batteries and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue.

PURDUE UNIVERSITY,

La Fayette, Ind.

THE BALL & WOOD CO.,

OWNERS OF BALL PATENTS AND BUILDERS OF

Improved BALL Engines.

Office 15 Cortlandt St., New York.

W. B. PEARSON & CO., Agents, - Home Insurance Building,

CHICAGO, ILL.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

H. T. PAISTE,

MANUFACTURER OF

Paiste Electrical Specialties.

241 THE ROOKERY, CHICAGO, ILL.

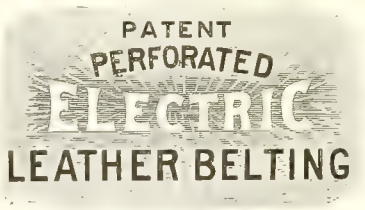
1201 MARKET ST., PHILADELPHIA, PA

PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.



Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

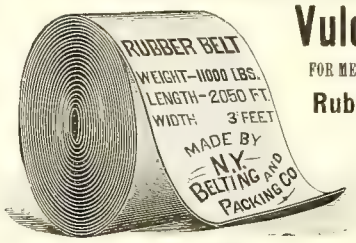
Also New York, Boston, Philadelphia, 46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

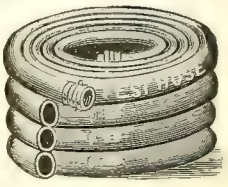
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 160 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 1624 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

From November 1, '90, to May 1, '91, the average cost per car mile for repairs to

SHORT ELECTRIC RAILWAY APPARATUS

In use on the Rochester (N. Y.) Railway Company's Lines was

$.0035.

THE BEST IS THE CHEAPEST.

REMEMBER That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

P AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, AUGUST 8, 1891. No. 6

Charles D. Shain.

Few men now in the electric lighting business are more deservedly popular than the subject of this sketch. Energetic and pushing, yet withal most courteous in his treatment of those with whom he is thrown in contact, Charles D. Shain has won alike the esteem not only of his business associates, but also of the large staff of employes under his personal direction.

Mr. Shain was among the pioneer representatives in the electric lighting business, and has traveled most extensively throughout the United States. A history of his varied business and engineering experiences shows him to be well fitted for his present responsible position. Like the most successful workers in the field, Mr Shain is a young man. Born in Philadelphia Nov. 8, 1855, he is therefore but 36 years of age. His school days were spent in Philadelphia. In 1872 he was graduated from the Central high school and commenced his business life as assistant to H. P. M. Birkenbine, the hydraulic engineer. While filling this position Mr. Shain was engaged on the surveys for the waterworks in Harrisburg, Lebanon, Bethlehem and other Pennsylvania towns. He was afterward employed on the engineer corps of the Johnstown & Somerset railroad. In 1873 he was appointed assistant engineer in charge of the construction on the Jefferson division of the Texas & Pacific railroad. The company, however, became financially embarrassed and the young engineer concluded to embark in a commercial venture. Accordingly he organized a party and equipped the members with an outfit for trapping, and engaged in trading with the Indians. His expedition started out early in the fall, but returned in the spring. It was not a success, and, aside from the many hardships and mishaps which befell the party, it was a failure financially, and the promotors were left in an unenviable position.

From the far West Mr. Shain drifted to Galveston and thence to Havana. He was in Cuba at the time when the United States fleet was off Havana awaiting developments in the Cuban troubles. In the spring of 1874 he returned to Philadelphia, where he engaged in engineering work on the Centennial buildings. When this contract was nearing completion he again decided to try his luck in a commercial enterprise, and accordingly returned to Philadelphia. This time he engaged in the brokerage business. The second venture was successful, but in 1880 his love for engineering led him to sever his mercantile connection and accept a position as superintendent of a New York mining company, in which he was largely interested. His mining work led him into California and Arizona, but mining in those days, on account of the restlessness of the Indians, the high price of labor, fuel, etc., was by no means an alluring occupation. So, when the position of assistant engineer on the Toledo, Cincinnati & St. Louis railroad was tendered him, it was accepted, and he then located in St. Louis. After holding the position of chief engineer of the Burlington & Ohio River railroad, Mr. Shain went to Chicago and commenced his work as a pioneer in the business with which he has since been so prominently identified.

The majority of the readers of the WESTERN ELECTRICIAN are familiar with Mr. Shain's rapid advancement since his coming to Chicago. He entered the field with the old United States Electric Lighting company at the time that concern opened its Chicago office, and filled various positions with the company until he was finally made assistant to the Western manager. At the time of the lease of the United States company by the westinghouse people, the latter company showed its appreciation of his ability by making Mr. Shain its general district agent. But he had hardly settled in Cincinnati as the representative of the Westinghouse interests, when a favorable offer was received by him from the Edison people, and Mr. Shain then associated himself with H. Ward Leonard, general manager of the United Edison Manufacturing company, with headquarters in New York. Another promotion followed shortly, and at the present time Mr. Shain is eastern district manager of the Edison General Electric company, having been appointed to that position by Second Vice-president Samuel Insull.

Mr. Shain is prominently identified with the New York Electric club, being one of its board of managers.

CHARLES D. SHAIN.

Tapping Telegraph Wires in Chicago Conduits.

It is charged that the bucket shop men of Chicago obtain the board of trade quotations by tapping the telegraph lines laid in the conduits. C. H. Wilmerding, president of the Conduit company and secretary of the Chicago Arc Light & Power company, has been interviewed on the subject. "Our franchise does not permit us to refuse to lease our wires to any one," said he. "We only ask whether applicants need them for telegraph or telephone purposes, and there our inquiry as to the nature of their business ends. I know there are several bucket shop men who use our wires, but we cannot stop them unless they are doing something illegal, such as tapping wires in order to get the quotations. As soon as we find out that anything of that kind is being done we shall dissolve the contracts. Our price is high, solely to keep bucket shop men out, but they do not seem to stop at money and they pay us for our wires."

New Use for Electric Light.

The utility of the electric light is demonstrated in a new phase, the ingenuity of which is apparent to those who patronize the cable routes through the North or West Side tunnels, Chicago. Passengers on the cars as they whirl past the whitewashed walls are suddenly startled at the sight of distinctly shadowed letters. If one looks carefully about, he may see suspended from [illegible] wire placed [illegible] such a position that the glare from the electric light will throw into bold relief on the side wall a much enlarged but perfectly distinct shadow of the advertisement. As bill-posting is not allowed in the tunnels this new device enables the far sighted merchants to advertise on the forbidden walls and yet obey the letter of the law; although it is an open question whether or not a shadow may be said to be posted.

Old Time Telegraphers.

The eleventh annual reunion of the old time telegraphers will be held at Washington Wednesday, Aug. 19th. It promises to be of unusual interest. Many notable guests will be present, including Mrs. Roswell Smith, wife of the president of the *Century* company. When Prof. Morse was endeavoring to secure an appropriation from congress for the establishment of a telegraph system, Mrs. Smith, then Annie G. Ellsworth, a daughter of the commissioner of patents, was an enthusiastic advocate of the professor's claims. It was she who first announced to Morse the fact that the bill in which he was so greatly interested had been passed by the senate. On receiving the news Prof. Morse promised his informant that she would have the honor of sending the first message over the new line from Washington to Baltimore. When the time arrived Miss Ellsworth was summoned and invited to indite a message for transmission. She immediately wrote the words: "What has God wrought?" When it was transmitted the strip of paper on which it was written was claimed by Governor Seymour of Connecticut in honor of the lady, who was a native of that state, and as Prof. Morse was educated there.

There will be many others in attendance whose recollections of the first days of telegraphy in this country will add much to the interest of the occasion.

The United States Military Telegraph corps will hold its convention at the same time as the "Old Timers." The organization embraces those who comprised the United States Telegraph corps during the late war.

At the conclusion of the business meetings of the organizations the members join hands and celebrate the remaining festivities conjointly, since many of the members of the one organization belong also to the other.

George C. Maynard of Washington, D. C., is the president of the "Old Timers," Col. W. R. Plum of Chicago is the president of the Military society, and J. E. Pettit of the Postal Telegraph company, well known to many Chicagoans, is its secretary and treasurer. Mr. Pettit is a member of both organizations, and, together with Col. Plum, founded the Military society

Following is the programme as at present organized:

August 19th, [illegible]—Business meeting of Old Timers' telegraphers' association.

August 19th, [illegible]—Business meeting of United States Military Telegraph corps.

August 20th, [illegible] societies, opportunity will be given [illegible] Capitol, Museums, Mount Vernon [illegible] interest.

The American Association for the Advancement of Science will meet in Washington on the same day that the societies meet. Many prominent men who are connected with telegraphy belong to the American association, and their presence will add to the interest of the occasion. In connection with the reunion there will be a loan exhibit of historical telegraph [illegible] articles are to be sent [illegible] properly labeled, to Geo. C. Maynard, 1309 New York avenue, Washington, D. C. [illegible] before the meeting. The National Museum has offered to

provide space and cases in the electrical section for this exhibit, and it promises to be an important feature of the occasion.

Electrical Signaling on Board the Chicago in New York Harbor.

The White Squadron made a hit as far as New York is concerned. The metropolis has been agog over the manœuvers of the cruisers. The daily papers devoted columns of space to descriptions and diagrams innumerable relating to the evolutions of the vessels. But the electric search light drill brought the growing enthusiasm to its height. Whether the interest was directly due to the mention of the magic word electric, ever so fascinating and attractive to the curious, or whether it was that the New Yorker's mid-summer evening hangs heavily, is hard to say. In any event the display on the North River was one which the New York dailies asserted to be the sight of a lifetime.

The drill took place on Thursday evening, July 23d. The squadron was anchored so that a good view of the spectacle could be had from the New York shore between Twenty-sixth and Fortieth streets. The night was cloudy, but in spite of the threatening aspect of the heavens, thousands crowded the houses along shore, and the docks and vessels, not to mention the more favored observers who found desirable points of view on board the innumerable small craft out in the stream. One New York daily went so far as to estimate the number of spectators who witnessed the electric signaling, as being more "than there are people in the state of Montana." The signal to commence the exercises was given from the Chicago at 9 o'clock and the display was over at 10:15.

FIG. 1. ELECTRIC SIGNALING ON BOARD THE CHICAGO IN NEW YORK HARBOR.

As has already been stated, numerous accounts of the proceeding have appeared. But, to the electrical man, interested more particularly in the apparatus with which the signaling was carried on, the vivid descriptions which must of necessity accompany such startling head lines as "Flashes of Fire Shoot from the Cruisers" can but be more or less unsatisfactory. With the object, then, of giving the readers of the WESTERN ELECTRICIAN a glimpse of the Chicago's electrical equipment as it appears to the visitor on board the ship, a representative of this journal, through the courtesy of Captain J. W. Miller and Lieutenant Sperry, secured the accompanying views.

Figs. 1 and 2 show the Chicago's search light and the [illegible] in the Ardois electric system of night [illegible]. Fig. 2 is taking in the Ardois apparatus [illegible]. The Ardois operating stand, or keyboard, and the five lanterns hung in the rigging, through which [illegible] may be clearly distinguished [illegible]. Fig. 3 shows the interior of the conning [illegible], the wheel house [illegible]. [illegible] get an idea as to the arrangement [illegible] each gun after the primer has [illegible] for firing. In this view it [illegible] Cape. Mounted [illegible] Mangin projectors made by Sautter, Lemonnier & Co. of Paris. The carbon holders in this instrument are set at an angle of forty-five degrees so that a better distribution of the light from the crater in the carbon may be obtained on the reflector behind. The lamp is fed by hand. The Mangin projector consists of a concavo-convex lens, the convex surface being the one of greater radius. The latter surface is silvered. The radii of curvature of the faces are so calculated that the two refractions at the concave surface destroy almost all aberration. It is claimed that this gain counteracts the loss by reflection. The beam has a divergence of but two degrees. The weight of the sixty centimeter search light complete is 1,301 pounds. The light is said to equal that of 23,000 candles.

The dynamos furnishing current to the search lights are located in a small room on the berth deck. They are on the same bed plate with the engine driving them. These machines are series wound Gramme dynamos. A glance at Figs. 1 and 2 will help the reader to understand the Ardois method of night signaling with lanterns. In this system five lanterns are employed. These are hung in the rigging, as shown in Fig. 2, and in each one there are two incandescent lamps which can be controlled from the operating stand on the bridge. One lamp in each lantern is behind a red globe, and the other is covered only by plain white glass. By this construction any lantern may be made to show either red or white. The leads from these signal lamps unite into one cable, and connect with the operating box on the bridge. In the controlling box on the bridge, Fig. 1, there is a circular plate carrying contacts, and marked with little dots of paint to indicate the combination of colored lights constituting a given signal. By moving around a needle or pointer which is pivoted on the center of the dial to the code word desired, and turning on the current, the proper combination of lights appears in the rigging. The following will give the reader an idea as to the combinations employed in the message which was spelled out after the recent search light drill. The lanterns were read from the bottom to the top:

T	Red	Red	White	White.
H	Red	White	White	
E	Red	White	Red	White . . . White.
D	Red	White	Red	White . . . Red.
K	Red	Red	White	Red . . . White
I	Red	White	White	Red.
L	Red	White.	White	White.
L	Red	White	White	White
S	Red	Red	White	Red . . . Red.
H	Red	White	White.	
A	Red	White	Red.	
V	Red	Red	White	White . . . White.
E	Red	White	Red	White . . . White.
B	Red	White	Red	White.
E	Red	White	Red	White . . . White.
E	Red	White	Red	White . . . White.
N	Red	White	White	White . . . White.
S	Red	Red	White	Red . . . Red
A	Red	White	Red.	
T	Red	White	White	White
I	Red	White	White	Red
S	Red	Red	White	Red . . . Red.
F	Red	White	Red	Red . . . White.
A	Red	White	Red.	
C	Red	White	Red	Red.
T	Red	Red	White	White.
O	Red	Red.		
R	Red	Red	White	Red . . . White.
Y	Red	Red	Red	White . . . Red.

It is understood that the display of this system in New York harbor was the first to be made public in this country. The Ardois system has been in service, however, on the White Squadron since last January.

The gun firing system in use on the Chicago has also a number of interesting features. In the conning tower, Fig. 3, there are sighting vanes which enable the captain to determine when the enemy's vessel is on a given bearing. Each gun, through these vanes, is laid at a proper angle of train so that the fire will be concentrated. Referring again to Figs. 3 and 4, the operation of this system, which is simplicity itself, will be understood. At the gun there is the double conductor cable fitted at one end with a primer connection, Fig. 6, and the other end terminating at a socket in the deck above. In this cable there is a circuit closer which the gun captain holds in his hand. Over each gun as shown there is an incandescent lamp which is in circuit with the cable. In making ready, the gun captain inserts the primer and arranges the cable as indicated. The gun is now ready to be fired. In the conning tower there is a row of push buttons just beneath the row of lamps. These lamps are used as indicators, and the push buttons control the current for firing the guns. Assuming for the sake of illustration that the gun shown in the cut has been loaded and is now pointed at the enemy, the gun captain, circuit closer in hand and with his eye along the sights, notices whether the aim is correct. If the gun is properly sighted, he closes the current. This action brings the lamp overhead to redness, indicating a completed circuit. At the same time a lamp on the same circuit, but in the conning tower, reddens, and this is the gunner's signal to the captain of the ship that this particular gun is ready. Should a gun captain notice the line of sight to be off the target, a touch of the button opens the circuit and signals the captain in the conning tower. When it is desired to fire the gun the captain of the ship presses his button, and this short circuits the indicator lamp in the tower, and also its German silver resistance. Practically speaking, the only resistance now in circuit is the lamp at the gun, as the current flashes up to the firing strength and the discharge takes place.

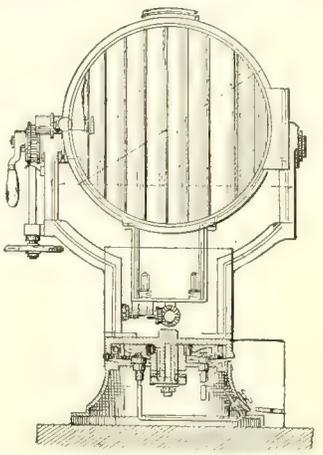


FIG. 7. ELECTRIC SIGNALING ON BOARD THE CHICAGO IN NEW YORK HARBOR.

The primers in use are of the same electrical dimensions as those employed for the service torpedoes. Their hot resistance is .05 ohm. Edison 24 candle power high economy 106 volt lamps are used. In addition to the two lamps in series in each circuit, there is also a German silver resistance of 175 ohms, which keeps the test current down to .18 ampere. With the current just mentioned the lamps give light enough to serve as indicators, but are not sufficiently bright to reveal the ship's position to the enemy. Okonite insulation is used on the conductors of the system.

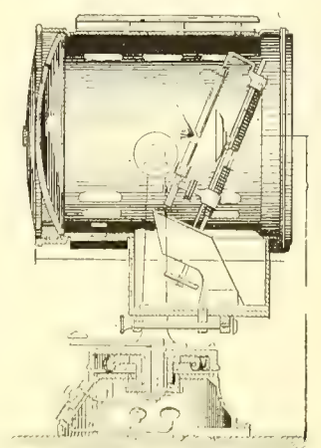


FIG. 8. ELECTRIC SIGNALING ON BOARD THE CHICAGO IN NEW YORK HARBOR.

The advantages of the electric firing system will be appreciated, for through it a broadside or any one gun can be fired from the conning tower.

The motor shown within the gun carriage, Fig. 5, is

used for training the gun. This machine is an old style 5 horse power Sprague motor wound for 105 volts, and when running under maximum load it takes 40 amperes of current. It is series wound. The reversal of the direction of rotation is accomplished by changing the direction of current through the armature. By throwing a clutch the gun can be trained by hand.

Electricity at the World's Fair.

It has been decided to locate the temporary power house at Jackson Park 100 feet south of the site of the transportation building. Engines and boilers sufficient to furnish 600 horse power have been loaned to the exposition authorities without charge, and so there will be no expense on this score.

Electrical Engineer Sargent of the construction department, representing Chief Burnham, issued circulars inviting bids for the temporary electrical plant over two weeks ago. These were mailed to all the prominent electrical companies of the country, eighteen or twenty being sent out. Mr. Sargent asked for bids for an installation capable of supplying 100 arc and 250 incandescent lights, together with a 80,000 watt generator for a motor circuit and such motors as may be necessary. This machinery is to be installed and rented to the exposition authorities until January 1, 1893.

This circular emphasized and increased the friction existing between the departments of electricity and construction. It was asserted on the part of the officials of the former that the circular was issued entirely without their knowledge. Some of the companies receiving it refused to put in bids, on the ground that propositions for the installation of electrical machinery should come from the head of the electrical department and not from the construction department. It was contended that one of the chief considerations that resulted in the appointment of Prof. Barrett was that he was free from entangling alliances with any of the electrical manufacturing or supply companies, and that he was thus peculiarly fitted to preside over the department. On the very first occasion, however, when impartiality needed to be assured, it was added, the task of supervising the letting was taken out of the hands of the man with whom all the companies were satisfied. There was talk of a petition to the board of directors of the exposition asking that all contracts for electrical supplies be made through Chief Barrett.

Before this Mr. Sargent had talked of resigning his position as consulting electrical engineer to the department of construction. As can easily be conceived, the place was, and is, a delicate one, combining tendencies that are now pulling in opposite directions. It is not strange that Mr. Sargent should be willing to resign it, especially as he could well afford to devote all his time to his private business. After the circular was issued, and the ensuing dissatisfaction was openly expressed, on July 23d, Mr. Sargent did actually send in his resignation to Chief Burnham. On the same day the two gentlemen named had a long conference, however, and the upshot of it was that Mr. Sargent withdrew his resignation. He now declares his determination to stay in his present position until the fair is over.

This is the situation as it is to-day, and this is why so little, comparatively speaking, has been accomplished in the electrical department of the World's Fair. In plain words, Chief Burnham and Mr. Sargent on one side and Prof. Barrett and Mr. Keller on the other have widely divergent views as to who should have charge of work in which both departments are interested, as in the case of the temporary plant. On the one hand it is urged that the work is clearly a phase of the general construction, while on the other it is asserted that, as it is purely electrical in character, it should be designed and supervised by the electrical department, only the actual work of construction falling within the scope of Chief Burnham's department. This state of affairs cannot fail to work injury to the department of electricity. Indeed, it has already done so. It is with the hope of hastening a happy solution of the difficulty that the WESTERN ELECTRICIAN has endeavored to set forth the facts clearly and impartially, without assuming to lay the blame on any one. But there should be some clear understanding by which these vexatious delays and disagreements could be avoided. There is enough work to be done, without the representatives of different departments contending with each other. The matter has already been called to the attention of the executive committee. It is to be hoped that it will speedily arrive at an equitable basis of adjustment.

A realistic miniature model of the World's Fair is now on exhibition at the old exposition building on Michigan avenue. It covers an area of [illegible] square feet at the south end of the building. The model occupies the center of the room and is about level with the floor. The low roof has seventy-five incandescent lights, which give the effect of

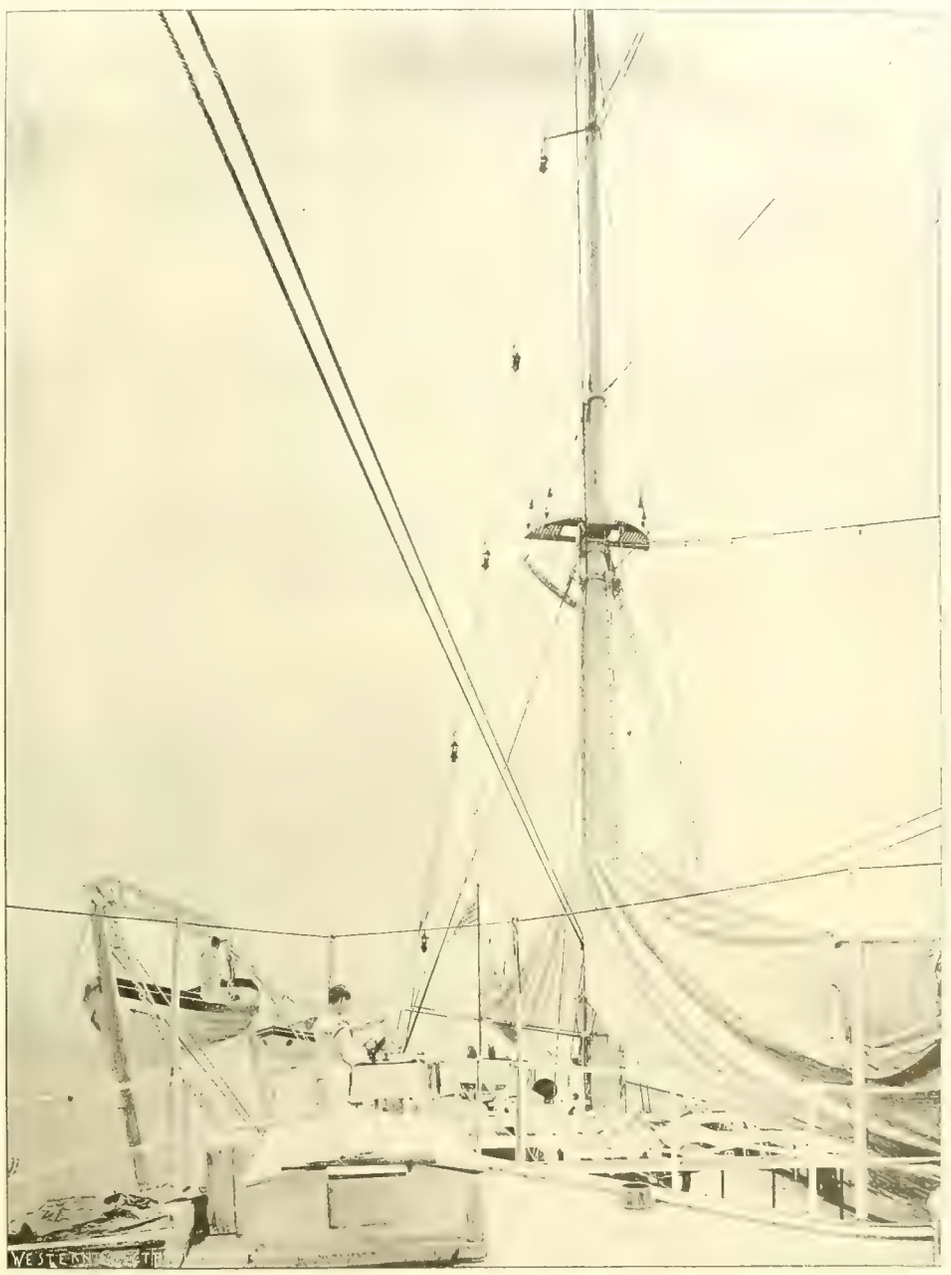


FIG. 2 ELECTRIC SIGNALING ON BOARD THE CHICAGO IN NEW YORK HARBOR.

weary of looking at the miniature are given a chance to [illegible] the lights changing auto-

Construction company fur-

equipment. Mr. Phillipson, one of the originators of the design, asserts that this is the finest spectacular elec-

George Cutter has invented an automatic motor starter, by which, he says, all the motors at the exposition could be started at once by one person pressing a button—[illegible] Washington.

One of the "Exposition Notes" of the *Chicago Tri-*[illegible] of August [illegible] as follows: "The application of the Day Electric railway company for space in which to operate its railway has been referred to Chief Burnham."

London *Industries*, a leading English technical paper, has this to say of the World's Fair: "Chicago is under the disadvantage of being a thousand miles by rail from New York, the port at which European visitors and goods will chiefly arrive, but it is the chief commercial center of the great states of Illinois, Indiana, Kentucky, Iowa, Wisconsin and Minnesota, and its recent increase in wealth and population has been without precedent, even in America. It has already become a great seat of manufactures, for the conduct of which the nearness of coal and iron supplies [illegible] and its [illegible] will furnish the exhibition with [illegible] When these considerations are taken into account, it [illegible] the Chicago exhibition will in many repects surpass all [illegible] held."

But little is being done on the subway scheme until the plan and location [illegible] Mr. Sargent says that [illegible] employed in [illegible] and paths [illegible]

The [illegible] arrival of the [illegible] beginning [illegible] Further evidence of the work of the visitors is shown in the [illegible] electricity building at the World's Fair, of which the [illegible] temporary, however, failed to give credit for the cut. Possibly [illegible] from the [illegible]

World's Fair officials and adopted by them, not, however, until it had been published in this journal, May 9th.

Three bids for supplying the temporary plant at Jackson park were opened last Monday. They were from the Thomson-Houston Electric company, the Edison General Electric company and the Western Electric company. The award was not made at that time, however.

Col. Clowry's committee on electricity held a meeting on Monday afternoon at Chief Burnham's office. Prof. Barrett and Secretary Hornsby, representing the department of electricity, were present. The relations of the two departments were discussed, and various propositions were advanced, but no conclusion was reached, the committee adjourning to meet on Tuesday at 2 P. M., in the office of the electrical department.

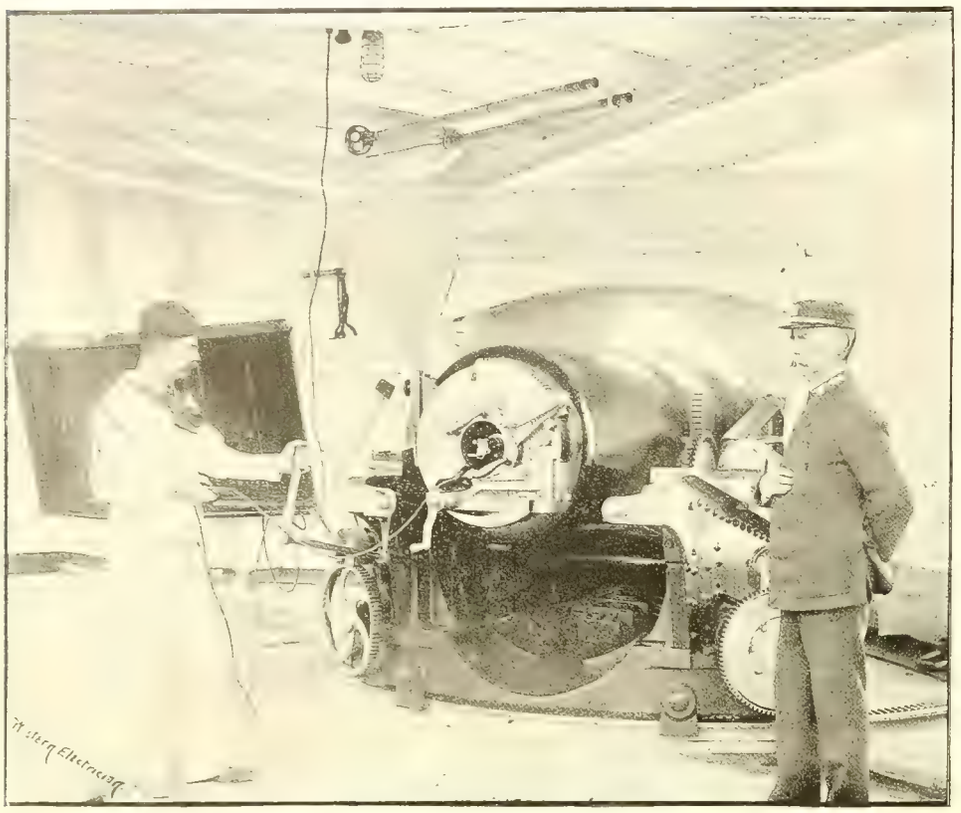


FIG. 4. ELECTRIC SIGNALING ON BOARD THE CHICAGO IN NEW YORK HARBOR.

Chicago Electric Club.

The mid-summer season, though not conducive to laborious scientific discussions, has not, however, lessened the interest of the members of the Chicago Electric club in the recently rearranged club rooms. The fact that the attend-

FIG. 3

Edison Station at Riverside, Ill.

The contracts have just been signed by which the Chicago Edison company will furnish the entire electrical equipment for the Riverside Edison company, which has recently been organized with a capital of $40,000. Riverside is a pretty suburb of Chicago, about twelve miles west of the city, on the Des Plaines river. The new central station will have a capacity of supplying 1,080 incandes-

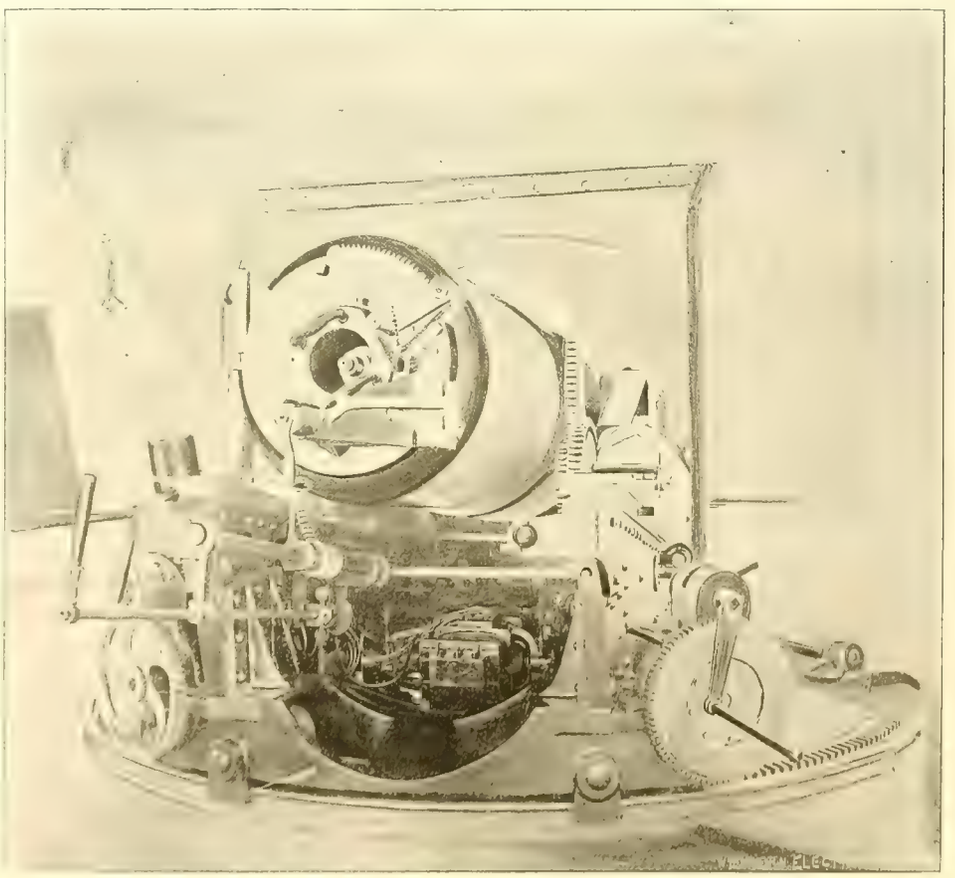


FIG. 5. ELECTRIC SIGNALING ON BOARD THE CHICAGO IN NEW YORK HARBOR.

Electric Motors for Switching and Suburban Traffic on Steam Railroads.

As a rule the steam railroad journals of the country have been very conservative in commenting on the application of electric motors to railway work, other than in the line of street cars. The following editorial, therefore, from the *Railroad Gazette*, second in influence to no paper of its class in the United States, will be accepted as significant:

"There is renewed activity among electric motor companies in matters pertaining to large motors for heavy work, such as switching freight in cities where smoke is objectionable and for elevated roads. Two of the largest companies believe that they have solved the problem, and

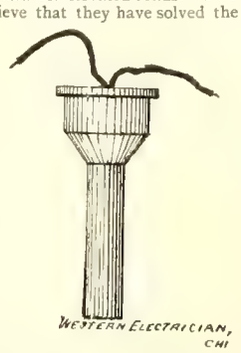


FIG. 6 ELECTRIC SIGNALING ON BOARD THE CHICAGO IN NEW YORK HARBOR.

one of them will at once build a motor with a capacity ranging from 500 to 700 horse power and a hauling power equal to any steam locomotive with 45,000 pounds on the drivers. This has been rendered practicable by recent improvements in motors, of which the slow-moving armature and the subdivided field are probably the most useful for heavy work. Railroads in such cities as Chicago, where a city ordinance prohibits the use of locomotives that emit smoke in any considerable amount, are now compelled to use a non-smoking fuel, such as coke or anthracite, or put on a device for preventing the formation of smoke, the action of which is acceptable to the city inspector. As such devices are more or less ineffective, even in their best form, it has been found necessary on at least two Chicago roads to resort to anthracite coal, at a cost of $4 to $4.50 per ton on tender, to meet the requirements of the law. Where steam costs at this rate it cannot be difficult to construct an electric motor which will work with at least equal economy, as cheap coal can be used in the stationary plant which furnishes the electric current. With such advantageous conditions, the difficulties in the way of the use of the electric motor for suburban work are mainly in the mechan-

ical devices in the motor itself and the arrangement of the conductors. The electric companies feel sure that they have now removed all these difficulties, and they will make a trial of a heavy motor to prove what can be done. When the railroads of this country are assured that an electric motor of sufficient power to switch trains at terminals and to haul suburban traffic can be built of as simple design as those now used for street railroads, and can be run with reasonable economy of fuel, there will be no lack of opportunities for trial on a large scale."

Electric Lighting in Paris.

Electric lighting in Paris has lately made rapid strides, and several large central stations have been erected dur-

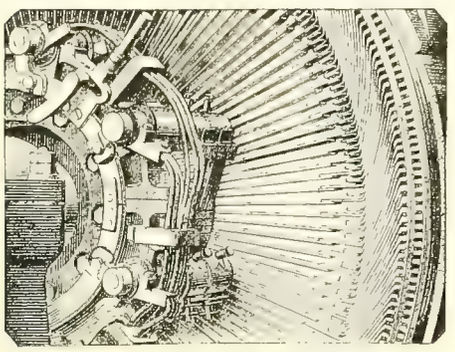


FIG. 2. ELECTRIC LIGHTING IN PARIS.

ing the last year. The great station at Rue des Dames de Batignalle has already been illustrated and described in the WESTERN ELECTRICIAN, and in this issue are presented views showing work at the new station at Faubourg Montmatre, which is furnishing lightts on many of the great boulevards and the adjoining streets and avenues. The building is a large iron structure, with an adjoining basement utilized for a boiler room, in which there are four high pressure boilers, furnishing steam for four 300 horse power triple expansion vertical engines, coupled to four large multipolar dynamos. The front part of the building is used for switchroom, storeroom and offices. Room is also provided for adding a large accumulator plant, which is now being considered. The generators employed in this station are of a special design, and are multipolar double dynamos. Fig. 1 gives a perspective view. The machine is composed of a double ring armature, each ring having its own field of induction and its

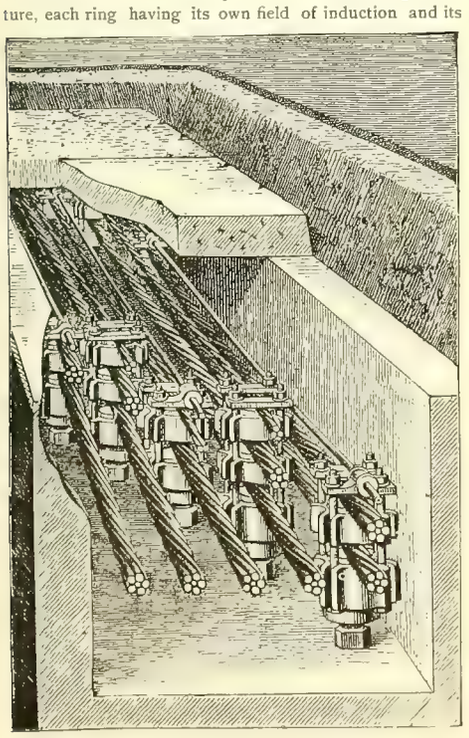


FIG 4. ELECTRIC LIGHTING IN PARIS.

own commutator, so that it actually comprises two dynamos united on one shaft. The advantage of this, it is claimed, is found in the greater uniformity obtained in operating the dynamos on the three-wire system, than could be secured in coupling two separate dynamos in series. This double dynamo requires a 300 horse power engine to operate it and furnish 1,000 amperes at 125 volts. It is operated at 130 revolutions. The diameter of the armature is five feet four inches. The iron core is laminated, and has the shape of a Gramme ring, but the mode of winding is similar to the Siemens multipolar dynamo. Its winding consists of only one layer of square copper bars, covering both the outside and the inside of the ring; these are joined at their extremities by flat copper strips running in a curve to the right on the front of the armature, and at the junction of this are connected with radial copper strips leading to the commutator. On the inside between the two ring armatures the copper bars of both are connected in such a way as to form a continuous circuit. The field consists of eight poles, and is built as a concentric ring of eight electro magnets, of 8¼ inch diameter, with a winding of eight layers of No. 8 wire B. & S. gauge. The pole pieces are large, and joined together in pairs, thus forming a ring which surrounds the exterior of the armature. The exciting current for the field magnets, which are connected in series, is taken from the bus bars of the switch-board, and amounts to 25 amperes or about two per cent. of the total output. The commutator is large, its diameter being about one-third of the armature. It is furnished with eight sets of brushes coupled in multiple. Fig 2 shows a section of the armature and commutator, showing the setting and arrangement of the brushes. The efficiency of this dynamo is claimed to be high. An important feature claimed is that it will endure a very long run without heating on account of the large heat radiating surface of the armature.

On account of the arrangement of this double dynamo the two armatures always work together, and consequently the arangement of the switch-board is made on the same principle, so that meters and switches always appear in pairs. Fig. 3 represents the switch and meter arrangement, *E E E* being the bus bars composed of heavy round bars clamped together, while *F F* represent two

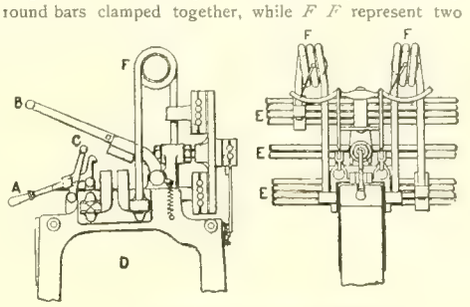


FIG. 3. ELECTRIC LIGHTING IN PARIS.

ampere meters, remarkable for their simplicity of construction. A heavy copper wire is turned so as to make three sections of a spiral. Through the center turn is bored a small hole which supports an axle carrying a spool of fine wire in the center of the coil. On the outside is an indicator needle showing by deflection the amount of current passing through the spiral. The switch is so arranged as to break both the distributing current from the dynamo and also the exciting current for both fields. In closing the switch *B* is pressed down and forms the connection between the brushes and the bus bars. At the same time the catcher *C* on the lever *A* clasps a protruding point on both sides of the main lever, keeping it in position and making the connection for the field. In opening the switch *A* is pressed down until the catcher detaches itself and the lever *B* flies up by the action of a spring.

The distribution of current is carried on through an underground conduit, Fig. 4. This is built of cement. In the bottom of this conduit are five rows of iron posts placed at intervals of fifteen feet. On these posts are porcelain insulators held by four iron bolts. On and between these insulators are suspended bare copper cables.

The conduit is covered by slabs, cemented together to prevent surface water from soaking through. The merits of this system are cheapness, high insulation and great facility in handling and splicing the cables. The heavy feeders are placed nearest to the bottom of the conduit, and the mains and service wires in the upper rows so that the work of replacing a cable with one of heavier size is a comparatively easy task.

The station at Montmatre has been in operation only a short time, but is already taxed to the full capacity, so that an extension of the plant is now under consideration. The illustrations are reproduced from *Electricite*.

THE BOOK TABLE.

PRIMARY BATTERIES, by Henry S. Carhart, A. M., Professor of Physics in the University of Michigan. Published by Allyn & Bacon, Boston. 103 pages, 67 illustrations, type page 3½x5½. Price $1.50.

This is probably the only book in the English language which gives the principles involved in the construction, operation and theory of primary batteries systematically arranged. It will be of great value to students and all those who have anything to do with primary batteries in practical use or in laboratories.

The book gives the latest theories relating to voltaic [illegible] is well printed and profusely illustrated.

Accumulators in Belgium.

[illegible] read with interest: "The judgment given against M. Gadot and his colleagues in the proceedings with reference

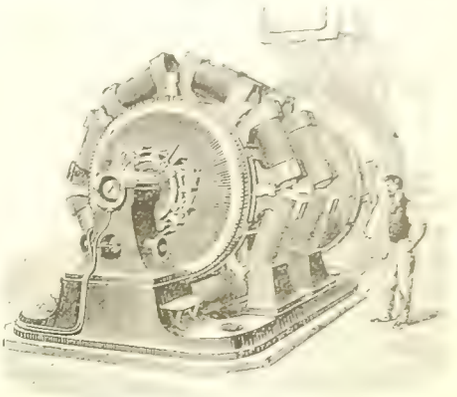
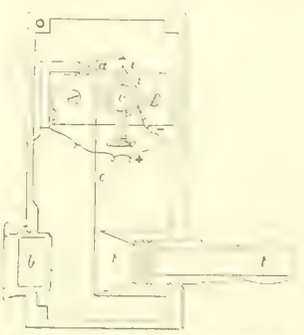


FIG. 1. ELECTRIC LIGHTING IN PARIS.

to accumulators has been confirmed in the higher court, and much uncertainty has thus been removed. The Julien company, which owns the F. S. V. patents in this country, is extending its operations. M. Julien has obtained the right of using the Faure patents throughout the continent. Some large transactions are under discussion, and an improved type of apparatus is about to be manufactured. M. Julien has already received many requests for the right of making use of these patents. M. Julien first introduced accumulators in Belgium, and after overcoming various difficulties, he now seems likely to be thoroughly successful."

Apparatus for Indicating Variations of Pressure in Gaseous Currents.

In the accompanying diagram is shown the method of operating an electrical device invented by G. and L. Richard for the purpose of indicating automotically slight variations of pressure in currents of gas. It is very small but extremely sensitive, being capable of responding to variations of pressure which are no greater than the pressure of a column of water a few hundredths of a millimetre in height. The essential features of this apparatus are as follows: A metallic box is placed in communication by



APPARATUS FOR INDICATING [illegible] PRESSURE IN GASEOUS [illegible].

means of a tube *t* with the conduit through which the current of gas is passing. The tube is closed by a clack valve *c*, made of light metal, movable around an axis *x*, and balanced in such a way that when the pressure is lower than the limit for which the apparatus is set, it remains, closing an electric circuit [illegible]. In this circuit a coil may be placed. A box [illegible] charged with cotton [illegible] events dust and similar matter from entering the mechanism. Suppose a lowering of the pressure to take place, then the clack-valve *c* closes the orifice of the tube *t* and the circuit is thus open and the current no longer passes. The apparatus is capable of having its sensitiveness modified to suit any given circumstance. It is capable of many industrial applications. For example it may be applied in order to regulate ventilation; also to certain forms of slow-combustion stoves, etc. [illegible] from the London

[illegible]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KR[illegible]ER, ... Editor and Publisher
I. B. O'HARA, . . .)
F. L. PERRY, . . . } Associate Editors.
W. F. KELLY, . . .)
. I. FAKE[illegible], . . . Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK

W. I. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3 [illegible] for a full year of 52 numbers in clubs of four or more, $2.50, with free extra copy for eight subscriptions, foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application

CONTENTS OF THIS NUMBER.

PAGE.

[illegible] D[illegible], with portrait 71
[illegible] Wires in Chicago Conduits 71
[illegible] 71
[illegible] 71
[illegible] Chicago in New York Harbor [illegible] 72, 73, 74
[illegible] 73, 74
Chicago Electric Club 74
[illegible] 74
[illegible] 74, 75
[illegible] Paris. Illustrated 75
The Book Table 75
[illegible] . . . . 7[illegible]
[illegible] Variations of Pressure in Gaseous [illegible]. Illustrated . . . . 7[illegible]
[illegible] . . . . 7[illegible]
[illegible] Illustrated 77
[illegible] Torpedoes. Illustrated 77
[illegible] 77
[illegible] Steam Engine. Illustrated . . . . 7[illegible]
[illegible] . . . . 7[illegible]
Improved Feed Water Heater. Illustrated 78
[illegible] . . . . 7[illegible]
[illegible] of New York . . . . 7[illegible]
[illegible] Writer . . . . 7[illegible]
[illegible] H. F. Pr[illegible] . . . . 7[illegible], 8[illegible]
[illegible] . . . . 8[illegible]
[illegible] . . . . 8[illegible]

DEPARTMENTS.

[illegible]

[illegible] made [illegible] the Domin[illegible] telegraphic, telephone and electric apparatus of all kinds for communi-[illegible]

[illegible]

the electric railway best serves the public on account of the speed attainable, the absence of dirt and noise, and its numerous other advantages, has long been established, and now it is shown that the new system is equally advantageous to the operating company from an economical standpoint. This combination will work wonders toward extending electric railways.

CABLE railways, once so popular on the Pacific coast, have fallen in the public estimation of late, and now it is possible to dispose of stock in cable roads only at a sacrifice. A Los Angeles company which has expended over a million in cable construction has passed into the hands of a receiver, and it is expected will soon be disposed of and transformed into an electric system. Examples of this kind are presenting themselves so regularly of late that they fail to excite much attention.

OUR New York correspondent mentions a remarkable instance of profit making in electric railway property in the sale of the Rapid Transit street railway of Newark, N. J., for an advance of $800,000 over the price paid by the vendors. The latter purchased the road about a year ago for $200,000, and accordingly made 400 per cent. on their investment in that space of time. This is of course an unusual case, and one that cannot be taken as typical; but it is nevertheless true that street car companies operated by electricity have almost invariably proved paying investments, both in large cities and small towns.

THE announcement that an American steam railroad company would endeavor to negotiate a loan of $5,000,000 in London attracted considerable attention in financial circles not only in England but also on the continent. This was due largely to the fact that the company in question had been obliged to withdraw its suburban trains owing to its inability to compete with the electric road which was recently opened in the territory which it covered. Not long ago our friends across the water expressed the belief that much of the advancement made in electric railways in this country was on paper, but now they are hesitating about putting money in steam railroads, especially those that are liable to invite competition from electric railways.

THE idea of operating submarine torpedoes by means of a reflected view—a sort of camera obscura arrangement—and an electric exploding device, illustrated in this issue, is characteristically French. It reads like one of Jules Verne's scientific extravaganzas in fiction. We may be permitted to doubt the availability of the scheme in actual warfare, but there is a certain glamor in the idea of sitting "comfortably in a bomb-proof station on shore," watching the enemy's fleet coming on with the confidence of approaching triumph, and then calmly touching the vessels off one by one as they come up the fatal spots, until all the ships are destroyed or in retreat. What could be more simple? Possibly the enemy might interpose objections, or the apparatus might get out of order; but the idea is very picturesque, nevertheless.

A BRIEF article from the *Railroad Gazette*, copied on another page, is worthy of attentive perusal. It is entirely within the bounds of possibility—indeed it is not unlikely—that electric motor cars may yet come to play an important part in the switching yards of the great railroads of the country. Our contemporary points out several advantages that the innovation would have in certain cases, and their pertinence is apparent. The remarks of the *Gazette* in relation to the application of electricity to suburban traffic, however, will not be received by the electrical fraternity so favorably. This branch of electrical locomotion is spoken of as in the future, whereas the experience of Boston, Pittsburg, Rochester, Minneapolis and other cities shows that a large suburban traffic can be handled easily and rapidly by the electric system. This feature of the business is no longer in the conjectural or experimental stage. It is an assured success.

I[illegible] issue of the WESTERN ELECTRICIAN there is presented a series of views illustrating the electrical signaling apparatus with which the cruiser, Chicago, of the White Squadron is equipped. The movements of these war ships have excited the greatest interest in New York, and on the night of the search light drill there was much enthusiasm. The cuts, which are reproductions of photographs taken [illegible] to the WESTERN ELECTRICIAN, will enable the inland reader, as well as those in New York who had not the opportunity to go aboard the vessels, to obtain as correct an idea of the Chicago's outfit as though a personal [illegible] of electrical [illegible] with the thoroughness with which all work has been carried out. Naval men realize that cleanliness is a virtue, and the appearance of the machinery on the Chicago convinces one that some one has had to practice what another has preached. A few of the many so-called wiremen and expert dynamo tenders might be set thinking by a visit to the Chicago.

RAPID transit continues to occupy the attention of the people of New York city. Commissioner Steinway repudiates the ideas presented in an alleged interview with him which have already been criticised in this paper. Last week Frank J. Sprague called him to task, and the commissioner immediately disclaimed responsibility for the statements attributed to him. He said that he looked upon the Greathead system as one of the best for work of that kind.

There are, however, many features of the system proposed by the commission in its report which have passed without much notice, though they can scarcely receive the approval of the people. In the first place the idea of having a common track for the down town district would be a grievous blunder, and one that would soon be recognized in practice But the people of the city and the newspapers do not seem to appreciate the fact that the rapid transit they are clamoring for cannot be secured as long as measures of this kind are seriously considered. The overcrowded condition of the "L" road under the present administration would be repeated only in a worse form in the new system.

STORAGE battery cars will soon be seen again in the streets of New York. The recent decision of Judge Coxe has given the capitalists controlling the patents of Brush the assurance they required and now they are proposing to put the cars in operation that have been idle since January last.

This is not all, however. In addition to the sixteen cars formerly used in New York city further equipment will be added and the entire Fourth avenue district served by storage battery cars provided the tests prove as favorable as the company anticipates. The people of the district are in favor of the storage battery car and will have no other.

The outlook for the system in other cities is equally attractive; for instance, in Washington, there will be 44 cars put in operation at once. Indianapolis and New Orleans are about to install initial systems If they prove successful, extensions will follow. The storage battery now has an excellent opportunity, one which its advocates have long been desiring, and if it does not now prove successful it will not be because it has not had a fair trial. Much is expected of the system and its projectors will be obliged to go to work at once to develop it.

THE disciples of Morse will be interested in the convention of telegraphers at Washington this month. The Old Time Telegraphers and the Military Corps will as usual meet at the same time and place. It is probable that further measures will then be taken to secure proper recognition by Congress of the telegraphers who risked their lives and endured great hardships in the interest of their country during the civil war. It cannot be denied that their services in those trying times were of great value. They were exposed to all the dangers of the regular troops and their position was even more trying than that of the men about them actively engaged in the conflict. Yet Congress has repeatedly seen fit to deny the surviving members of the telegraphers' corps the recognition which is their due—an unjust discrimination. They only demand an official acknowledgment of their services and an honorable discharge. Little enough for the services they gave their country in its hour of trial.

But there is another feature of this meeting of veteran telegraphers which will be of general interest. As Washington was fixed as the place of meeting it was thought appropriate to invite Mrs. Roswell Smith to attend. Mrs. Smith was a prominent figure in the struggle which Morse made in Washington to secure an appropriation from the government for his first telegraph line. This lady had the honor to convey to Prof. Morse the news of the successful termination of his struggle. To show his appreciation of the interest displayed the inventor conferred upon Mrs. Smith, who was then Annie G. Ellsworth, the honor of sending the first message over the new line. It is probable that Mrs. Smith will relate some personal recollections of Prof. Morse, which will no doubt be very interesting, as Mrs. Smith's father, who was then commissioner of patents, took a great interest in the telegraph project, as in fact did all his family, and Mrs. Smith had an excellent opportunity to study the character of the man in whom so much interest was shown, even at that time. Her presence therefore at the Washington reunion will be very appropriate.

Goubert's Watt Meter.

The accompanying illustrations represent a new watt meter designed by M. Goubert of Paris. In principle it is entirely different from the ordinary watt meters and ampere-hour meters, and combines novel and interesting hydraulic and electrical features.

The construction is simple. Fig. 1 gives a view of the apparatus showing the several parts. *A* is a dynamometer inclosed in a box and having an oscillating extending axle. It is furnished with a spiral flexible tube, the

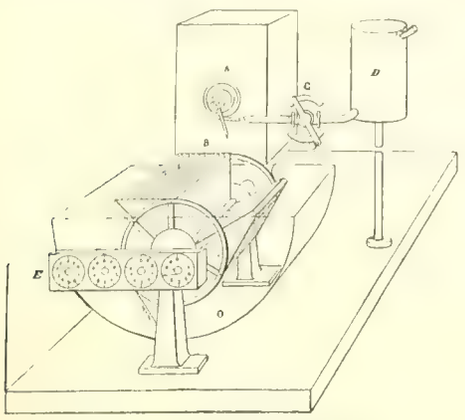


FIG. 1. GOUBERT'S WATT METER.

center of which is fastened on the axle while its other end is connected to a water reservoir *D*; this is so arranged with feed water and overflow pipes that the pressure in the spiral tube is kept constant. A valve *C* opens and closes for the flow of water into the tube, and at the same time acts as a switch for the electric current, so that the water is stopped simultaneously with the current. Below the outlet of the spiral tube is a hydraulic wheel *B* composed of three buckets, each of which is divided into ten compartments. The shaft of this water wheel is joined to a velocimeter *E*, which registers the number of rotations, and a trough *O*, which receives the water from the bucket and leads it away through a waste-pipe. The action of this mechanism will be readily understood. When the switch-valve is turned, the electric current is closed and the water commences to flow. If the load is very small no visible action will be noticed on the dynamometer and the faucet as shown in Fig. 2 will spout its water in the direction of *O* past the bucket *b* of the water wheel. When the load increases, the faucet will move to the left and take the position 1, 2, 3, 4, etc., in accordance with the energy acting on

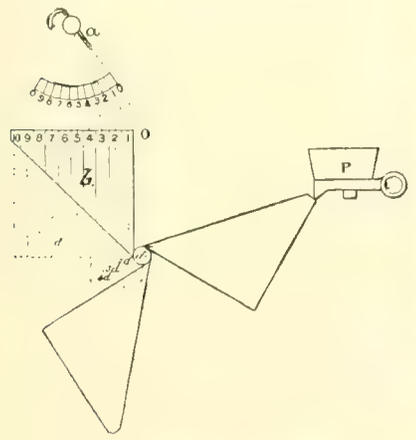


FIG. 2. GOUBERT'S WATT METER.

the dynamometer. The water will flow into the compartment of the wheel corresponding to the position of the faucet, and when this is filled the weight of the water will trip the counterweight *P* and turn the wheel one-third of a revolution. The force of the water on the shaft *d* is equal for any part of the wheel, but the time required for filling the compartment decreases toward the periphery, thus increasing the rate of the rotation of the water-wheel in accordance with the load on the dynamometer. Each rotation represents 100 watts, which is recorded on the velocimeter.

This hydraulic meter possesses the advantage of great simplicity, and has no complicated mechanical movements, but it remains to be seen whether its accuracy is proportional to the simplicity of construction. The illustrations are reproduced from *L'Electricien*.

The city council of Hillsboro, Tex., has decided to erect an electric light plant.

Electricity for Submarine Torpedoes.

The advancement in the application of electricity to the operation of implements of destruction employed in modern army and navy practice is becoming more marked. The main idea in the recent developments in torpedo practice has been to obtain a high degree of exactness in manipulation, and to protect the operators from any possible danger. This has been practically accomplished by the employment of electrical power. By aid of the system illustrated in the cuts, the defense of a harbor or city may, it is claimed, be left to the care of two persons whose strategic abilities do not need to exceed that of an average boatswain. These defenders can be seated comfortably in a bomb-proof station on shore, while the image of the harbor with the enemy is reflected on a table in front of them On the same table are marks which indicate the location of the submarine torpedoes. When a man-of-war is seen to approach one of the marks, it is only necessary to turn a switch and blow up the non-suspecting enemy without exposing themselves whatever.

In the accompanying illustration Fig. 1 represents a diagrammatical sketch of two such torpedo stations, the location of which should be on opposite sides of a harbor or bay, and as nearly as possible on the same level. In each station is a disk *A* carrying a telescope *I* mounted on a movable stand. This is furnished with a lever, which by turning the telescope sweeps the edge of the disk. From the torpedo four wires are connected to different contact points on the edge of the disk. The telescope stands are joined through a switch *B* to a battery *P*. When now an enemy approaches, the two operators being in telephonic connection with each other, direct their telescopes and all they have to do is to follow continuously the movements of the vessel If in turning the two telescopes, the levers on the disks of both instruments strike the same contact point at the same instant, the current is closed and the torpedo fired. The contact points on the disks are adjusted in such a way that the closing of the circuit can only take place when the vessel is exactly over one of the torpedoes.

Fig. 2 represents another plant on the same principle. In the ceiling of a dark chamber is placed a mirror reflector under an angle of 45 degrees; this is reflecting a picture of the surrounding harbor on a polished table placed below the opening in the ceiling. On the table is marked

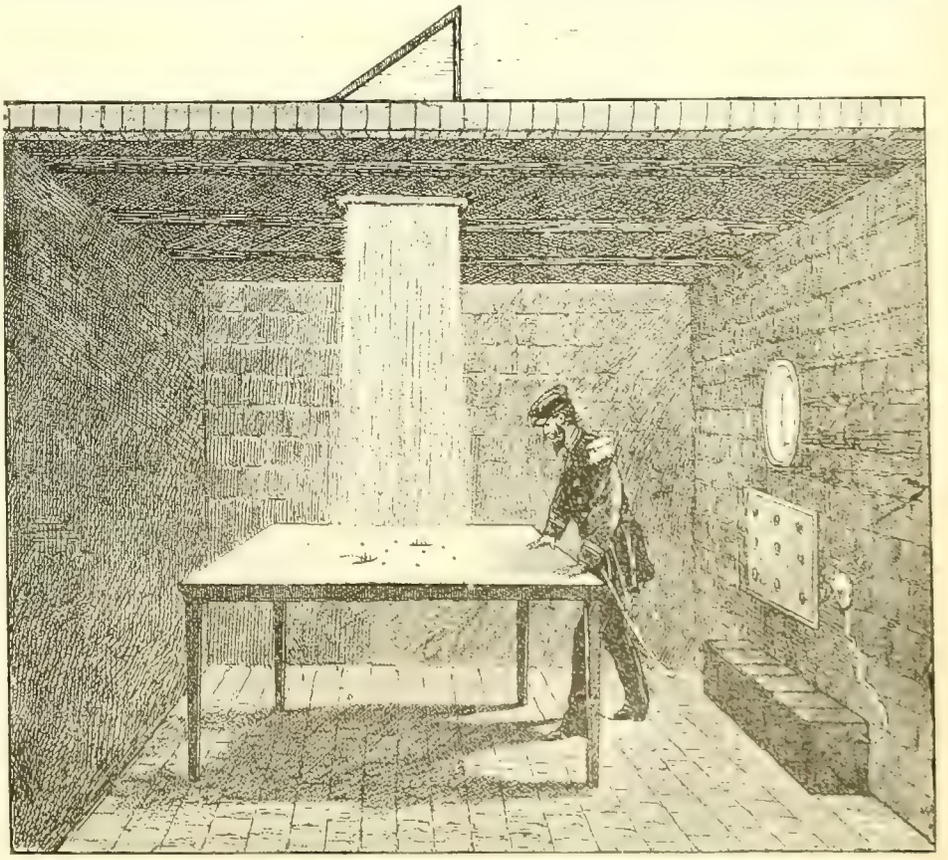


FIG. 2. ELECTRICITY FOR SUBMARINE [illegible]

the exact position of the torpedoes, and whenever a vessel gets in close contact with one of these marks, the operator presses a button, closing the circuit, and exploding the torpedo. The illustrations are taken from the [illegible].

The Allgemeine company of Berlin, Germany, is to construct two electric tramway lines on the Sprague system at Stockholm and at Kiew.

A Prediction from San Francisco.

this prediction:

youthful helper, Smalley, have looked fairly forward to this time, would not their eyes have brightened, when, in 1534, they were laughed to scorn by neighbors for discovering the [illegible]

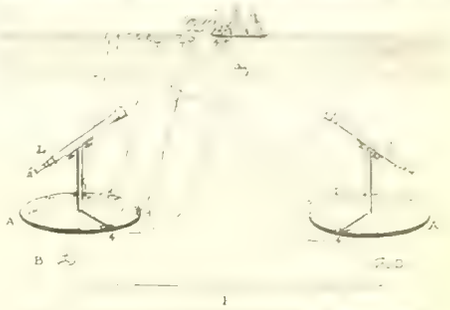


FIG. 1. ELECTRICITY FOR [illegible]

We of old California can look back and see our mountains on all sides, our rich and fertile valleys, our prosperous mining camps, and then ask ourselves what one agent of all others has been the means of developing them. The answer is, water. From one end of our glorious state to the other the perpetual snows of the Sierras yield an abundance of water, never-ceasing, powerful water, placed at our service by the hand of God; made infinitely more powerful by another Providential gift—gravity. Unprofessional as it may seem, in my case, it is with misgiving that I assume to be a prophet, and yet, inspired by the occasion and encouraged by your kindness, I will essay the task. I say to you now that I look to see a railroad operated with one moiety of this great power of ours, working quietly and rapidly, and connecting us with our brothers and the great markets in the East—all accomplished through

that inexpensive [illegible] water. Why, right in one county of this [illegible] to waste, is power enough [illegible] between San Francisco and [illegible] every two hours. Think of what [illegible] practically nothing but the [illegible] the plant and the [illegible] no noise, [illegible] and cast service."

Improved Governor for Steam Engines.

The accompanying cuts represent the improved Ball governor for the new engines manufactured by the Ball & Wood company of New York. This device constitutes a radical departure from all previous types of governors and has but recently been patented by Mr. Ball. It has many elements of interest to electricians, as the Ball & Wood engines are especially designed for use in electric plants.

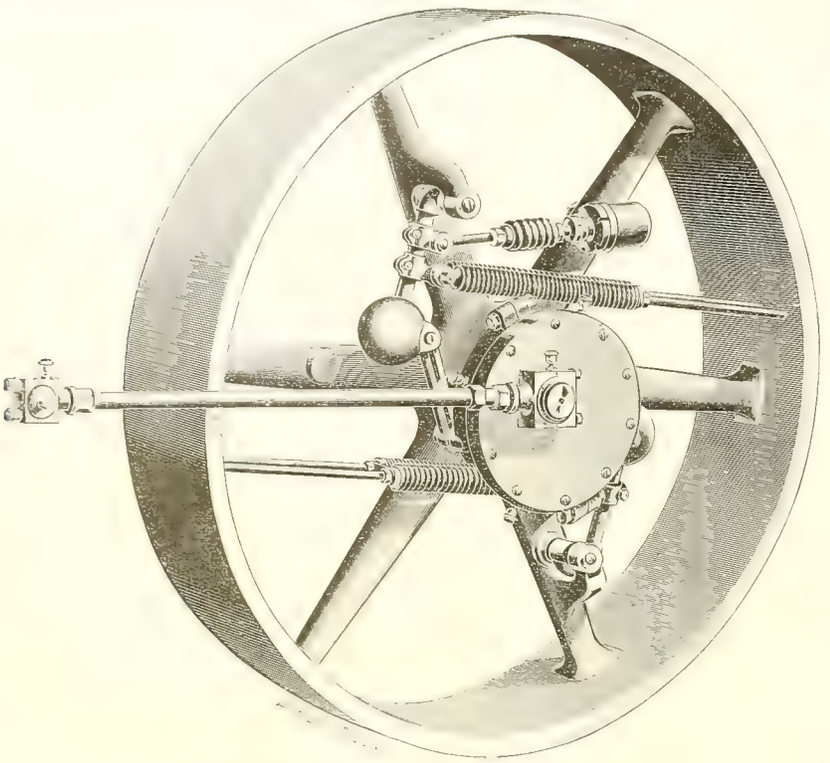


FIG. 1. IMPROVED GOVERNOR FOR STEAM ENGINES.

Referring to the cuts, Fig. 1 gives a perspective view of the governor, while Fig. 2 shows the details. In the latter the hub of the governor wheel is shown with the eccentric *A* bolted securely to its outer end, thus becoming practically apart of the hub. This eccentric is provided with an eccentric strap *B* made in halves and held in place on the eccentric by a flange on one side and the plate *C* bolted to the other side, as shown in the cut. The governor weights are connected by links *D* to studs in the side of the eccentric strap, so that the strap and plate *C* are turned slightly around the eccentric by the radial movement of the weights. This plate *C* carries a crank pin *E*, which, through the medium of a connecting rod, actuates the valve. The radial movement of the weights is thus made to turn the plate *C* around its center, which is eccentric to the shaft, and the crank pin *E* is thus moved through the arc of a circle whose center is the center of the plate, and the various points of cut-off are thus obtained. The curved path of the crank pin is made to give almost a constant lead to the valve until a very early cut-off is reached, when the lead rapidly disappears and prevents the engine from running away. A much better indicator card, with the earlier points of cut-off, is thus produced than would be possible if the crank pin moved in a straight line when [illegible] the point of cut-off.

[illegible] mechanism, only two [illegible] surfaces are interposed between the shaft and the connecting rod which ac[illegible] the crank pin is practically the [illegible] the only one constantly in motion relatively to the surfaces with which it is in contact. The other, the eccentric strap, only moves on the eccentric when the weights change their position. The wear here, [illegible] manner for [illegible] the plate and scraping the [illegible] motion can always be eliminated.

[illegible]

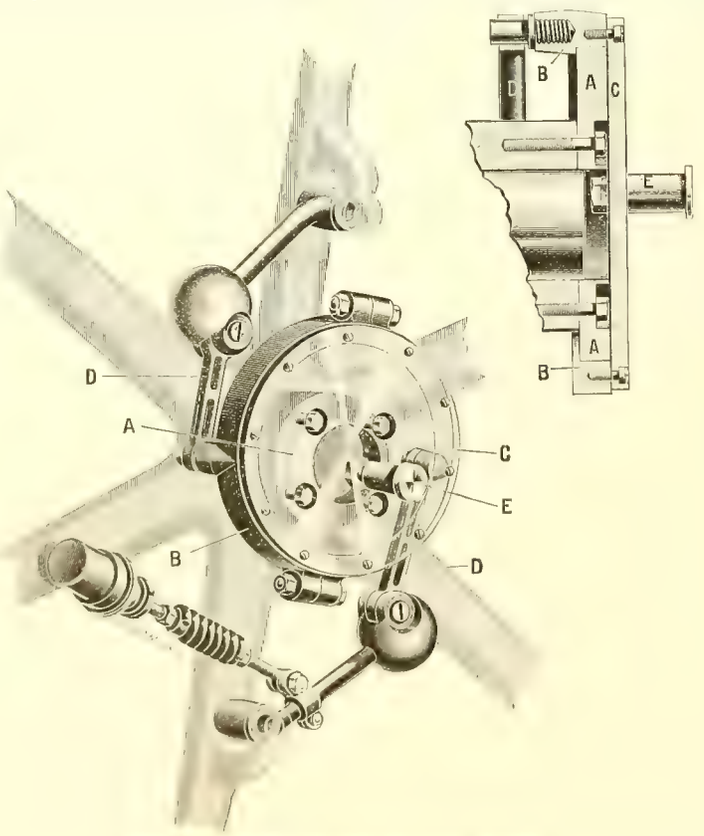


FIG. 2. IMPROVED GOVERNOR FOR STEAM ENGINES.

Electricity in Mining.

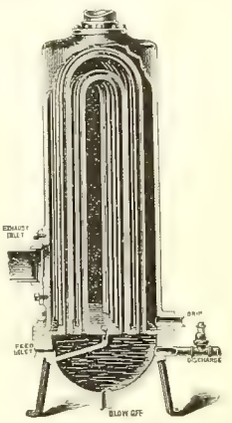
[illegible]

"Recent experiments in the utilization of electricity in this manner have been watched with a great deal of interest by miners and mine owners, and the success of the one at Telluride is of no small importance. The Gold King stamp mill at that point is now in successful operation from electricity conveyed two and one-half miles from an [illegible] current dynamo, capable of developing 140 horse power, in turn operated by water power. The idea of [illegible] power of the mountain streams here[illegible] with L. L. Nunn, who is inter[illegible] of the Gold King property. [illegible] Telluride district have been [illegible] scheme, and [illegible] put in at once. The Belmont will convey power to its mills three miles and a half from the valley below, and others will follow as soon as possible.

"The saving to the mine owners and the increase in profits which will accrue to owners of mines high up the mountain or away from convenient water power can readily be seen. Mills can now be built at the mines, and the concentrates rather than the ores conveyed to the valley below. Mills that have been forced to burn timber or coal can through this method operate more economically, and the many low grade properties to which the expense of power has been a bar to operation can be worked to a profit. It is a step forward in mining, and when thoroughly understood and put into common use will add millions to the output of Colorado mines."

Improved Feed Water Heater.

In Radway's improved feed water heater, illustrated in the accompanying cut, the advantages of simplicity and re-



IMPROVED FEED WATER HEATER.

liability are claimed. Drawn seamless bent brass tubing is used, both ends being secured into the one head or tube plate expander. The shell is made of cast iron, and the settling chamber is divided into two compartments. As the water enters the heater it passes through the tubes and down into the settling chamber, then out at the top to the boiler. The chamber and tubes are from twelve to twenty times larger than the inlet and outlet of the feed, thereby allowing a slow and free passage of the water as well as plenty of time for the sediment to settle at the bottom, where it can be blown off. The area for the exhaust to pass around the tubes is from four to six times the size of the exhaust pipe, which is claimed to totally prevent back pressure.

A recent number of London *Engineering* contains a brief account of the origin and growth of municipal electric lighting in Chicago.

Edison Convention in New York.

Secretary Jenks of the Association of Edison Illuminating Companies has issued the programme of the annual convention of the association at the Murray Hill hotel, New York, August 11th, 12th and 13th. It is as follows

FIRST DAY, TUESDAY, AUGUST 11, 10 A. M.

Opening address by the president, roll call, election of officers for the ensuing year.

Report of executive committee and action by the association regarding applications for membership.

Report of secretary and treasurer.

Afternoon Session, 2 p. m.

Report of committee on the prevention of damage from crosses of high tension circuits, by C. P. Gilbert of Detroit, chairman.

Report of the committee on lightning protection, by A. E. Kennelly of the Edison laboratory, chairman, and the results of experiments at the laboratory on new forms of lightning arresters.

Report of committee on grounding the neutral wire in three wire systems, by A. E. Kennelly, chairman.

Report of committee on fuel gas, by J. R. Markle of Detroit, chairman.

A visit to the office and stations of the Edison Electric Illuminating company of New York, in response to an invitation from the company to inspect the special features of its three plantss and plans for the proposed comprehensive station near the City Hall.

SECOND DAY, AUGUST 12.

Morning Session, 10 a. m.

Address by officers of the Edison General Electric company as to matters of commercial interest to the association and the patent litigation.

Paper—"How to get a Paying Load for Stations," by William D. Marks of Philadelphia.

Paper on the meters in use in the station of the Brooklyn company, by R. S. White.

Paper—"How Can Our Association Best Serve Central Station Interests," by Frederic Nicholls, of Toronto.

Afternoon Session, 2 p. m.

Paper by W. L. Garrison of the Brockton, Mass., company. Subject to be announced.

Paper on "Important Details in Underground Conductors," by Mr. Stevenson of the New York Illuminating company.

Paper—"Some Practical Ideas on Distribution," by Leigh Carroll, of Birmingham, Alabama.

Paper by C. L. Edgar of Boston. Subject to be announced.

Paper—"Peculiar Features of the Edison Feeder System," by Wilson S. Howell.

"The Success of the Mutual Insurance Idea in Electric Light and Power Stations," by the secretary.

Paper by H. J. Smith of the New York Illuminating company. Subject to be announced.

Visit to the station of the Edison Electric Illuminating company of Brooklyn, in response to an invitation from the officers of that company.

THIRD DAY.

Visit to the Schenectady Works of the Edison General Electric company. Delegates will leave the Grand Central depot, New York, at 6 A. M. by special train with dining car attached, breakfast being served between New York and Albany. Arriving at Schenectady about 10 o'clock, the larger portion of the day will be spent in a detailed examination of the immense factories of the company, returning to New York in season to enable the delegates to attend the theaters or other amusements during the evening. Opportunity will also be given for a visit, by all members who may desire, to the lamp works of the general company at Harrison, N. J., the New York works, corner Avenue B and Seventeenth street, and the Edison Laboratory at Orange, N. J.

Electrical Census of the State of New York.

Horatio A. Foster has been appointed special expert agent for the collection of statistics relating to the electrical industries of New York. It is the intention of the census office to complete the work for the state of New York, and to publish the results in a special bulletin at the earliest practicable date. Mr. Foster will visit every central station, electric railroad and the more important isolated plants in the state, and assist their superintendents in correctly filling the official schedule. All schedules that have been sent to Washington are to be put into his hands for correction and verification. He will notify each company of the date when he will call for the purpose of finishing up its schedule, and will give all the assistance that may be necessary. Those particularly interested in the matter have issued a circular letter impressing on the superintendents of stations the importance of expediting the business in hand, as it is their desire to have the bulletin in question the first issued from the census department. To assist in saving time it is suggested that each superintendent should have a correct memorandum for Mr. Foster, covering the following details:

1. Average number of poles per mile.
2. Kind of wood.
3. Number of poles, part wood and part iron.
4. Total length of conductors on poles.
5. Total length of conductors on housetops.
6. Total length of conductors on bridges.
7. Total number of service connections.
8. Number of service connections on each alternating current main.
9. Total cost of all aerial conductors.
10. Total annual cost of maintaining all aerial conductors.

Where the Street Car Company Uses Sleighs in Winter.

The street car company in Montreal has to meet peculiar difficulties. It wants electric cars, but is afraid it cannot get them. The *Canadian Magazine of Industrial Arts* thus describes the situation:

"Although Montreal is behind certain other more favored cities in not having an electric street railway, many of our citizens would gladly welcome such a system of rapid transit, if it were practicable. It must be recognized that the City passenger railway has to contend with difficulties which are not encountered to so great an extent in those cities which have resorted to the desired system with more or less success. The winter's snow, which burdens our streets, presents the most formidable obstacle. It would be impossible to keep the tracks clear for many weeks—a necessity which now compels the use of sleighs instead of cars for the time being. In fact, the snow is packed down in the streets sometimes to a depth of from three to four feet. To have an electric system merely for the season when the track is clear would raise a serious problem as to the disposal of the large number of horses required by the winter sleighs.

"As the business of the city increases however, and the suburbs continue to extend, the need of some more economical and efficient method of transit becomes more and more felt, and surely Canada's metropolis should have a system adequate to the need. The problem is one which will more and more commend itself to those who regard with practical interest the city's progress."

Advantages of the Electric Street Railway.[1]

BY H. B. PRINDLE, B. S.

In this day of advancement it seems only reasonable to suppose that the already extensive and rapidly increasing use of electricity for street car propulsion is due to the fact that it possesses in a marked degree advantages over its competitors, steam, animal power and the cable. The belief is strengthened by the fact that among the street railway companies that have adopted it are to be found some of the largest and, at the same time, the most conservative companies in the country. Even if there were no other recommendations, its employment by such companies is good evidence that electrical propulsion of street cars has reached a state of perfection sufficiently high to warrant its general introduction

Nearly every one is familiar with the struggles through which the electric railway passed before it assumed a condition alike successful from a commercial and practical stand point, and although it may never be said of any system or method that it is entirely beyond the experimental stage, the electric railway is certainly beyond this stage in the ordinary acceptation of the term. Its permanency is unquestionable, and whatever changes may take place in the next few years will, in all probability, be in the nature of improved apparatus, the result of time and experience, rather than changes in the underlying principles of electrical propulsion. Roads now operating by animal power are fast changing to electricity, while the new road that does not employ it is the exception and not the rule.

The competitors of electricity in this field are steam, horses and the cable. In considering the merits of these systems steam may be omitted, as the past has shown that its use for street cars is not likely. There are but few cities in which permission could be obtained to operate steam roads and to use inside the city limits apparatus which brings to the already sufficient nuisance an additional amount of dirt, noise, smoke and escaping steam. Aside from these objections by municipal authorities, the economy of steam locomotives is far below that of the large stationary engines used in cable and electric systems, and their great weight causes a rapid deterioration in the track. Their use must be confined to the present long distance passenger and freight roads on which, as yet, steam exclusively has found employment. Many prominent engineers unite in saying that while up to the present time steam has been unchallenged on our great trunk lines, the marked development in electric traction points to a time not so very distant when steam shall have found a strong competitor in the electric current.

Leaving steam out of the question, of the three systems in common use to-day—the cable, the horse and the electric current,—the last named embodies all the advantages of the first two and lacks those features which render the use of the two former open to serious objection. In the question of the adoption of any system of car propulsion the first considerations are cost, operating expenses, safety, reliability and durability. Granting for the sake of argument that the operating expenses of electric, horse and cable roads are the same, are there not many advantages offered by the first over the second and third systems which would commend its employment and which would render its adoption certain? So far as the reliability of the system is concerned there can be little question. The experience of existing roads, many of which have known no tie-up, while others have only had such trouble of a trifling nature, is the best proof on this point. Experience has shown, too, that the durability of the apparatus has been all that could be expected of machines and appliances subjected to the wear and tear attendant upon this class of work. The more important parts of the machines are subjected to no wear and but little depreciation, and the parts wearing have to be renewed no oftener than like parts in stationary engines used for equally arduous work. The secular press has done its best to damage the system by exaggerated tales of the dangers due to electricity at high speeds. So far, in this country at least, there is no record of any person having met death by the current from an electric railway. Fear, then, in this direction is groundless.

Among the many advantages of electricity over the horse and cable systems is increased speed. In the cable and horse systems there is limit to speed, which cannot be exceeded in the latter and cannot be increased or diminished in the former without great wear upon the cable. In the crowded city streets and in the suburbs, the same speed, approximately, must be maintained. With the electric system all this is changed, and cars can be run at almost any desired rate. In the heart of the city they can be operated at three or four miles an hour, and, if necessary, at twelve or fifteen, as soon as the crowded streets are passed. What does this increased speed mean? It is equivalent to rapid transit to and from the suburbs for the traveling public, and an increased car mileage and increased receipts. At the same time, the ability of a motor car to haul one or two tow cars should not be lost sight of, as this renders it possible to double or treble the carrying capacity of a road. Compare the cost and operating expenses of these extra cars with the cost and maintenance of enough horses to do the same work in what, it must be admitted [illegible] that high speeds are not suitable to city and suburban [illegible]

[illegible] the operation of the others may not be interfered with, in case [illegible] feeders is arranged so that the accidental breaking of the trolley wire cuts out but one section, and cars on either side can operate without difficulty. A more flexible system than the electric is not to be found. It can be extended to cover more territory at less expense than any other, switching and turn outs are easily accomplished, and can be used where revenue derived from cars operated by other systems would not pay expenses. Experience has shown that where electric railways have been installed in districts sparsely settled they have carried great activity in building of new homes for those whose income precludes their living within city limits.

These are, briefly stated, some of the advantages which are brought by the use of electricity as a means of street car propulsion, but the most important features are to be found in the cost of installation and expense of operation. Those who are familiar with cable systems, with their enormous power plants and expensive conduits, can see at once how disadvantageous the comparison with the electric system will be. From reliable figures on first cost of equipment the average cost of five roads operated by cable in various parts of the country is \$1,317,570.83, these roads averaging in length 7.15 miles, making the cost of installation per mile of road about \$350 000. Five roads operated by horse power cost on the average \$759,609.25, or \$41,283 per mile. Five roads using electricity as a motive power cost on the average \$242,628, or \$36,000 per mile. These figures show in favor of electrical equipments per mile of track of \$5,283 less than horse roads, and \$314,000 less than cable. Assuming 10 per cent. for depreciation, the contrast between the three systems is not less marked. So much for original equipment, all of which is most favorable to the electric railway. A comparison of the cost of operation is more than likely to be incorrect, unless it is assured that the same expenses are included in each item which goes to make up the total cost of operation, and as comparison is the only method for attaining an idea of the comparative merits of systems so far as operating expenses are concerned, care should be taken that all comparisons are made upon an identical basis. From the report of the railroad commissioners of the state of New York for the year 1889 it appears that in the case of horse railways the average proportion of receipts to operating expenses for thirty-three roads was 79.39, while for electric roads, two in number, it was 53.50. From a similar report for the state of Massachusetts for 1889 the average proportion of receipts to operating expenses for thirty roads was 82.87, while for two electric roads it was 55.50.

From various reliable sources the following information is compiled regarding the operation of various electric railways:

ROAD NO. 1.

Length including sidings	[illegible]
Cars, 4 box, 3 open, total	7
Total mileage for year	[illegible]
Total passengers "	[illegible]
Total round trips "	[illegible]
Rate of fare, 5 cents	
Total income for year	\$2[illegible]
" expenses "	[illegible]
Ratio of exp. to income	[illegible] per cent

ROAD NO. 2.

[illegible]	[illegible]
4 box, [illegible] open, total	[illegible]
Total mileage for year	[illegible]
" passengers "	[illegible]
" round trips "	[illegible]
Fare [illegible]	[illegible]
Total income for year	\$[illegible]
" expenses "	[illegible]
Ratio	[illegible]

ROAD NO. 3 (from May [illegible] to Sept. [illegible]).

Length including sidings	[illegible]
Cars, 4 box, [illegible] open	[illegible]
Total mileage for year	[illegible]
" passengers "	[illegible]
Total round trips for year	10,123
Rate of fare, [illegible] cents	
Total income for year	\$[illegible]
" expenses "	[illegible]
Ratio	[illegible]

ROAD NO. 4.

Length including sidings	4.5
Cars, 3 box, 1 open	4
Total mileage for year	[illegible]
" passengers "	[illegible]
" round trips "	[illegible]
Rate of fare, 5 cents.	
Total income for year	\$[illegible]
" expenses "	[illegible]
Ratio	[illegible]

ROAD NO. 5 operated by horses. [illegible]

[illegible] cars for 4 months [illegible]	[illegible]
Earnings 4 mos.	\$[illegible]
Expenses	[illegible]
Ratio	[illegible]

(Operating by [illegible])

[illegible] cars [illegible] 1880	[illegible]
Earnings	\$[illegible]
Expenses	[illegible]
Ratio	[illegible]

[illegible]

ROAD NO. 7 [illegible]

[illegible] cars	[illegible]
Receipts [illegible]	\$[illegible]
Expenses	[illegible]
Ratio	[illegible]

[illegible]

These roads are by no means special instances. The West End Street Railway company of Boston is undoubtedly the largest electric railway system in the world, and the following data concerning its operations are of the greatest value. [illegible] that this company has its power stations not complete and is now buying current to operate certain lines, and also that this showing is in the face of the disadvantage of changing from horse to electricity. When the power stations are completed and in running order it is fully expected to

1 *Engineering Magazine.*

operate electric cars at an expense of not more than 20 cents per car mile

The company is operating about 75 twenty-six foot cars which during the month of May earned forty-four cents per mile operated, and forty-six and nine-tenths cents per mile operated during the first half of the month of June. When this long car service is extended the operating expenses will scarcely exceed 50 per cent. The net earnings of the company gained over the previous year $15,000 in May. Such is the result of electrical propulsion in the largest system in the world, and further comment is unnecessary.

A [illegible]

	Total.	Electric	Horse
[illegible]	$ 478,717	$ [illegible]	$ 344,496
General expenses	[illegible]	8,[illegible]	22,514
[illegible]	[illegible]	47,[illegible]	130,703
[illegible]	[illegible]	33,[illegible]	118,740
Total operating expenses	[illegible]	88,[illegible]	270,947
[illegible]	[illegible]	4,[illegible]	67,440
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	25,[illegible]	73,32
[illegible]	76.82	03,3[illegible]	86.02
Earnings per mile run	[illegible]	34.0[illegible]	31.77
Expenses per mile run:			
[illegible]	10.01	07.[illegible]	10.86
[illegible]	01.[illegible]	01.[illegible]	0.03
[illegible]	0.[illegible]	00.[illegible]	00.78
[illegible]	0.03	07.[illegible]	08.28
[illegible]	04.[illegible]	04.03	04.70
[illegible]	24.[illegible]	21.75	25.55
Net earnings per mile run	7.85	12.30	06.22

Ma[illegible] STATEMENT.

	Total.	Electric	Horse
[illegible]	$ 510,244	$ 144,638	$ 374,605
[illegible] general expenses	30,[illegible]	7,[illegible]	22,682
[illegible] and car expenses	172,384	45,443	127,602
Motive power	142,[illegible]	33,[illegible]24	118,072
Total operating expenses	353,720	84,103	269,556
Net [illegible]	156,524	60,475	105,049
Miles run	1,471,004	376,321	1,094,683
[illegible]	1.00	25.58	74.42
Per cent. of operating expenses	68.12	58.18	71.95
Earnings per mile run	35.20	38.48	34.22
Expenses per mile run:			
Motive power	10.19	08.22	10.86
Car repairs	00.74	01.33	00.60
Damages	00.[illegible]	00.[illegible]	00.37
Conductors and drivers	08.[illegible]	07.36	08.24
Other expenses	04.[illegible]	04.56	04.55
Total expenses per mile run	24.04	22.36	24.62
Net earnings per mile run	11.25	11.07	09.60

Of all systems of street railway that which gives the quickest transit is the one demanded by the traveling public, and that which gives the best results is the one desired by the railway companies. Electric propulsion satisfies both requirements.

Lighting the Model City.

The *New Review* of London is publishing a series of articles on "A Model City; or, Reformed London." That in the July number treated of 'Lighting," and the portion on electricity was contributed by no less an authority than Lord Rayleigh. As a clear, though brief, resume of the best English practice, the article possesses much interest to American readers, and it is herewith reproduced in full:

Electricity is applied in two distinct ways to the production of light. When a current traverses a fine wire of metal, or other suitable material, energy is expended locally in overcoming the resistance of the wire and assumes the form of heat. the temperature of the wire rises until by radiation and communication of heat to the surrounding atmosphere a balance is established between the heat emitted and that received electrically. If the supply of electricity be sufficient, the temperature may attain to a red or white heat, and the wire becomes a source of light. This is the principle of the incandescent or glow lamp.

The economy of the lamp depends upon the temperature attained. Short of redness there is no luminous return at all for the electrical energy expended. Beyond that point the return is at first small, but gradually augments as a white heat is approached. The limit depends upon the properties of available materials. Among metals the most [illegible] platinum and iridium give way comparatively soon. The infusible character of carbon attracted the attention of inventors at an early date, and the [illegible] material for the wire or filament allows the temperature, and consequently the economy, to [illegible] possible with any metal.

[illegible] not, as might at first be supposed, an objection to its use, inasmuch as a platinum wire would [illegible] of oxidation by contact with [illegible] experience [illegible] disintegrated by the molecular bombardment to which they are subjected, even [illegible]

[illegible]

depends upon several considerations. In a few years the patents which now control the manufacture of lamps will expire, and the reduced cost will then justify a severer treatment.

The difficulties which oppose the attainment of a higher efficiency in glow lamps are evaded in the arc light. According to the discovery of Davy, near the commencement of the century, if two pieces of carbon, connected with a powerful source of electricity, are brought into contact, and then separated through a small space, a permanent current, constituting the electric arc, establishes itself across the interval; and the passage of electricity gives rise to a light of great intensity. It is however, a mistake, although a common one, to suppose that the arc itself is the principle source of light. A little examination shows that the light comes rather from the white hot carbons upon which the arc abuts.

It appears, then, that both electric lights have their origin in incandescent carbon. Nevertheless, there are many important points of difference. In the glow lamp the carbon must be retained intact; and this, as we have seen, imposes an early limit upon the admissible temperature. In the arc light the carbons are undergoing rapid disintegration all the while, and the temperature is much higher. The greater efficiency of the arc as a transformer of electrical energy into light is undisputed; but it is equally certain that this advantage is not without its attendant drawbacks In the first place the gradual consumption of the carbons implies a more or less complicated mechanism for preserving the proper interval between them, and their renewal means daily attention. Another difficulty is that of adequate subdivision of light. For domestic purposes we do not require single lights of 1,000 candle power. A hundred separate lights each of 10 candle power are really worth much more. Again, in spite of recent improvements, arc lights are rarely quite steady. There is also the question of color. The blueness with which arcs are often credited is an illusion dependent upon contrast; but the fact remains that the white light which they supply is thought to be more trying to the female complexion than the yellow color of candles, approximated to by glow lamps. For picture galleries, factories and shops where the nice discrimination of colors is important, arcs are unrivalled, as well as for special purposes, *e. g.*, in magic lanterns and lighthouses, where great concentration is an advantage.

The comparison of the two ways of applying electricity thus leads to the conclusion that there is a field for both. Large buildings and open spaces may well be illuminated by arcs, but for ordinary domestic use the superiority lies unquestionably with the glow lamp.

How far the electric glow lamp will displace other illuminants is a question upon which opinions naturally differ. Experience already shows that a large number of people prefer electricity even at a cost amounting to several times that of gas. In many cases the comparison to be made is rather with candles than with gas, for the latter is not usually considered good enough for the drawing-rooms and dining-rooms of those who can afford to pay for comfort. Modern paraffin lamps are, it is true, a great improvement upon those of our youth; but here arises the question of domestic labor. Electricity is as convenient as gas, while it consumes no oxygen, smokes no ceilings, and needs no matches. The ease with which it can be turned off and on by a switch near the door as a person leaves or enters a room offers a great opportunity for economy. A good deal probably still remains to be done in the way of finding the best disposition of lights. The comparative absence of heat allows of situations impossible to other illuminants, of which advantage has not yet been fully taken. Those who indulge in the luxury of reading in bed have a grand time before them. It seems likely that many dark underground places may be rendered much more available than at present by the use of electricity.

The vaunted coolness of electric light may seem paradoxical after what has been said of the high temperature of the filament. These apparently contradictory characteristics are really connected in the closest manner by the laws of radiation. The exceedingly high temperature of the filament is the very reason of the small heat in comparison to candle power. How far the coolness will tell in favor of electricity remains to be seen. One can imagine that in cold weather the heating effect of gas and oil would be missed by those unable to pay for ample firing.

So far we have been dealing with the private consumption of electricity, if such a term may be allowed. A still more important branch of the subject relates to the character of the supply. It may be taken for granted that it will be public, analogous to the usual supply of gas and water. At the present time, it is true, many of the theaters, hotels and clubs possess private plants and supply their own needs. This arrangement is not likely to last, unless, perhaps, in the case of institutions of exceptional magnitude. It is in the main a result of the Electric Lighting Act of 1882, which in the supposed interests of the community threw such impediments in the way of enterprise as to cause London to fall into the rear of American villages and distant islands of the Pacific. During the last two years, and under a more rational law, there has been considerable progress, and it is probable that before very long most people who want electricity will be able to get it.

Whether the supply of electricity to the model city should be in the hands of private companies, or should be undertaken by the local authorities, are questions likely to be answered in a different way by different people. Those of a sanguine temperament will embrace the latter alternative, picturing to themselves a municipal body, elected by the people, animated by the purest public spirit, and eager [illegible] the path of improvement. Others doubt how far this ideal is attainable in the present state of the [illegible] of human nature, and in the meantime would prefer [illegible] so far as may be, to private enterprise. [illegible] in favor of arrangements similar to those now in force with certain gas companies, whereby [illegible] upon a certain standard carrie with it an obligation to reduce in a proportionate degree the price charged to the public. In this way the management retain in a sufficient degree the natural stimulus to seek out and adopt improvements, whether of a scientific or of a commercial character, but at the same time they are not allowed to use their position as monopolists to put the whole money value into their pockets.

The supply of electrical energy may be either on the steady or on the alternating current system. The former is the easier to understand, as it is analogous to hydraulic power. All students of mechanics know that in the latter case the power may be treated as the product of two factors (1) the pressure, measured perhaps in pounds per square inch, and (2) the flow, measured in gallons per minute. In precisely the same way electrical power depends upon the electrical pressure measured in volts, and upon the current, measured in amperes. So far as energy is concerned it comes to the same thing whether we have one ampere at 100 volts or 100 amperes at one volt. But as the loss of power in the conducting mains depends upon the current and not upon the pressure, economy of distribution is promoted by the use of high pressures. This consideration becomes more and more important as the distance increases to which the supply is to be carried; so that economy precludes the extension of a low-pressure system over a very wide area. On the other hand two obstacles stand in the way of high pressures. Above 200 or 300 volts electricity become dangerous, and it is usually considered that the pressure brought into private houses should not much exceed 100 volts.

If the district to be dealt with is of moderate area the simplest plan is to use one pressure throughout. The Kensington and St. James' stations, now in successful operation, are upon this system. The current is generated by dynamo machines driven directly by quickly revolving engines, and is led through the streets by massive copper strips, supported at intervals by glass or porcelain, and contained in culverts under the footways. Such is the efficiency of the machinery that Mr. Crompton estimates the electrical output as 85 per cent. of the power indicated in the cylinders of the steam engines.

In the alternating current system the flow of electricity is backward and forward. For perhaps one two-hundredth of a second the motion is forward and during the next two-hundredth of a second backward, so that the complete cycle occupies one hundredth of a second. The principal, perhaps one may say the only, advantage of this system is the facility with which it lends itself to transformation. Electricity may be generated and distributed at high pressure, and at the last, or nearly the last, moment be transformed without much loss of energy into electricity of low pressure. It is as if a gallon of water at a pressure of 100 pounds to the square inch could be converted into 100 gallons at a pressure of 1 pound. In this way the security of a low pressure in the consumers' houses can be made compatible with the economy of a high pressure in the distributing mains. It is thus possible to supply at a considerable distance from the source, as is actually being done in London by the Electric Supply company, whose generating station is seven miles away, at Deptford. On the other hand it is contended that the losses in the transformers, together with the increased cost of insulation for mains at high pressure, neutralize the advantage which the alternate current system might otherwise possess.

He would be a bold man who should pronounce with confidence at the present moment upon which system the model city of the future will be lighted. It may be that both will hold their own. More probably the question may be decided upon other grounds than those connected with lighting. It is the opinion of many competent authorities that the supply of mechanical power may ultimately prove to be as important as the supply of light. If this be so, the scale can scarcely fail to turn in favor of the steady non-alternating current, which lends itself more readily to mechanical and chemical uses.

The extended employment of electricity for various purposes would remove one difficulty which at present presses heavily. The demand for light is unduly concentrated upon three or four hours of the evening. During these the station must be able to meet the simultaneous requirements of both shops and private houses. Mr. Crompton finds that on the average of the year the demand in a residential district is only about 8 per cent. of that which the plant could supply if capable (as it must be) of dealing with the hours of greatest strain. It is needless to point out that under these conditions the machinery works at great disadvantage. On the steady current system a partial remedy may be found in the use of secondary batteries, by which electrical energy is stored in a chemical form, somewhat as gas is stored in gasholders. But anything tending to equalize the consumption over a large part of the twenty four hours would greatly simplify matters, and would ultimately enable the companies to reduce their charges. Such would undoubtedly be the effect of the extensive application of electricity to the distribution of mechanical power.

The Power of the Future.

It is only a question of time when electricity will universally supersede horses, steam and gas, in all their various applications. The late remarkable discovery in electrical forces made by Nikola Tesla, described by him at the recent meeting of electricians in New York, presents new possibilities in the universal application of the most marvelous power in nature, and promises to transform all means of lighting cities. Nor is it in vain to look to it for heat, and we believe that the time is in the near future when we shall turn on the heat in our rooms by the key, as now we turn on gas at night. This will do away with at least one servant, who, in large houses during the winter is required to attend to the furnace and grate fires, without adding further to his duties. It will be also a great economy in the wear of furniture and the preservation of books and pictures. Electricity is the power of the future. *Boston Manufacturers' Gazette.*

CORRESPONDENCE.

New York Notes.

NEW YORK, August 1.— The rapid transit question is emphatically the topic of the hour. Last week I endeavored to give some idea of the involved condition in which the commissioners have succeeded in landing the whole scheme, the results of which are of such vital importance to the city of New York and its million and a half of workers. The plan of having a common track for the down town portion of the two lines has evoked only the faintest protest from the daily press, although the comments that have been made are for the most part unfavorable. The fatuity of the error that has been committed in adopting such a plan does not seem yet to have struck home either to the people or the press, but it will in time, and it is only to be hoped that the awakening will not be left to the rude shock of bitter experience. The remark of the chairman of the Rapid Transit Commission, which I quoted last week, to the effect that the Greathead system would not be used because it is specially applicable to deep tunneling, and the tunnels in New York would be as near the surface as possible, called forth a very strong letter of protest from Frank J. Sprague, the president of the Greathead Subway Tunnel company. Mr. Sprague protests in vigorous language against the proposal of the commission to forward the reports of the engineers to the mayor and common council for approval, without allowing them to be made public for criticism and comment. He also protests against the assertion that the Greathead system of tunneling is too expensive, and that a system of open cutting on Broadway would be resorted to. As MR. Sprague says, the opinion of many noted engineers who have been, and now are, connected with some of the most important engineering works, is that by the use of the Greathead shield the lower Broadway tunnel can be more rapidly, cheaply and safely constructed than in any other way. The North River tunnel, a most difficult piece of work, is being constructed with English capital subscribed on condition of the employment of the Greathead system. The same method of construction has been successfully employed on the St. Claire tunnel and under the River Thames, and is to be used on other works in London of equal magnitude to that of the Broadway tunnel.

Mr. Sprague's letter, which was a most forcible indictment of the bungling policy of the commission, caused the chairman of that worthy body to altogether lose his temper. Mr. Steinway felt very much aggrieved at being taken to task, and in a newspaper interview proceeded to contradict most of what he had said before. He denied that he had said that the Greathead tunnel would be too expensive, or that "our" roads were to be as near the surface as possible, and qualified such statements (which in a previous interview with the same reporter he was explicitly reported to have made), as the most unmitigated nonsense that he had ever heard in his life. He looks on the Greathead system as being "among the best and cheapest ways of making tunnels." How many "best and cheapest ways" the Greathead system shares the distinction with, Mr. Steinway did not state. Mr. Steinway wound up by making this handsome undertaking: "The people of this city may rest assured that this commission will exhaust every means to devise for them the most perfect system of rapid transit possible. They will not hastily adopt any scheme. They are not going to adopt finally any plan until they have had the advice of the most eminent engineers in the world—men totally detached from schemes of profit, and able by character, attainments and position to look at the problems presented from a purely scientific point of view." Mr. Sprague may be able to discern "one for himself" in the last part of this important announcement, but at any rate he has done a public service in drawing out the chairman of the commission and inducing him to correct previous reports of a very disquieting nature. One word more on rapid transit, and this to show that great minds run on parallel lines. Mr. Sprague in his letter made precisely the same suggestion that I made in my last to you, namely, that the company obtaining the franchise should be allowed to build and equip the road in its own way, of course with certain well-defined limitations, and curiously enough Mr. Steinway seems to concur in this, although all his previous utterances have led us to understand that the engineer's plans would be presented cut and dried and have to be followed to the letter.

The district attorney has selected another newspaper for a free "ad" in connection with the publication of details of the recent executions at Sing Sing. The proprietor of the *New York Herald* has been indicted for the same offense against the law that secured the indictment of the city editor of the *Daily News*. The proceedings in these cases are farcical in the extreme. The district attorney and his assistants give newspaper interviews in which they state that they believe the law to be a bad one, unconstitutional, and all the rest of it, and that it is certain to be amended; they even go so far as to suggest points that may be made by the defense to the indictment. The *Herald* of course is jubilant at being selected and publishes a column or two of matter on the subject every day, declaring that it is made the representative of American journalism, the defender of the liberty of the press and the champion of the people's rights; the honor is accepted with "confidence that the result will be the annulment of a law that should never have blotted our statute book."

The naval militia has acquitted itself admirably during the week's drilling off Fisher's Island which has just come to an end, and the officers of the White Squadron, from Rear Admiral Walker down, are loud in their praises of the smart bearing and excellent discipline of the members of the battalion. Some capital practice was made with the big guns, the firing being at floating targets while the ships were steaming four knots; the *Herald* accomplished quite a feat of journalism by transmitting by telegraph a diagram of the target giving the results of the various shots fired from the different ships.

The grand jury has been investigating the hospital and ambulance service of the city and has just made a presentment regarding the defective system of sending in calls for ambulances. The jury considers it a libel on the development of this great city that it is without a comprehensive system of signal boxes or stations scattered through the streets in large numbers from any of which an ambulance could be summoned to the prompt relief of an urgent case. It is urged that the board of police commissioners use all possible speed in selecting the most perfect system by which the entire patroling force of that department may be at all times in complete and rapid communication with the station houses, both for police purposes and for the relief of the ambulance service. When this selection shall have been made, after exhaustive competitive tests by the police department, prompt action is urged on the part of the board of estimate and apportionment in making the appropriation necessary to bring into existence this greatly needed addition to the useful functions of the city. This is a step in the right direction, and the general system of police and ambulance calls is something that is badly needed in New York. In such matters, New York, as the presentment says, is behind scores of smaller cities If the matter is carried through on the lines suggested by the grand jury, there will be an excellent opportunity for the electrical contractor.

Questions of surface traction are almost as active as the much discussed rapid transit schemes. There is now talk of another cable road on Sixth avenue. The Sixth avenue company tried to get an injunction against the Broadway company to restrain it from crossing the Sixth avenue tracks with the cable, on the plea that such a crossing—which is a matter of necessity for the Broadway road—would interfere with any cable that they might put down. The injunction was denied, and now the Sixth avenue road is asking for permission to use cable traction. The petition is put forward in the names of business men and real estate owners, but it is understood that the railroad company is in favor of using cable power and is backing up the petition, which is signed by over two hundred well-known business men who have places on Sixth avenue. A delegation from among these will appear before the sinking fund commissioners at the next meeting of the board and urge favorable consideration for the new scheme. Fourth avenue, wiser in its generation than its neighbors, scorns the clumsy mechanical devices that they are content to impose on the traveling public, and prefers the agile and independent storage battery car. The equipment of sixteen cars, idle since last January, when their accumulators were unable to overcome the high resistance offered by an injunction, is to be put in thorough working order at once. The cars have been removed to the factory of the United Electric Traction company, at Marion, N. J., to be repaired and overhauled generally. New batteries are to be provided, and the cars will probably not be in service again until late next month. The superintendent of the Madison & Fourth avenue railway says that the company will adopt the accumulator system definitely if the trial, which was broken off by legal proceedings before the specified time had expired, is satisfactory. He also said: "Of the cars that were used on our line, I have no hesitation in saying that, mechanically, they were entirely satisfactory, and by 'mechanically' I mean all their features, electrical and otherwise."

The president of the Consolidated Electric Storage company, which now owns the Brush patents, expects future business in electric traction by storage batteries to be pretty lively. The system will be immediately adopted at Washington, where the Metropolitan Street Railway com-

[illegible] cars in service at once, and in New Orleans the Carondelet street [illegible] Mr. [illegible]

tric traction by storage batteries has been prevented only by the uncertainty arising from the litigation. Electrical men will certainly be glad to see the storage battery cars have a fair chance to show what they can do. They provide the ideal system of electric traction for surface railways in cities, and if they can be made a success financially no city would be justified in allowing the use of either the cable or the trolley within its limits.

Electric railway matters excited some attention in Newark for a day or two last week. The Newark Passenger Railway company bought the line of the Rapid Transit Street Railway company for $1,000,000, and it may be mentioned in passing that the seventeen stockholders who owned the "Rapid Transit" line put into the enterprise just about a year ago exactly $200,000, so that they cleared a net profit of 400 per cent., which goes to show that electric traction systems are sometimes very profitable. A day or two after the transfer eighty of the motor men and conductors went on strike because the company that had acquired their line increased their hours of duty without increasing their pay. The cars were stopped for some time during the day, but the company soon got men to fill the places of the strikers, and although there was some disturbance the strike was very soon at an end. The amalgamated Newark Passenger Street Railway company will operate an electric railway between Newark and East Orange. In Orange, by the way, the common council is in doubt whether the streets shall continue to be lighted by electricity for the next five years, or a return be made to gas lamps. It is said that to return to gas lighting would mean a saving to the city of $7,500 a year. Surely, with Llewellyn park and all its wonders so near at hand, Orange will not discard electricity for the sake of such a trifling sum as $7,500 a year!

Last Saturday Mr. and Mrs. Edison gave a dinner at their Long Beach cottage to celebrate the victory in the incandescent lamp suit. The center piece for the table—a huge cake—was designed by an Orange caterer; it was surmounted by a trophy of incandescent lamps and a "rooster," and bore this inscription: "Victory. England—America. 1879—1891." Edison stock, by the way, in spite of the victory, has not been very strong during the past week. Yesterday 146 shares were sold at 96¾, or 3¼ per cent. below par, and the closing price was 94 bid, 97 asked.

Failures in the electrical business are the order of the day in this part of the country The sheriff has this week received an attachment for $15,000 against the Easton Electric company, late of No. 45 Broadway, in favor of Samuel Rowland, on promissory notes of the company made a year ago, and indorsed by P. Minturn Smith, the late president, and William D. Perry, vice-president. Other judgment have also been taken out against the company. The Easton Electric company was incorporated in October, 1889, with a capital stock of $1,000,000 to work the Easton system of electric lighting, which had been in use in Canada. The factory of the company was in Brooklyn. Two executions, aggregating $83,580, were received by the sheriff against the North American Underground Telegraph & Electric company, formerly of 45 Broadway, but no property could be found to levy upon. The company was formed several years ago with a capital stock of $5,000,000, to work the Johnstone system of underground conduits for electrical subways, but the system was not looked on favorably by the [illegible] Electrical Control or by the Subway company, and it was never adopted in New York. The North American company some time ago took proceedings to recover damages against the Consolidated Subway company for not using the system, but nothing came of the action, which was let drop after a good deal of [illegible]

W. H.

Pittsburg, Pa.

PITTSBURG, Pa., July [illegible] residents of Indiana, Pa., are determined to keep in the front rank. A few days ago the electors of West Indiana Borough voted on the question of lighting the town by electric light. Two weeks ago the Indiana councils decided to light their streets with [illegible] the rate of taxation in the west end is considered pretty high already [illegible] pass upon the [illegible] for the electric lights [illegible]

Francis P. Mann of the laboratory force of the Westing-

house [illegible] Manufacturing company left Pittsburg last week for [illegible] vacation.

The Duquesne Traction company has had its road now in operation for more than a month, and it has so far not been able to report a very brilliant success. As has been stated in this correspondence before, the company runs Pullman palace cars, equipped with Thomson-Houston motors. Experience has proved, however, since then that the equipment of one car with two motors was inadequate to the demands made on the motive power. Each of the motors was 15 horse power, and, irrespective of the fact that the cars themselves are rather heavy, the road has also a number of very heavy grades, and whenever the cars came to the bottom of one of these hills much difficulty was experienced in ascending them, especially when the cars were filled with passengers. The Thomson-Houston people have tried a number of schemes to get over this difficulty, and they have at last decided to attach another motor under each car, making the entire equipment for each car three motors. This is expected to obviate the trouble.

On last Wednesday the adjourned meeting of the stockholders of the Westinghouse Electric & Manufacturing company was held in the Westinghouse building. Mr. Westinghouse, who was himself present at the meeting, stated that the details of the reorganization of the company were being rapidly completed, and he expressed it as his opinion that everything would be ready within four weeks. B. L. W.

Minneapolis, Minn.

MINNEAPOLIS, Aug. 1.—The Western Union Telegraph company officials of New York have sprung a very agreeable surprise on the city authorities of Minneapolis, *i. e.*, that all its wires are to go under ground. An ordinance exists requiring all the telegraph and electric lighting companies to keep their wires under ground, but the authorities have never yet been able to enforce it with any degree of success. The North American Telegraph company's wires are still overhead, and also those of the Brush Electric company. The latter concern has abandoned the Dorsett conduit, which was laid over two years ago for its particular use. No reason is given for the unexpected decision thus announced by the Western Union company. It is therefore reasonable to suppose that an understanding exists between the Western Union and local officials that the other companies will be compelled to get their wires under ground at once. It is an exceedingly expensive enterprise for the Western Union, whose wires in this city are on most of the principal streets. It is a work, also, which will require considerable time before it is completed. The telephone company has made excellent progress in the work of laying its wires in underground conduits, most of them being already down. On lower Nicollet avenue, the principal retail street, and across the suspension bridge into East Minneapolis the telephone wires are still overhead, work having been delayed here by the construction of the bridge. The estimated expense of the Western Union work is $25,000. Two miles of conduit will have to be laid. The plans for the work are understood to have been completed, and a strong effort will be made to get the wires all underground before winter.

R. C. Clowry, vice president of the Western Union Telegraph company, recently dropped a few words relating to the policy of the company with reference to laying underground wires in this city, which indicated that nothing further [illegible] this [illegible] for the present at least. He holds that so long as the trolley wires of the street railway company and the wires of the North America Telegraph company and the Brush Electric company are above [illegible] of the authorities, the Western Union was scarcely under obligations to discuss a [illegible] and expensive as this would [illegible] get ready to put their wires under ground his company would be ready to consider [illegible]

[illegible] electrical and [illegible] Thomas Lowry [illegible] Mr. [illegible] have been satisfied with the magnificent achievement of building [illegible]

relinquish Mr. Lowry from his implied obligations to further extend the local electric railway system. Following close upon the announcement of his election to the presidency of the Soo, the city council has passed resolutions asking for several important extensions to complete the local system. Mr. Lowry has heretofore stated that it would be against the policy of the company to build any new lines, but that statement was undoubtedly made with the expectation that none would be asked by the city council. He has never yet been in conflict with the city government in any particular and he has more than met the council half way in the past. So it may be expected that next spring plans will be perfected and arrangements made for more inter urban electric lines, as well as many of equally great importance connecting Minneapolis with suburban localities. The headquarters of the Soo road being in Minneapolis, Mr. Lowry's personal attention need scarcely be divided between the street railway work and the duties of his new position, and he is not disposed to relinquish or even divide the responsibilities of either.

Julius Miner, chief engineer of the Milwaukee street railway, has been in the city during the week investigating the Minneapolis system in company with a few members of the Milwaukee council. General Manager Goodrich of the local company has been piloting the visitors around and giving them all the points possible with reference to the details of electrical construction. The visit of these gentlemen indicates that the local lines are held in high esteem as models of electrical street railway work.

One important decision of the city council at its last meeting was with regard to the extension of the Penn avenue line along Thirty-second avenue north to the city limits. Instructions were laid upon the street railway company to complete such an extension at once. This will close up the long desired connection between the Robinsdale electric line and the Minneapolis system. Its completion will give the inhabitants of Robinsdale facilities of connection with the city which they have long desired. Another matter considered at this meeting was to prevail on the street railway company to lay tracks on Twenty-ninth street from Hennepin avenue to Lake street, and thence to the city limits, where it will connect with the line for the Minneapolis Land and Investment company. This is the line which will connect with the new suburb of St. Louis park. It is reported that the line of the Investment company will use horse power for the present with a view of ultimately putting in electrical equipment.

The Northern Car company of this city, has just turned out some exceedingly fine cars for the use of the Minneapolis Street Railway company, and also a few for the Duluth electric system. It has been for some time busily engaged on eastern and southern contracts and is only now getting its works in shape for the accommodation of local business which has been offered to it. It has good facilities which were extended largely last spring, but it is still crowded for room and may find it necessary within a short time to make further additions to the plant.

The old equipment of steam motors, passenger coaches, and horse cars of the Minneapolis Street Railway company are fast passing away through advertising and other agencies. Nearly every little western town has some of the company's old equipment disguised with new paint and fixed up for the unexacting requirements of country use. One of the steam motors has been sold to a St. Paul suburban line. Helena, Mon., Billings, Duluth and La Crosse have drawn heavily upon the old bobtail equipment of the company and are using the old cars at present. F.

San Francisco, Cal.

SAN FRANCISCO, July 28.—According to the press dispatches which have appeared in the San Francisco papers during the last two months it appears that the Consolidated Electric Railway company of Los Angeles is determined to acquire control of all the horse and cable railway systems of that city, and that its principal ambition is to absorb the lines of the Pacific Cable Railway company. The latter corporation is now in the hands of a receiver, who charges that the electric railway people intend paralleling every one of the cable lines and resorting to other practices tending to depreciate the values of its securities. These charges are denied by the officers of the electric company, and it is believed that the cable people, who commenced operations comparatively recently, after having expended over a million dollars in construction, [illegible] find an escape for their unwise investment. The Pacific Rolling Mills of San Francisco hold [illegible] Consolidated Electric Railway company for acquiring the right of way and the building of [illegible] or ten miles of double track, complete with power house and all machinery and equipment, the contract price being $675,000, one-third of which is to be paid in cash and the balance in first mortgage $1,000 bonds bearing 6 per cent, to be secured by a trust deed of all the real estate, franchises and other property of the company. The contract was dated December 24th last, and agreeable to its terms, the Second street division was completed July 1st, and six miles of double track of the second division is to be completed by October 1st. The electric company's franchises cover 50 miles of streets, and its new power house, just completed, is somewhat indefinitely reported to have "a capacity for 200 miles." The trouble between the two rival companies has been carried into the courts by an action brought by the electric road to compel the cable company to permit the electric road to run over portions of the cable company's tracks over which the electric road has franchises. The court has intimated very plainly that it would grant the required permission, but no order can be issued until a jury has fixed the compensation. As already intimated the cable company regards the action as an effort to force it to the wall, particularly as the company is in financial difficulties. Considerable cable stock is held in Chicago, and the stockholders there are endeavoring to effect a reorganization, in which event the present horse car lines of the system will be equipped with electricity.

John W. Hearst, representing San Francisco and Oakland capitalists, has applied to the Oakland council for an electric railway franchise for a line from Twenty third avenue station to East Sixteenth street, thence east to and along the Old County road to the Redwood road, along which it will run skirting the foothills to Mills Seminary and Haywards. A branch road will run from the Redwood road along the foothills down through Hays canyon to Temescal and Emeryville. The projectors claim that the views of the city, bay, Golden Gate and ocean scenery, will make this the finest street car ride in the world. The road, as projected, will be nearly 30 miles long.

The Oakland Consolidated Street Railroad company, which operates the Oakland and Berkeley electric road, and which contemplates building an electric road from West Oakland to Twenty-third avenue, has decided to issue $500,000 of 6 per cent. first mortgage, 20 year bonds to be used for construction purposes. Six 28 foot combination double end cars and six smaller cars, to be used with trailers, are now being built for the Berkeley line

The newly elected directors of the Santa Monica Wharf & Terminal Railway company believe it may be practicable to operate their terminal system by electricity and are looking into the matter. The company is to connect Los Angeles by lines of standard broad gauge railroad with the seaport towns of Santa Monica, Redondo and San Pedro, and, with all its branches, wharf and shipping facilities, will probably consist of 75 miles of track. Here is evidently a possible opportunity for the relegation of the steam locomotive.

The Reno Nev., Water, Land & Light company which owns the gas works, has secured control of the Reno Electric Light company, which gives it the monopoly of furnishing light in that city.

Louis Glass, of the Pacific Phonograph company, the telephone company and other local interests, has been appointed manager of the Edison General Electric company, Pacific States district, vice A. H. Reese, who has been transferred to the Southern district, with headquarters at Atlanta.

It is stated that the anti-trolley men have carried the day in San Francisco and that consequently the erection of overhead electric railway circuits in this city will be prohibited within the business section. No final action has been taken as yet, but a member of the Board of Supervisors who favored overhead railway circuits is authority for the statement made.

The old directors and officers of the California Electric Light company were unanimously re-elected for the ensuing year at the annual meeting of stockholders. The action of the directors in effecting the organization of the Edison Light & Power company, and in consummating the sale of the plants, franchises and entire central station interests of the California Electric Light company in San Francisco to the new company, was approved. Of the 50,000 shares of capital stock, 31,425 were represented at the meeting.

The Citizens' Light & Power company has been organized at Seattle, Wash.; capital stock, $50,000. It proposes to enter into the central station and electrical supply business. S.

The Greensboro, N. C., Female College association has let the contract for an electric light plant and other improvements at a cost of about $[illegible],000.

PERSONAL.

Superintendent Church of the Chicago Edison company returned from an eastern vacation trip last week.

D. B. Dean returned from the East last Tuesday, bringing with him several fine contracts for the Electric Merchandise company.

W. R. Mason of the Electric Merchandise company left for New York and Richmond on Wednesday to be absent ten days on a business trip connected principal'y with the interests of the Burton heater.

Gerald E. Fish, formerly superintendent of the Chicago Arc Light & Power company, and lately appointed superintendent of electric lighting at Little Rock, Ark., has been elected to the office of city electrician of Little Rock. Mr. Fish is to be congratulated on his rapid advancement.

NEW INCORPORATIONS.

Virginia City company, Portsmouth, Va ; capital stock, $1,000,000; water, electricity and gas works.

App'eton Edison Electric company, Appleton, Wis.; capital stock, $100,000; general electric business; A. L. Smith, Appleton, Wis.

Cambridge Electric Light & Power company, Cambridge Washington county, N. Y.; capital stock, $7,000; to supply electricity for light, heat and power.

Realty Development company, Norfolk, Va.; capita stock, $25,000; real estate and improvements, streets, bridges, water and gas works, electric works, etc.

Washington Charlottesville Construction company, Charlottesville, Va.; capital stock, $100,000; water, gas and electric works, mining, manufacturing, building, etc.

Radford Water, Light & Power company, Radford, Va.; capital stock, $1,000 000; water, electricity, gas and steam works, and machinery therefor, real estate and improvements.

Lincoln Street Railway company, Lincoln, Neb.; capital stock $2,000,000; to continue business as conducted by the Lincoln Street Railway company and the Lincoln Electric Railway company.

Van Gestel Incandescent Lamp company, Denver, Col.; capital stock, $200,000; manufacturing, buying and selling incandescent lamps, storage batteries, etc., and all kinds of electrical appliances.

Edison Light, Heat and Power company, Wheeling, W. Va.; capital stock, $500,000; to supply light, heat and power by electricity to people of Wheeling, W. Va.; N. E. Whittaker, Wheeling, W. Va.

Riverside Edison company, Riverside, Ill.; capital stock, $40,000; to erect, own and operate a plant for producing and distributing electric light and power; A. G. Barnes, Room 42, 115 Monroe street, Chicago, Ill.

Ashland & Centralia Electric Railway company; capital stock, $20 000; to conduct an electric street railway from Ashland, Schuylkill county, to Centralia, Columbia county, Pa; J. N. Minogue, Ashland, Schuylkill Co., Pa.

Spring Hill Street Railway company; capital stock, $12,000; to operate an electric street railway from O'Hara street and Madison avenue, Allegheny, to Reserve township, Allegheny county, Pa; J. H. Goehring, Pittsburg, Pa.

Fottrell Insulated Wire company, Philadelphia, Pa.; capital stock, $200,000; to manufacture insulated wire and cables, insulating materials and compounds, and electrical appliances; J. B. Colahan, Jr., 509 Drexel Bldg., Philadelphia, Pa.

Chicago Electric Manufacturing company, Chicago, Ill.; capital stock, $10,000; to make, use, sell, patent and exploit all kinds of electrical devices, appliances and machinery; Francis W. Parker, 1007 Opera House Block, Chicago, Ill.

Mt. Pleasant Electric Street Railway company; capital stock, $50,000; to operate an electric street railway from Mt. Pleasant township to Morewood in East Huntington township, Westmoreland county, Pa; Jas. S. Beacon Greensburg, Pa.

Roland Park company, Baltimore, Md,; capital stock, $1,000,000; buying, selling, leasing, mortgaging and dealing generally in lands in the state of Maryland; also to manufacture and supply gas or electric light outside the limits of Baltimore.

Norwood Park and Maine Electric Railway company, Chicago, Ill.; capital stock, $250,000; to operate and construct a line of street railway from a point in the village of Des Plaines to a point in Chicago, to be operated by electricity or other motive power; M. E. Cole, 99 Washington street, Chicago, Ill.

Boston, Mass , & Great Falls, Mont., Electric Light and Power company, Jersey City, N. J., and Boston; capital stock $150,000; to manufacture and use electricity for producing light, heat and power and construct, operate and maintain and purchase, sell and rent, mortgage and otherwise acquire electric light and power companies, lands, buildings, machinery and rights, and privileges appertaining or incidental thereto; Wallace D. Dickinson, Great Falls, Mont.

ELECTRIC LIGHT.

Another electric lighting company is being organized at Charleston, S. C., which, it is said, depends upon Philadelphia capital. It is to be known as the Economic Light [illegible] Power company, and will be capitalized at $100,000.

There is some talk of the formation of a new electric lighting company in Indianapolis.

The Hyde Park Electric Light & Power company of Chicago has increased its capital stock from $100,000 to $500,000.

The Montgomery Box company, Montgomery, Mo., has purchased a 500 National incandescent dynamo, with 40 National 32 candle power street lights.

The Chicago Edison company has installed 24 Ward arc lamps on an incandescent circuit in the drill hall of the First regiment armory on Michigan avenue, Chicago.

The Fort Wayne Electric company has lately secured large contracts in Wheeling, W. Va., Independence, Mo , and Grand Rapids, Mich. In Philadelphia it is installing its ninth central station.

A telegram from New York, August 3d, announces that fire destroyed the big plant of the Richmond Electric Light, Heat & Power company at St. George, Staten Island. The building was valued at $200,000, and was a total loss.

A special dispatch from the Brush Electric company of Minneapolis announces that the contract for the underground wire has been awarded the Standard Underground Cable company. This is the contract about which there has been so much competition during the last few months.

At the annual meeting of the stockholders of the Electric Improvement company, San Jose, Cal., it was decided to increase the capital stock to $1,000,000. Extensive improvements will be made in the works, and it is proposed to put in an all-day incandescent light service, so that there will be a continuous service night and day.

From Buffalo, N. Y., comes the statement that the conduits built for the Brush Electric Light company, but which on account of legal entanglements the company cannot use, have been attached by the sheriff of Erie county. The Brush company is the complainant, claiming $15,000 damages. The sheriff is now in possession of all the conduits and wires of the Cobb company in Buffalo. George J. Sicard, counsel for the Brush company, says that this step has been taken to obtain possession of the conduits without unnecessary delay.

The Minneapolis Electric Street Railway company has just installed a 100 light arc plant, combining the Excelsior generator and the Thomson-Houston lamps, 35 lights being used to light the central station and grounds in Minneapolis, and 65 for the suburban track and the pavilion and grounds at Lakes Harriott and Calhoun The circuit is 14 miles in length, extending along the track to these popular resorts, quite a number of the lights being put in use along the route. The current was turned on July 25th and everything worked satisfactorily.

ELECTRIC RAILWAYS.

It is reported that the Belt Line Railway company of Washington, D C., will try the storage battery system.

E. T. Lynch of New York has obtained the contract to build the North Highlands Electric road at Co'umbus, Ga.

An electric street railway line operated by the storage battery system is shortly to be established at Newton, Mass.

The North Avenue Railway company of Baltimore, Md., which is building an electric railroad, has increased its capital stock from $100,000 to $500,000.

On Friday of last week, "circus day," the Rochester, N. Y., Railway company is said to have carried 60,000 people in 140 cars, of which 65 were motor cars.

The Calumet Electric Railroad company of Chicago has agreed to pay 2 per cent. on its gross receipts to the city during the period of construction, being the first three years, and after that period 5 per cent.

The Citizens' Street Railroad company of Indianapolis is pushing the work of construction, expecting to have the new Irvington and North Indianapolis lines in operation by August 10th. Superintendent Steele says that twenty-two new motors have been ordered. These in addition to the sixteen now in use, will enable the company to give first-class service on all the lines.

The English electrical journals occasionally express doubts as to the progress made in this country in electric railways. The London *Electrical Engineer*, however, has evidently experienced a change of heart. In its last issue the following note appears: "Is not the St. Paul, Minneapolis, and Manitoba Railway company, which is coming before the British public this week for £1,000,000 mortgage bonds, just exactly that company on whose line (between St. Paul and Minneapolis) the trains have ceased running, owing to the vigorous opposition of the electric railway? The line spoken of is probably only of small length, but that a line is already forced to give up such a service by reason of this opposition is suggestive of troubles to come."

ELECTRIC MOTOR.

Two young business men of Des Moines, Iowa, Schiller Kurtz and A. I. Lee, have an electrically propelled boat, the Gayle Lee, with which they attract attention when they go boating on the Des Moines river. The power is obtained from secondary batteries, which operate a two horse power motor. The storage cells were furnished by the [illegible]

ELECTRIC MINING.

[illegible] and mill. The plant is reported an unqualified success.

[illegible] contract for eight electric drills from the Poorman Mining company at Burke, Idaho. They will be put in operation at once. A complete electric plant for the operation of the [illegible] greatly increased.

TELEGRAPH.

In the lower house of the Austrian Diet the Marquis von Bacquehem, minister of commerce, recently stated that there was a prospect of the establishment in the course of the year of a direct telegraph line connecting Vienna, Munich, Paris and London.

There are 7,600 postal telegraph offices in Great Britain and Ireland. The charge for telegrams to all parts of the United Kingdom is 12 cents for the first twelve words, including the address, and one cent for every additional word. Postage stamps, such as are used on letters, are used in payment, and the sender must affix them to the message.

"It is said that the comparative activity in Western Union," says the *Daily Financial News*, "is due to the report that with the closing fiscal year, on September 30th, the directors will promptly declare an extra dividend of 1 per cent, as the statement will show something like 9½ per cent. for the 12 months, out of which the money will be taken to repair the damage to 195 Broadway caused by fire, etc"

A press dispatch from Washington says that Second Comptroller Gilkeson has approved bills of the Western Union Telegraph company amounting to $166,000 for telegraph service for the United States signal bureau at the rates established by the postmaster general. The company has notified the secretary of the treasury that it will accept payment at the rates named under protest until the question of the legality of the ruling can be judicially determined.

TRADE NEWS.

H. N. Bates & Co. of 120 Pearl street, Boston, manufacturers of traction pulley, and machinery, are about to move into quarters double the size of those now occupied. Their new catalogue will soon be ready for distribution, and it promises to excell all previous ones of their issue. They are now filling a number of large orders in Maine and Massachusetts.

The Engineering Equipment company of New York and Boston announces that its business is steadily increasing. It has just taken charge, as sole eastern selling agent, of the Boston office of the Underwood Manufacturing company, whose cotton-leather belting it will now push in the Eastern market. This company is also pushing the Indurated Fiber pipe in New York and Boston.

H. A. Reed, manager of the Bishop Gutta Percha company, has several samples of insulating material, which have been used as a cable covering, and which have been in water for eleven years. So far as could be seen they were in as good condition as the day they were made, being soft and pliable, showing conclusively that this material, if properly made, would stand for an untold period with ordinary usage.

Under the heading "Kind Words" the Fort Wayne Electric company has issued fac simile copies of about forty letters received by the Board of Public Works of the city of Jamestown, N. Y., in response to inquiries as to the efficiency of the Wood arc lighting system. All are highly commendatory in tone and form a flattering testimonial to the excellence of the apparatus. The Jamestown people put in the Wood system.

The Reddi g Electric company, 41 Federal street, Boston, has on the market an improved watchman's register. It is claimed for the Redding instrument that it is the only watchman's clock which gives a plain printed record. The record on many other clocks is made by needles which perforate the dial, making minute holes, very indistinct and hard to read. In the Redding system the register prints the number of every station in plain figures on the dial, showing the exact time of the watchman at each one. The company is also introducing the "Electrix" specialties, among which are the latest and most improved forms of gas attachments, ceiling cut-outs, single pole and double poleswitches, , sockets, etc.

A. C. Fletcher, doing business under the name of the Fletcher & Fletcher company [illegible] interest to Herbert [illegible] been connected with the business, the general public knowing him as "the other [illegible] unusually prosperous, and Mr. Gray will probably continue it under the old name [illegible] from an attack of asthma for some time and is obliged to get away from the lake winds at Cleveland, and will probably locate in Denver, taking up some form of electrical work in that city. Mr. Fletcher is an active energetic business man, and will undoubtedly succeed wherever he may locate.

The [illegible] activity in the territory [illegible] Chicago and St.

Louis offices. In addition to the two 400 horse power Armington & Sims engines now being furnished the Edison station in Chicago it has just started 250 horse power [illegible] in the station of the Cicero & Proviso Electric railway. This is the second electric railway now in Chicago, both of which are using Armington & Sims engines, furnished by the Pond Engineering company. It is furnishing the Murphysboro Water Works & Electric Light company an Armington & Sims engine of 120 horse power; also a complete steam plant for the Grand Ridge, Ill., Electric Light company, and one automatic engine, vertical pattern, to the Chicago office of the Edison General Electric company.

The Ball & Wood company is the sole manufacturer of the Improved Ball engine, and is now ready to deliver engines from its new shops at Elizabeth, N. J. The officers of the company are gentlemen who are well known to engine buyers, and are well posted as to the requirements of the business. They state that it will be their policy to anticipate, if possible, the requirements of the trade and with this in view they have designed and built, in addition to other types of engines, a vertical compound engine of 500 horse power for central station and railroad work, which is highly spoken of by all who have seen it. They are now prepared to furnish all types of engines, simple, tandem or cross compound, condensing or noncondensing, triple expansion, vertical or horizontal. All engines will be furnished with the governor. W. B Pearson & Co, 401 to 403 Home Insurance Building, are the Chicago agents for the Ball & Wood company.

BUSINESS.

The Creaghead Engineering company of Cincinnati is bringing out several specialties looking to the perfection of trolley line insulation, using glass as the medium. Several new forms are now being patented, and when perfected will be placed on the market.

The Chicago Electric Motor company has purchased the necessary machinery for a general repair shop in connection with its manufacturing business, and will rewind and repair armatures for railway and other motors and generators of all makes.

The Bush Revolving Store Fixture company, 24 Park place, New York, has just completed and put on the market a triple spool motor, to be run by a current of two volts and two-tenths of an ampere Instead of a commutator contact points are used. These motors are used principally on revolving store fixtures, and one motor will propel three to five tables with two cells of Edison "G" battery.

The Electrical Supply company, 104 Michigan avenue, Chicago, reports that general business is unusually large for the present season of the year. It finds that the new and commodious building is proving quite an attraction for out of town customers, as well as those in the city. Its sale of Sunbeam lamps keeps up to a phenomenal degree for the summer, which seems to indicate that they are finding much favor with consumers in general. The demand for Habirshaw wire still continues.

The C. E. M. jack-knife switch, made by the Consolidated Electric Manufacturing company, is having a large sale, and is pronounced one of the best current breakers on the market. The C. E. M. company is also doing a good business with its new key socket, and the new Davis arc cut-out switch is being shipped all over the country and Europe. Many other new and useful inventions are being pushed forward by this company, and under the new management success is assured.

The Law Telephone company, 85 John street, New York, has just issued a new and attractive pamphlet setting forth the merits of the improved Law battery, the Bailey current regulator, milliampere meter and Dubois-Raymond coil Simplicity and durability are the two principal claims made for these appliances. The book contains many flattering testimonials from well-known physicians in all parts of the country, from which the popularity of these appliances among the medical fraternity may be judged.

The Copenhagen Electric Alarm company, 92 Sycamore street, Cincinnati, is meeting with flattering success in the introduction of a new thermostat fire alarm system for buildings, which has recently been perfected. The com[illegible] Cincinnati [illegible] equipped [illegible] giving satisfaction. The ap[illegible] on the market a few months, but [illegible] from other cities. The company [illegible] at Auburn, N. Y.

[illegible] company has [illegible] 20 feet [illegible] aluminum [illegible] 2 [illegible] wide [illegible] guaranteed [illegible] one of [illegible] num would give better service, requiring less labor in [illegible]

[illegible]

The Fort Wayne Electric company has booked orders since June 1st for 3,850 arc lamps with dynamo capacity, and 8,450 incandescents, as follows: Arcs.—United States Electric Light & Power company, Buffalo, N Y., 120; Complete Electric Construction company, Weehawken, N. J., 80; Southern Electric Light company, Philadelphia, Pa., 60; Thomas Grimwood, Atlantic City, N. J., 160; Mutual Electric Light company, Alliance, O., 40; Detroit Electric Light & Power company, Detroit, Mich, 80; Fort Wayne Electric company, Coney Island, N. Y., 50; Inter-colonial Railway company of Canada, Moncton, N. B., 25; Citizens' Electric Light company, Pueblo, Colo., 80; Joseph P. Witherow. Middlesboro, Ky., 60; Paris Gas & Electric company, Paris, Tex., 80; Geo. W. Kelley, Philadelphia, Pa., 80; W. J. Morrison, Toronto, Ont., 15; City of Pulaski, Pulaski, Tenn., 30; J. P. Smith, Peoria Ill., 160; Louisiana Electric Light company, New Orleans, La., 600; city of Chicago, Chicago, Ill., 120; Greenwich Electric Light & Power company, Greenwich, N. Y., 60; village of Cuyahoga Falls, Cuyahoga Falls, N. Y., 50; city of Galion, Galion, O., 40; City of Wheeling, Wheeling, W. Va., 480; City of Grand Rapids, Grand Rapids, Mich., 300; isolated plants at Chicago, Ill, 600; Isolated plants at Tacoma, Wash., 120; Fremont Gas & Electric company, Fremont Neb., 50; Bessemer Machine & Foundry company, Birmingham, Ala., 75, People's Gas & Electric company, Chillicothe, Mo., 50; Municipal Construction company, Chillicothe, Ill., 60; Brush Electric company, Buffalo, N. Y., 80; People's Electric Light company, York, Pa., 60. Incandescents.—Thomas Grimwood, Atlantic City, N. J., 650; Dallas Electric Construction company, Dallas, Tex., 650; Beloit Electric Light & Power company, Beloit, Wis., 650; Monticello Electric Light company, Monticello, Ill., 650; Thomas Spencer, Cumberland, Md, 650; city of Pulaski, Pulaski Tenn, 650; Frankford avenue Merchants' Electric Light company, Philadelphia, Pa., 1,200; Moundsville Electric company, Moundsville, W. Va., 1,200; University of Michigan, Ann Arbor, Mich., 300; Citizens' Electric Light company, Pueblo, Colo, 1,200; Bessemer Machine & Foundry company, Birmingham, Ala., 650; village of Cuyahoga Falls, Cuyahoga Falls, O., 300.

ELECTRICAL PATENTS.

Issued July 28, 1891.

456,558. Electrode for Secondary Batteries. Otis C. Flick, Brooklyn, N. Y.

Claim one describes a method of making electrodes for secondary batteries, consisting in casting or placing pure metallic lead into apertures, cavities or recesses or upon the surface of a metal or alloy that is not affected injuriously by the exciting liquid of the battery, then converting the pure metallic lead into a carbonate of lead or other salt or oxide of lead, and then converting said converted pure metallic lead into lead of a spongy or granular nature while held in the cavities or apertures or upon the surface of the plate.

456,574. Span Wire Insulator. Walter S. Jarboe, William P. Seibert and John White, Allegheny, Pa.

This invention relates to what are commonly known as "span-wire insulators"—that is, to a form of insulator employed to insulate the span-wire from which the trolley wire is suspended in the overhead system of electric railways.

456,593. Regulation of Dynamos Driven by Compressed Air. Victor Popp, Paris, France.

This invention relates to a method of operating dynamo electric machines from a system of compressed air distribution, and it consists in an arrangement of the dynamo and its driving engine.

456,598. Electric Arc Lamp. Francois L Sautter, Paris, France.

This invention has for its object improvements in electric arc lamps, and relates especially to the automatic maintenance of the luminous point in the focus of the apparatus in which the lamp is placed, whether a light house, a projector or any other apparatus.

456,600. Span Wire Insulator. William P. Seibert, Allegheny, Pa.

456,611. Cable Head for Electric Wires. Upton H. Balsley, Philadelphia, Pa.

456,612. Electro Motive Force Regulator. Edward M. Bentley, Boston, Mass.

This invention has for its object the regulating of electric generators or motors, which consists in dividing them into two sources of electromotive force, and completing the circuit of each source through a variable portion of the other.

456,622. Magnetic Separator. David E. Lain, Yonkers, N. Y.

This invention relates to an improved form of magnetic separator, and contains such an arrangement of parts that the material to be separated is subjected to the action of gravity and of a centrifugal force of variable amount, which tends to remove the material from an apron or barrel on which it is carried, while the magnetic line of force from a battery of magnets inside the barrel tends to hold the magnetic part of the material against the barrel.

[illegible] Alarm for Grain Bins. Walter G. Adams, Racine, Wis.

This invention relates to devices for elevating and transferring grain, etc., in mills, elevators and other [illegible], the object being to provide an indicator which will surely give an alarm when the discharge of [illegible] or when the [illegible] condition.

[illegible] Controlled Photograph Apparatus. [illegible]

[illegible] for [illegible] for Electric Wires. [illegible] St. Louis, Mo.

456,684. Electric Gas Lighter. Adolph Wunderlich, Cleveland, Ohio.

456,685. Automatic Electric Gas Lighter. Adolph Wunderlich, Cleveland, Ohio.

456,718. Coin Controlled Electrical Apparatus. Theodore L. Brooks, Port Byron, N. Y.

456,746. Medical Induction Coil. Henry A. Voelkner, Detroit, Mich.

456,803. Annunciator. William C. Dillman, Brooklyn, assignor to Owen Walsh, New York, N. Y.

This invention relates to improvements in that class of annunciators which are used in connection with speaking tubes. These speaking tubes are usually arranged in a building so that the tubes connecting with the various rooms will all center at a common point, usually the office, and in case a person in a distant room is desirous of speaking with the office it is necessary to give some kind of a call and to indicate which tube is to be used. The object of this invention is to produce a simple electrical device which will indicate the tube to be used.

456,804 Alternating Current Motor Michael Von Dolivo Dobrowolsky, Berlin, Germany.

This invention relates to such electric motors as are driven by a plurality of alternating currents of respective different phases. As is well known, motion is produced in the said motors in such a manner, that the alternating currents are caused to generate in a body of iron, constituting a field magnet, magnetic poles which continuously alter their position, and that an armature placed movably under the influence of the said poles is forced by the latter to partake of their motion. The improvement forming the subject of this invention consists in the particular arrangement and combination, with the motor, of the conductors serving to receive the operating currents.

456,817. Electric Circuit Changing Apparatus. Hammond V. Hayes, Boston, Mass.

This apparatus as a whole was designed as a marine telephonic outfit, and is intended for use on ships as a means of communicating orders or instructions and other necessary messages between the bridge and other parts of the ship. It is of course not restricted to such use, but is of such character and construction as to be conveniently employed under varying circumstances and conditions.

456,827. Clutch. William H. Johnson, Brooklyn, N. Y.

456,835. Electric Condenser Regulator. James McBride, Brooklyn, N. Y.

This invention has reference to apparatus for automatically controlling the supply of cold water to condensers in accordance with the quantity or pressure of the vapor which is condensed, the object being to obviate waste water, to secure a uniform vacuum and to insure that the quantity of water supplied to the condenser is always proportional to the quantity of heat or the pressure going to the condenser.

456,836. Railway Signaling Device. William Newcomb, Johnsonville, N. Y.

This invention has for its objects to provide automatic devices which are conjunctively operated by electricity and a moving locomotive or train of cars, whereby said rolling stock will be protected from collision with other trains.

456,843. Secondary Battery. Henry Pieper, Liege, Belgium.

The purpose of this invention is to increase the capacity and efficiency of the electrolytic system, and this is effected by artificially increasing the opposing initial resistance to the chemical decompositions by means of which the work is to be stored up.

Claim one is the method of increasing the capacity of primary and secondary batteries effecting their depolarization which consists in maintaining within the battery fluid gases in solution under pressure.

456,859 Electric Light Crane Charles H. Shank, Armourdale, Kan.

456,865. Show Stand. John W. Tyler, Dayton, Ohio.

456,888. System of Electrical Distribution. Morris Feilbogen, New York, N. Y.

This invention relates to an improved system of electric distribution; and it has for its objects to provide for interrupting the current of a constant electric generator or dynamo electric machine generating a constant current, so as to give the proper impulses to an industorium or a series of such devices to generate a secondary current, or a series of secondary currents to be employed in an electric light or working circuit, or a series of such circuits.

456,889 Electric Circuit Breaker for Secondary Generators. Morris Feilbogen, New York, N. Y.

456,908. Electric Hoisting Machine. George H. Reynolds, New York, N. Y.

This improved machine is adapted for operating by an electric motor, and is controlled by introducing a greater or less resistance in the electric current which drives the motor. It provides convenient means for varying the amount of resistance at will between wide limits.

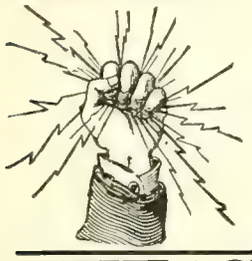
456,925. Armature for Motors and Generators. Norman C. Bassett, Lynn, Mass.

This invention relates to improvements in iron clad armatures, in which the armature coils, instead of passing over the periphery of the armature core, are passed through the perforations near the periphery, so as to allow the iron of the core to extend between and around said coils and form an iron periphery. The advantages of this construction in reducing the resistance of the magnetic circuit, and protecting the coils from injury are well known.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and is **guaranteed to be waterproof, and will not deteriorate, oxidize or crack,** and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS FANS

FOR ELECTRIC MOTORS.

MANUFACTURED BY

THE TURNER BRASS WORKS,

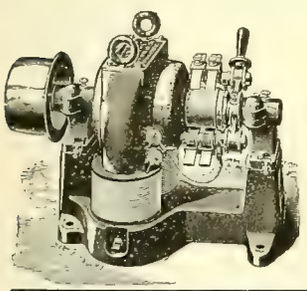
4 LaSalle Ave., Chicago.

Write us for prices.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. **Telephone, 1718.**

THE CROCKER-WHEELER PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

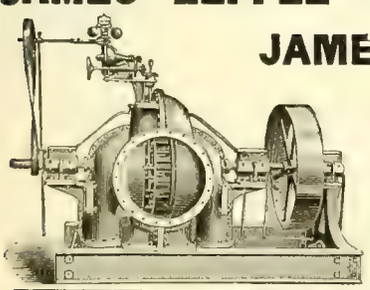
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS



BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

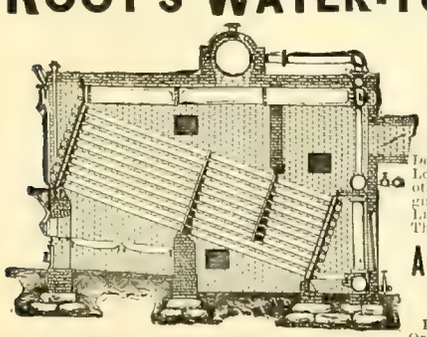
Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE.



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Electric Light Companies** of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City, and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass., and the Thomson-Houston Electric Co., Lynn, Mass.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

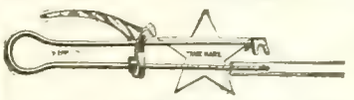
WANTED.

Position wanted by a man to take charge of an Electric Plant, Lighting or Street Railway; is a machinist by trade, and has four years' experience in Central Station work. Best of references furnished. Address **"Machinist,"** Care WESTERN ELECTRICIAN.

AN ELECTRICAL ENGINEER

ENERGY

STAR GAUGE GLASS CUTTER.



S. TAUSSIG, 45 River St., Chicago.

FOR SALE.

New 10 and 25 Light

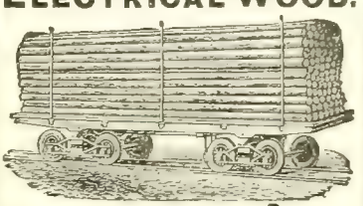
Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

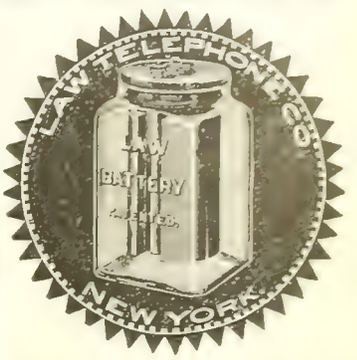
ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.



The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N. Y.**

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES

A SPECIALTY.

L. BLATZ, 103-107 West Monroe St., CHICAGO.

MEASURE YOUR INCANDESCENT LAMPS WITH

Queen's Portable Bunsen Photometer.

In every Central Station there is constant occasion to measure the candle-power of Incandescent Lamps, and to meet these requirements we have designed our **Portable Bunsen Photometer.** It is **compact,** gives **accurate results,** is **simple in operation,** and the **price is low.** Dimensions, 37 inches long and 5½ inches square. Total weight, 13 pounds.

PRICE, $30.00.

Indispensable to the Economical Operation of Every Central Station.

CORRESPONDENCE SOLICITED.

Send for Illustrated Catalogue of Electrical Test Instruments No. 165.

QUEEN & CO., PHILADELPHIA.

THE ELECTRICAL ENGINEERING AND SUPPLY COMPANY,

413 Jackson St., ST. PAUL, MINN.

Purchasing Dept., 931 Rookery, CHICAGO. Branch Office, DULUTH, MINN

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

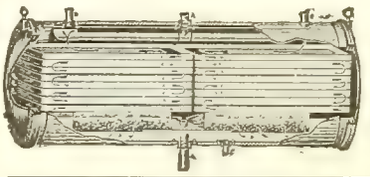
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

WANTED.

A mechanical engineer now holding responsible position in a large manufacturing concern desires to make a change, experienced in modern economical methods of manufacture, especially so in producing machinery and its products in quantities where jigs and duplicating machinery are required, also in the erection and testing of steam plants and in operating them to their highest economy, and in the manufacture of wire and wire working machinery; will be pleased to correspond with any party having a responsible position open, who requires the services of a competent, energetic man. Address **A. S. M. E.**, care of The WESTERN ELECTRICIAN.

FOR SALE. WEST END ST. RAILWAY COMPANY, 81 Milk St., Boston. This company having adopted the long car for traffic on its most populous lines, is now able to dispose of a portion of its box and open cars. Roads in want can be promptly supplied at advantageous prices. We invite correspondence, but believe an examination of our stock by a representative of parties in want would be to their advantage. HENRY F. WOODS,
JUNE 19, 1891. Purchasing Agent.

SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

Write for Prices and Samples. **S. TAUSSIG, Agent, 45 River St., CHICAGO.**

OLBURN ELECTRIC MFG. Co.

No. 180 MAIN ST.
FITCHBURG, MASS., U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

George P. Barton. Charles A. Brown

Barton & Brown,

ATTORNEYS AND COUNSELORS

Rooms 601 607 Temple Court Bldg.,

225 Dearborn Street, CHICAGO.

Patent, Trademark and Copyright Cases.

TRIPOD BOILER

Three Points of Superiority Guaranteed: **Safety, Economy, Low First Cost**

Repeated tests prove that it is absolutely **Non-Explosive** and the most **Durable** ever made.

Strong testimonials from hundreds of users, in all parts of the country.

Sizes 10 to 1,000 H. P.

For full information address,

HAZELTON TRIPOD BOILER CO.

809 Monon Block., CHICAGO, ILL.

TO AMERICAN INVENTORS.

Woodhouse & Rawson,

UNITED, LD.,

88 Queen Victoria Street,

LONDON, ENG.,

NEW YORK OFFICE, 36 WALL STREET.

Are Prepared to Negotiate and Introduce Inventions of Merit into Great Britain and all Parts of the World.

CORRESPONDENCE INVITED.

Fine Office Furniture and Folding Beds.

Brass and Wire Work. 215 Wabash Av.

A. H. Andrews & Co., Chicago.

To Colorado via BURLINGTON ROUTE

Only One Night On the Road.

Leave Chicago at 1.00 P. M., or St. Louis at 8.25 A. M., and arrive Denver 6.15 P. M., the next day. Through Sleepers, Chair Cars and Dining Cars. All Railways from the East connect with these trains, and with similar trains *via* Burlington Route to Denver, leaving Chicago at 6.10 P. M., St. Louis at 8.15 P. M., and Peoria at 3.20 P. M. and 8.00 P. M. All trains daily.

Tourists' tickets are now on sale, and can be had of ticket agents of all roads and at Burlington Route depots in Chicago, Peoria and St. Louis.

There is no better place than Colorado for those seeking rest and pleasure.

SLATE.

Six samples showing all finishes for $1.50.

T. J. MURPHY,

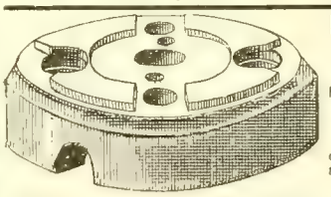
96 Columbus Ave., NEW YORK.

POWELL'S PATENT

LEVER UP—Shows oil dropping while machinery runs.

SIGNAL OILERS

Still in the Van as the BEST for **HIGH-GRADE ENGINES and DYNAMOS.** The drop-feed features prevent waste of oil which item alone will more than save their cost in a short time. **HAS OTHER EXCEPTIONAL POINTS OF MERIT.** Send for full descriptive circular. Address **THE WM. POWELL CO., CINCINNATI, OHIO.**



EMPIRE CHINA WORKS,

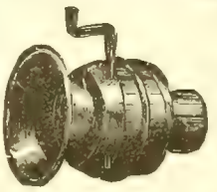
144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

Manufacturers of

OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

REMEMBER

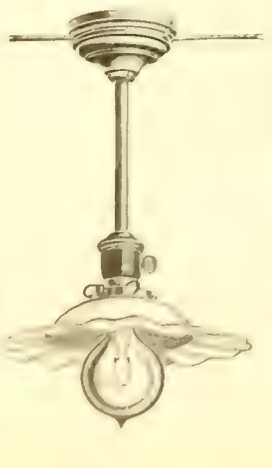
That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

FAN MOTOR,

—MANUFACTURED BY—

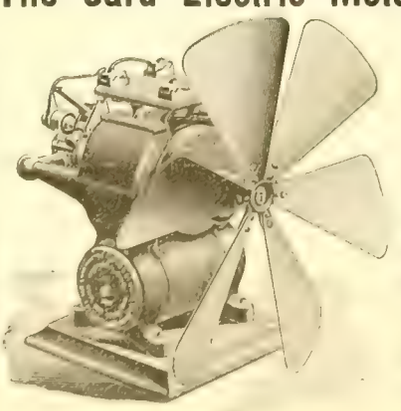
The Card Electric Motor and Dynamo Co.,

Cincinnati, Ohio,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits, from 1-6 to 50 H. P.

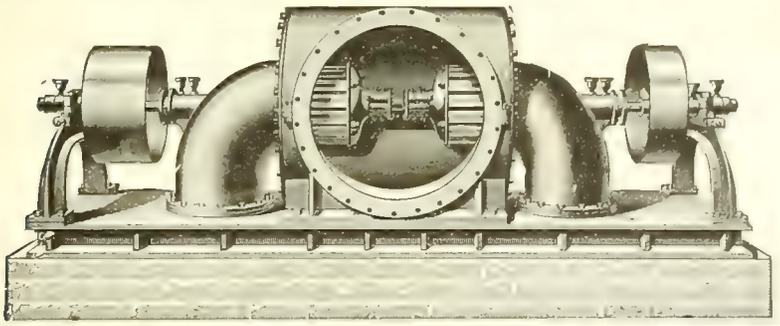
Correspondence Solicited.



AGENTS:

BOSTON—The Eastern Electrical Supply & Construction Co., 65 Oliver St.
CHICAGO—The Thos. L. Johnson Co., 312 Dearborn St.
MILWAUKEE—Henry Ramien, 641 Third St.
WASHINGTON, D. C.—J. Geo. Gardner, 1005 H St.
ST. LOUIS—Stagl Electrical Engineering Co., 1106 Pine St.
MONTGOMERY, ALA.—W. F. Murphy.
DETROIT, MICH.—The Michigan Electric Co., 212 and 214 Griswold St.
MINNEAPOLIS, MINN.—J. M. Lennon, No. 22 Loan and Trust Building.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES [illegible] CELEBRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity.** [illegible] being **double** the **Power** [illegible] number of the leading electric [illegible] ical use of water [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" [illegible] and it can be tested [illegible]

The accompanying engraving [illegible] **VICTOR TURBINES** arranged on [illegible] Tubes, End Bearings for Shaft and [illegible] a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ALUMINUM

IN ALLOYS 75c. PER POUND.

Aluminum in alloys equal in purity to any on the market, 75c. per pound for the contained Aluminum.

Cowles' Pure Aluminum in ingots is offered as low as that of any American concern; quality guaranteed.

THE COWLES

Electric Smelting & Aluminum Co.

LOCKPORT, N. Y.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),

DAYTON, OHIO.

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

FOR HANDLING

GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing.

Will carry two different kinds of material in opposite directions at the same time.

Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

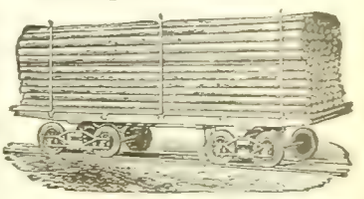
ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

VULCANIZED FIBRE CO.

ESTABLISHED 1878.

SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

OTHER PEOPLE

May Imitate Our Methods of Advertising

But They CANNOT Duplicate

THE

SUNBEAM LAMP,

STICK A PIN RIGHT HERE!

THE SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

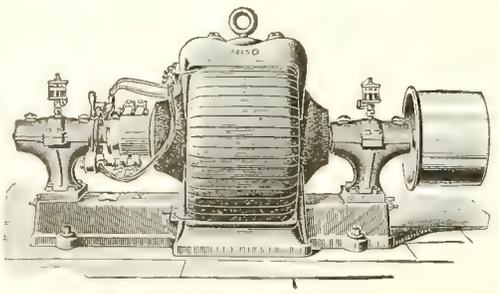
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



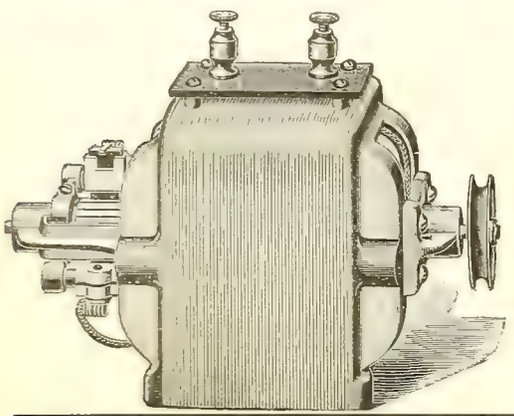
Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

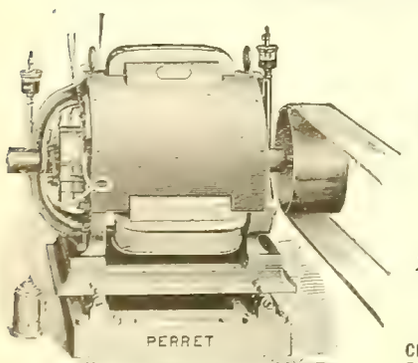
Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.



Perret 5 H. P. Motor, Speed 550, Weight 1,300 lbs.

—MANUFACTURERS OF—

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.

JOHN STEPHENSON CO.,

LIMITED,

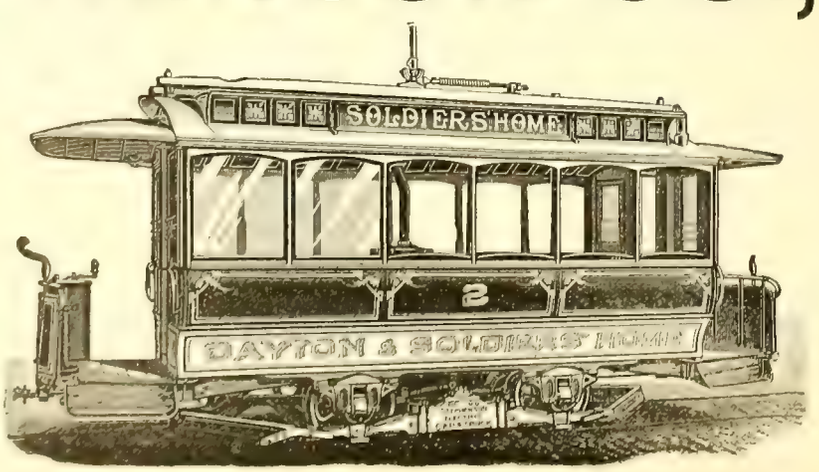
NEW YORK.

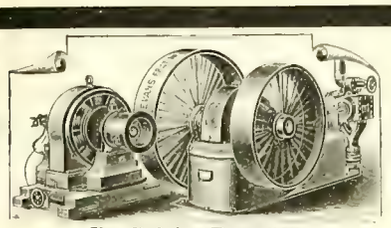
STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.



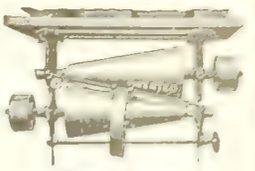


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones.
For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

THOMAS STURGIS, President. WM. C. LANE, Secretary and Treasurer. C. P. MACKIE, General Manager. S. S. BOGART, General Agent.

ELECTRIC SECRET SERVICE CO.,

45 BROADWAY, NEW YORK.

Owning the patents of Mosher, Gill, Hatch, Foote, Kintner and Moore for

INDIVIDUAL TELEGRAPH CALL AND CUT-OUT APPARATUS.

OTHER PATENTS PENDING.

The only practical and reliable system of electric selection invented.

Use either ***Morse Key*** or ***Automatic Transmitter.***

From every station selected an ***Automatic Answer back*** is received.

Gong rings until shut off by operator.

Any office on line can be selected without disturbing the others and either called up or cut out. No interference with regular telegraph service. No resistance added to main line. Easily applied. Economical. Convenient. Reliable.

Applicable to arc lights, singly or in groups; fire alarm service; police telegraph; electric motor circuits; railroad signals, etc.

The public is warned against infringing companies and devices.

For terms and other particulars, address as above.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

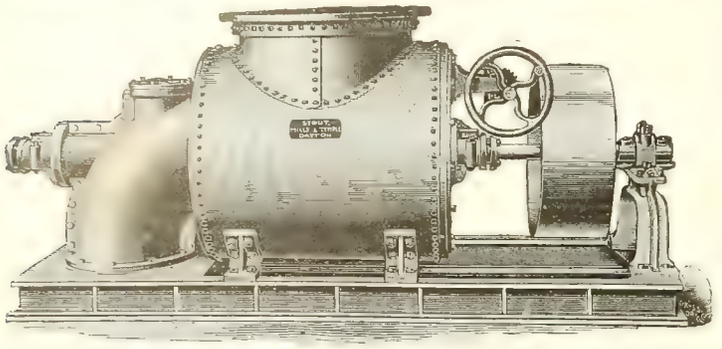
The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

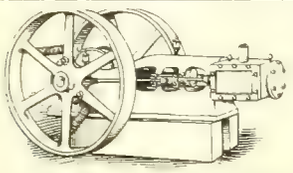
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North Street, BALTIMORE, MD.

Binders FOR THE Western Electrician **$1.00.**

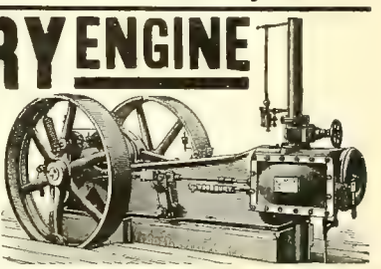
PLAYING CARDS.

You can obtain a pack of best quality playing cards by sending fifteen cents in postage to P. S. EUSTIS, Gen'l Pass. Agent C., B. & Q. R. R., Chicago, Ill.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO ERIE PA.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE.
—Catalogue sent on application.—
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



WESTINGHOUSE ENGINES

A FEW RAILROAD USERS:

	Engines.	Horse-powers.
Ashland Coal & Iron Railroad Co	1	60
Baltimore & Ohio Railroad Co	6	190
Boston & Albany Railroad Co	2	130
Camden & Atlantic Railway Co	3	75
Central Railway of New Jersey	4	275
Chicago & Erie Railway Co	2	30
Chicago, Burlington & Quincy Railroad Co	3	175
Chicago, Milwaukee & St. Paul Railroad Co	5	100
Chicago, Rock Island & Pacific Railroad Co	4	170
Colorado Midland Railway Co	1	25
Denver & Rio Grande Western Railroad Co	3	75
East Tennessee, Virginia & Georgia Railroad Co	3	325
George's Creek & Cumberland Railroad Co	2	50
Grand Trunk Railway Co. of Canada	12	500
Gulf, Colorado & Santa Fe Railway Co	3	135
Kansas City, Wyandotte & Northwestern Railway Co.	2	55
Newport News & Mississippi Valley Co	2	200
New York Central & Hudson River Railroad Co	4	125
New York, Lake Erie & Western Railroad Co	2	140
New York, West Shore & Buffalo Railroad Co	6	340
Northern Pacific Railroad Co	2	45
Pennsylvania & Northwestern Railroad Co	1	25
Pennsylvania Railroad Co	51	2330
Peoria & Pekin Union Railroad Co	1	55
Philadelphia & Reading Railroad Co	7	615
Pittsburgh, Cincinnati, Chicago & St. Louis Railway Co.	2	20
St. Louis & San Francisco Railway Co	3	260
Southern Railway Co	1	10
Wabash, St. Louis & Pacific Railroad Co	4	60
Washington & Georgetown Railway Co	1	15

Many foreign railroads unreported.

THE WESTINGHOUSE MACHINE COMPANY.
BUILDERS AGENT PITTSBURGH, PENNA. U.S. OF A.

FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO. HALF TONE PLATE SPECIALTY

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,

ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

"MERIT LEADS TO SUCCESS."

HEISLER

LONG DISTANCE SERIES INCANDESCENT LIGHTING

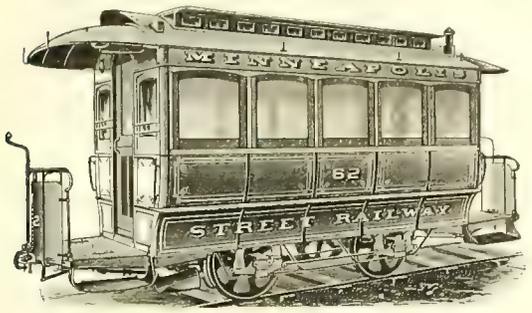
HAS NO EQUAL.

ONLY successful method of distribution covering a large area WITHOUT swamping the plant with INTEREST on Copper Wire or cost of FUEL.
Transformers or Converters are a CONSTANT source of TROUBLE and EXPENSE, will cost MORE for repairs in a year than to renew the Lamps by our system.
Our PLANTS can be operated with success ELECTRICALLY and FINANCIALLY where no others can.
Plant is SIMPLE, CHEAP and EFFICIENT.
Our 16 C. P. lamp noted for BRILLIANCY and BEAUTY of the light.
LONG SERIES LAMPS of any C. P. for Arc Light Circuits.
Gold Medal, Paris Exposition, 1889.

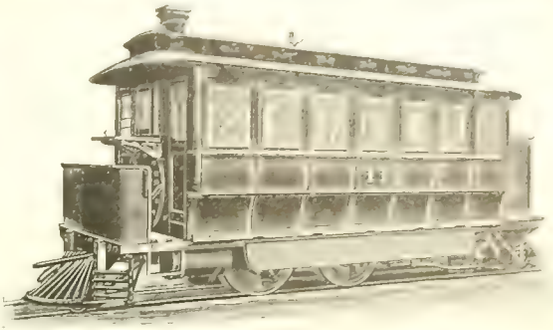
Estimates furnished on application, for erection of plants in any section. Correspondence solicited.

HEISLER ELECTRIC LIGHT CO., Drexel Building, PHILADELPHIA, PA.

Send for Circular.



STREET CARS



FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

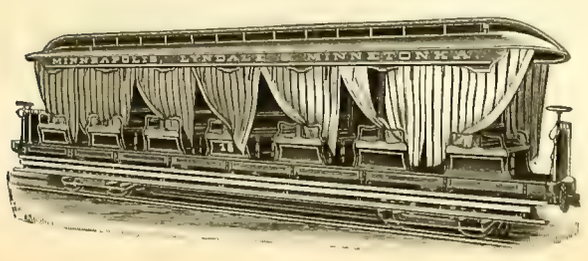
MINNEAPOLIS STREET RAILWAY CO.,

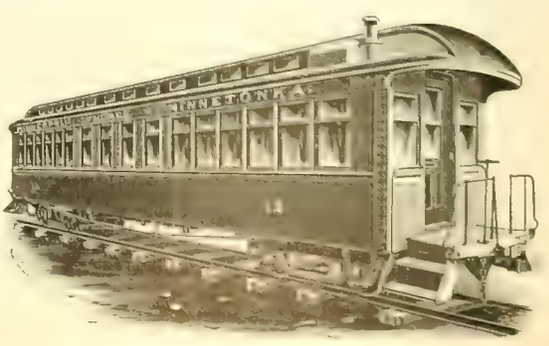
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

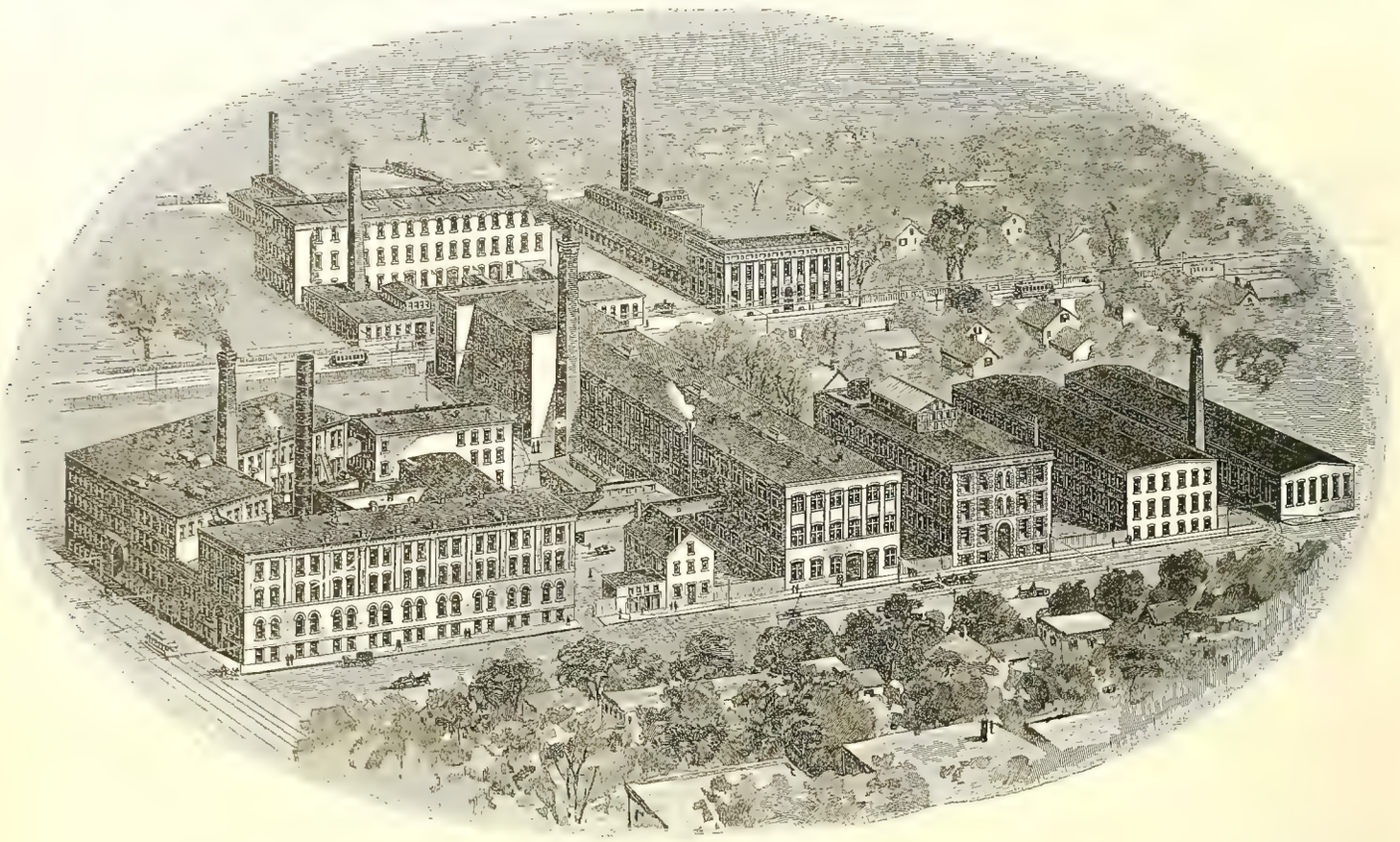
63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.

The KNAPP ELECTRICAL WORKS,

GENERAL AGENTS FOR

"SAFETY"

WIRES, CABLES AND CORDS

For Inside, Underground and Submarine Use.

"SAFETY" Fire-Proof House Wire. "ATLAS" Line Wire.

R. B. WATSON & CO., Agts., DETROIT, MICH.

J. W. MASON, Agt., 527 Delaware Street, KANSAS CITY, MO

POST & CO., Agts., CINCINNATI, O.

THE PERKINS ELECTRIC LAMP CO.

LAMPS

TO FIT ANY SOCKET.
ANY CANDLE POWER.
ANY VOLTAGE.
LONGEST LIFE.
HIGH EFFICIENCY.

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

54 and 56 Franklin Street, CHICAGO.

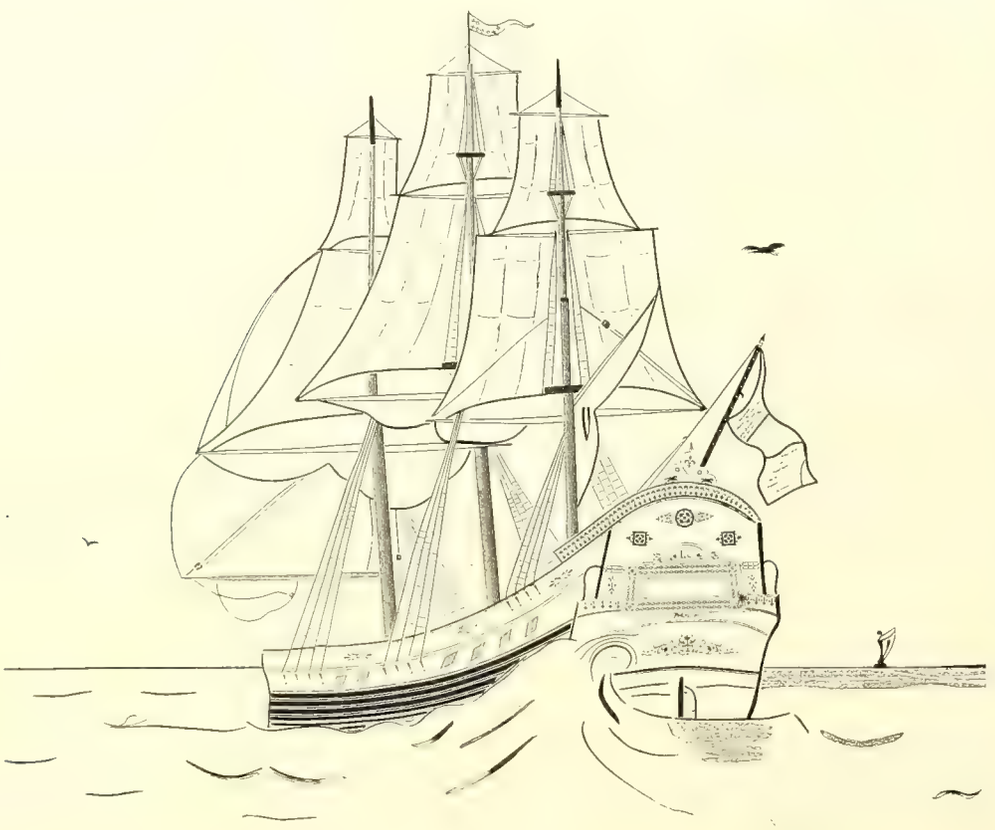
SEND FOR CATALOGUE.

The Electrical Supply Co.,

Corner **MICHIGAN AVENUE** and **RANDOLPH STREET,**

CHICAGO.

Factories: Ansonia, Conn.



Beware of little Expenses; a small leak will sink a great ship.—FRANKLIN.

The axiom which in Franklin's day was replete with Truth, is no less a vital law to-day. It applies as well to little ships as great ones, and to a host of other things about which you and we are more intimately interested.

It is suggestive of leaks in Insulation as well as ships.

We have regarded this so in the manufacture of Wires, and—but it matters not how well you listen to the sermon, if the precepts are not heeded and followed.

Have you used Shield Brand Moisture Proof Wire? Or have you cast aside our repeated asseverations of its merit and consigned them to the waste basket as simply another lot of trade prevarications?

"BE YE THE JUDGE."

HAVE YOU TRIED THE

ECONOMIC INCANDESCENT LAMP?

If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again*. Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

GEO. L. KIRKHAM, Manager. 1017 Chamber of Commerce, CHICAGO.

"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

WE GUARANTEE OUR LAMPS ELECTRICALLY AND MECHANICALLY.

In corresponding please give full particulars and state voltage.

ELECTRIC CONSTRUCTION AND SUPPLY COMPANY,

Phenix Bldg., CHICAGO, ILL. 18 Cortlandt St., NEW YORK CITY.

ESTABLISHED 1881.

ELECTRICIAN PUBLISHING COMPANY'S

HAND-BOOK SERIES.

22,000 Copies published to date. An Astonishing Record.

Each Work Sent Postpaid on Receipt of One Dollar.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

Dynamo-Tenders' Hand-Book.

By Lieut. F. B. Badt.

Fourth Edition, Eight Thousand Copies.

94 Pages, 70 Illustrations, Flexible Cloth Binding, Type Page 6x3 inches.

The only PRACTICAL Dynamo-Tenders' Instruction Book in the English language. Just the book for Dynamo-Tenders, Linemen, Stationary and Marine Engineers who wish to learn how to operate and care for electric light or power plants. Moonlight schedule for 1891.

Bell Hangers' Hand-Book.

By Lieut. F. B. Badt.

Second Edition, Four Thousand Copies.

106 Pages, 97 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches.

Designed for those engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat regulating apparatus, etc. The only book of the kind published.

Incandescent Wiring Hand-Book.

By Lieut. F. B. Badt.

Third Edition, Seven Thousand Copies.

72 Pages, 42 Illustrations, Flexible Cloth Binding, Type Page 6x3 Inches. Five Tables, 12x18 Inches.

These tables give *at once* and without any calculation the size of wire required in each case for any percentage of loss.

It is a book for practical wiremen and learners, and does not require any previous knowledge of wiring. It differs in this respect from other wiring tables, or computers.

The book contains full illustrations and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, wiring of fixtures, elevators, buildings, etc. The only book of the kind published.

Electric Transmission Hand Book.

By Lieut. F. B. Badt.

First Edition, Three Thousand Copies.

97 Pages, 22 Illustrations, and 27 Tables. Flexible Cloth Binding. Type Page 6x3 Inches.

This book contains all practical information for power producers, capitalists, agents of hydraulic and electric companies, engineers, motor inspectors and other persons interested in electric power transmission. By means of the tables anybody can find at once cost of plant for least operating expenses or for minimum first cost of installation.

The book gives all necessary information concerning [illegible] and rules for ascertaining [illegible] power of motors, driving various [illegible] machinery, as hoists, pumps, [illegible] fans etc. [illegible] and original tables give [illegible] on the subject in a [illegible] book heretofore published.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

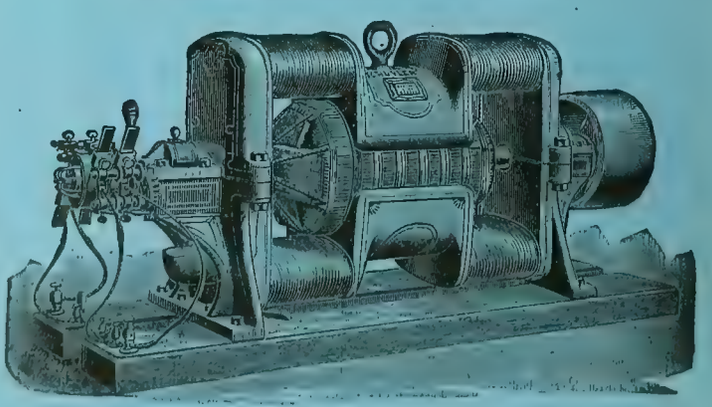
WORKS AND GENERAL OFFICES. BALTIMORE, MD.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, AUGUST 15, 1891. No. 7

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes
Telephonic transmission through Our Cable an easy
CAME.

An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices. Standard Underground Cable Co., New York, Pittsburgh, Chicago.

THE HOLTZER-CABOT ELECTRIC CO.,
MANUFACTURERS OF AND DEALERS IN
EVERYTHING ELECTRICAL.
SEND FOR 256-PAGE CATALOGUE.
111 Arch Street, BOSTON, MASS.
SPECIAL AGENCIES: { CLOWER & HARRIS, Dallas, Texas. / { PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.
A full line of our manufacture can be found at our Agencies.

WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

DO YOU WANT
A THOROUGH INSULATING PIPE?
AN INDESTRUCTIBLE PIPE?
PIPE TESTED SUCCESSFULLY?
THE PATENT INDURATED FIBRE PIPE
Costs less than iron and does better work in electrical subways and elsewhere.
SOLE AGENTS:
Engineering Equipment Co.,
143 Liberty St., NEW YORK.
126 Pearl St., BOSTON.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.
OKONITE TRADE MARK
INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.
BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP
AGENTS
J. W. PEALE, 1 BROADWAY, NEW YORK
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.
DAYS KERITE
The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.
Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.
GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.
THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.
Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.
STANDARD ELECTRICAL MEASUREMENT APPARATUS.

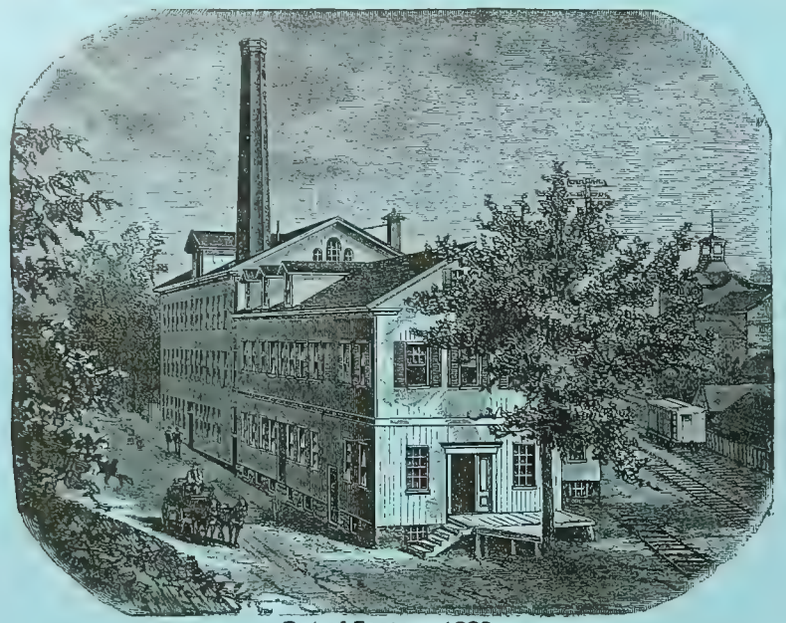
73-75 W. Jackson St. RELIABLE
WE ARE FITTED WITH RELIABLE Machinery and Tools,
And Employ RELIABLE Workmen.
All Kinds of Electrical Apparatus to Order.
CHICAGO ELECTRIC MFG. CO.

THE 1891 ELECTRIC MOTOR AND BATTERY.

SIMPLE. DURABLE.
ECONOMICAL. EFFICIENT.
For Offices, Sick-rooms, Restaurants Jewelers, Dentists, Confectioners, Amateurs, and at
ONE-HALF PRICE.
Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IS THE THOMSON-HOUSTON ELECTRIC CO.'S SYSTEM OF LIGHTING A SUCCESS?



Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, **1,653 Lamps.**	**None.**	**None.**

Cut of Factory, 1886.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, **21,840 Lamps.**	29 Companies, **11,275 Lamps.**	**None.**

Read the Answer on Page xx.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....xxiv
Abendroth & Root Mfg. Co....—
Alexander, Barney & Chapin.....i
American Electrical Works.....xiii
Andrews & Co., A. H..... xv
Automatic Switch Co..... x
Baggot, E.....xiv
Bain Electric Mfg. Co.....xvi
Ball Engine Co.....xviii
Ball & Wood Co., The..... xii
Baxter Electric Motor Co.....xxiv
Bernstein Electric Co.....—
Blatz, L.....—
Borden & Selleck Co.....xv
Braun Illustrating Co.....xiv
Brownlee & Co.....xii
Brookfield, Wm.....xii
Brush Electric Co.....xvii
Butler Hard Rubber Co.....—
C. B. & Q. R. R.....xviii
C. & C. Electric Motor Co. ...xvi
Card Elec. Motor & DynamoCo—
Central Electric Co..... ... v
Chicago Electric Mfg. Co..... i
Chicago Electric Motor Co..... xiii
Chicago Insulated Wire Co....xvii
Colburn Electric Mfg. Co..... xiv
Coolidge, Fuel & Supply Co... —
Consol. Elec. Mfg. Co., The.. —
Cowles Electric Smelting and Aluminum Co..... xiv
Crocker-Wheeler Electric Motor Co.....xiii
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co.xviii
Eastern Electric Cable Co.....xiii
Edison General Electric Co.,— Motor Dept..... vi
Edison General Electric Co., Cable and Wire Department.....vii
Electric Construction & Sup. Co.xxiii
Electric Merchandise Co..... iv
Electric Secret Service Co.....xxiii
Electrician Pub. Co.....xvii, xxiii
Elec. Construction Co., The....xiii
Electrical Engineering Co.....xiii
Elec. Eng. & Supply Co.,The..—
Electrical Supply Co., The...xxii
Elektron Mfg. Co..... xvi
Empire China Works.... xiv
Engineering Equipment Co.....i
Evans Friction Cone Co..... xvii
For Sale .....xii, xiii, xiv
Foster, O. A..... i
Fort Wayne Electric Co..... xxiv
Freeman, Coleman & Co..... xiv
Globe Carbon Co.... xv
Greeley & Co., The E. S.....i
Hale Elevator Co..... vii
Hazelton Tripod Boiler Co.....xviii
Heisler Electric Light Co.....vii
Hill Clutch Works..... xix
Hine Eliminator Co.....—
Holmes, C. H.....xiii
Holmes, Booth & Haydens... . viii
Holtzer-Cabot Electric Co.....i
Hood, Wm..... x
India Rubber & Gutta Percha Insulating Co..... viii
Interior Conduit & Insulation Co...iv
International Okonite Co.....i
Kartavert Mfg. Co..... iv
Knapp Electrical Works..... xxi
Law Telephone Co..... xiii
Leonard & Co., H. Ward..... iv
Leffel & Co., Jas.....xiii
Loud, H. M. & Sons Lumber Co. xiv
McLaughlin, James xiii
Mason, James H.....xiii
Milliken Bros.....iv
Minneapolis Street Railway Co..—
Monitor Electric Co..... x
Mosher Arc Lamp Co..... xiv
Munsell & Co., Eugene.....xiii
Murphy, T. J.....xiv
National Carbon Co.....iv
National Electric Mfg. Co.....ix
N. Y. Belting & Packing Co....—
New York Insulated Wire Co.... x
New York & Ohio Co..... i
N. W. Elec. Specialty Co.. ..—
Nuttall Company, R. D..... i
Ohio State University.....xiv
Ostrander & Co., W. R.....xviii
Paiste, H. T..... xii
Page Belting Co.....xv
Partrick & Carter Co..... x
Payne & Co., Geo. W..... —
Pearson & Co., W. B.....xviii
Phoenix Glass Co..... xix
Pond Engineering Co.....xviii
Powell Co., The Wm..... —
Purdue University..... xii
Queen & Co..... xiii
Rochester Railway Co..... xii
Rockford Electric Mfg. Co..... xii
Sargent & Lundy..... xiii
Sawyer-Man Electric Co.....xi
Schieren & Co. Chas. A..... xii
Schoonmaker, A. O.....xiii
Schuyler Electric Co..... xix
Short Electric Railway Co. xii
Shultz Belting Co.....xiv
Standard Underground Cable Co....i
Standard Paint Co.....xii
Stanley Electric Mfg. Co..... xix
Star Iron Tower Co.....—
Stearns Mfg. Co.....xviii
Stephenson Co., Jno.....xvi
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co.... xv
Taussig, S.....xiii
Temple, J. C..... xv
Thomson-Houston Electric Co. Lighting Department... ii, xx
Turner Brass Works..... ...xiii
Union Electric Mfg. Co., The..—
Union Electric Works..... iv
Union Hardware Co.....xii
U. S. Electric Lighting Co... .xi
Van Nuis C. S..... i
Vulcanized Fibre Co..... xv
Wanted .....xiii, xiv
Wenstrom Consolidated Dynamo & Motor Co., The x
West End Street Railway Co.. xiv
Western Electric Co.....viii
Westinghouse Elec. and Mfg Co—
Westinghouse Machine Co.... xviii
Weston Electrical Instrument Co. xii
Williams Engine Works.....xviii
Woodbridge & Turner Engineering Co xv
Woodhouse & Rawson, Ltd....—
Worthington, Henry R..... xii

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Hazelton Tripod Boiler Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Rochester Railway Co.
Stephenson Co., John.
West End Street Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Edison General Electric Co
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Engineering Equipment Co.
Fort Wayne Electric Co.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Colburn Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co,
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Brush Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Baxter Electric Motor Co.
Card Electric Motor & Dynamo Co.
Colburn Electric Mfg. Co.
C. & C. Electric Motor Co.
Crocker-Wheeler Electric Motor Co.
Electrical Engineering Co., The.
Electrical Supply Co., The.
Elevator Manufacturing Co.
Fort Wayne Electric Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors
Woodhouse & Rawson, Ltd.

Packing
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
Rochester Railway Co.
West End Street Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James
Stilwell & Bierce Mfg. Co.

Universities.
Ohio State University.
Purdue University.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

UNION ELECTRIC WORKS,

207 SOUTH CANAL STREET, CHICAGO, ILLINOIS.

The BEST ELECTRIC BELL in the market; Nickel plated Gongs; Double magnet, Platinum Contacts, side adjustment with set screw. The simplest and most durable Annunciator, all sizes, for elevators, hotels and offices.

— WRITE FOR PRICES. —

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class Work

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

THIS SPACE IS RESERVED BY

H. Ward Leonard & Co.

OF NEW YORK CITY,

WHO WILL UNDERTAKE A GENERAL

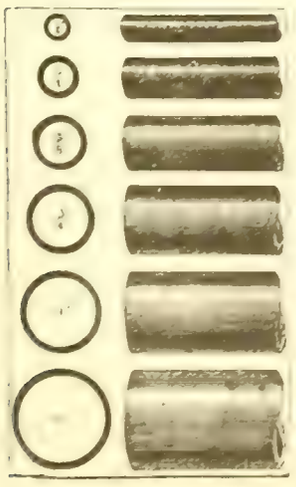
Electrical Engineering, Electrical Construction And Intelligence Business,

Commencing Sept. 1. 1891.

Write for Descriptive Circulars.

P. O. Box 2385, N. Y. City.

The SOLUTION of the PROBLEM of SAFE GUARDING ELECTRIC CONDUCTORS



Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

THE INTERIOR CONDUIT AND INSULATION CO.,

WORKS. 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

OKONITE TRADE MARK.

BANNER WIRE.

OKONITE

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 LOCUST ST., ST. LOUIS, MO.

GATE CITY ELECTRIC COMPANY,
522 DELAWARE ST., KANSAS CITY, MO.

A NEW WEATHER-PROOF WIRE.

Double, Triple and Quadruple Braid.

This is the best finished, best insulated, most durable and generally the most satisfactory of all the ordinary weather-proof Wires. Send for samples before placing your construction orders.

PRICES LOW. SHIPMENTS PROMPT.

Also GENERAL WESTERN AGENTS for

OKONITE TRADE MARK

AND

IMPROVED CANDEE WEATHERPROOF WIRES.

These Wires are positively the best of their respective classes.

BRANCH BLOCKS, SOCKETS,
MAIN CUT-OUTS, PAISTE SWITCHES
AND GENERAL ELECTRICAL SUPPLIES.

CENTRAL ELECTRIC COMPANY,

116 & 118 FRANKLIN ST.,
CHICAGO.

OKONITE TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., OMAHA, NEB.

Connected by private wire with Postal Telegraph-Cable Company's System.

OKONITE TRADE MARK.

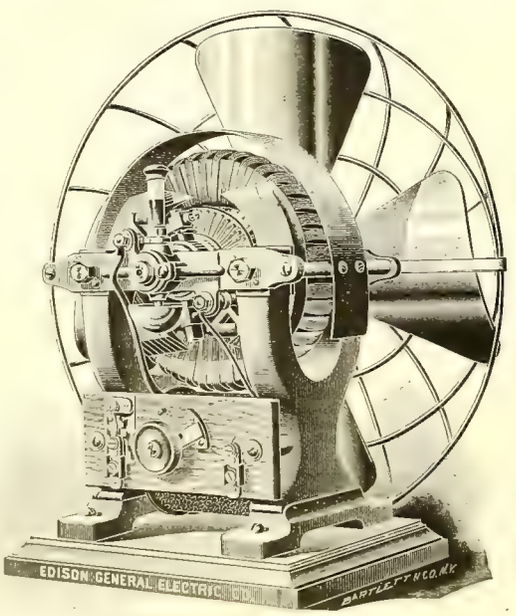
ELECTRIC POWER AND TRANSMISSION CO.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.

ELECTRIC FANS.

These Fans are operated by new Edison Slow Speed Motors, requiring Minimum amount of attention and lubrication.



They are compact and especially suitable for office desks and similar places.

Will operate on any ordinary Lighting Circuit without Wasteful Resistance.

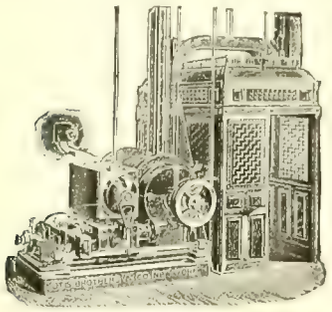
List Price, Motor and Fan, $42.50, less 45 per cent. to Users. Net, $23.36.

For Particulars Address Nearest District Office.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, 173 and 175 Adams St., Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

PASSENGER AND FREIGHT

Hydraulic and Electric ELEVATORS.

"MERIT LEADS TO SUCCESS."

HEISLER

LONG DISTANCE SERIES INCANDESCENT LIGHTING

HAS NO EQUAL.

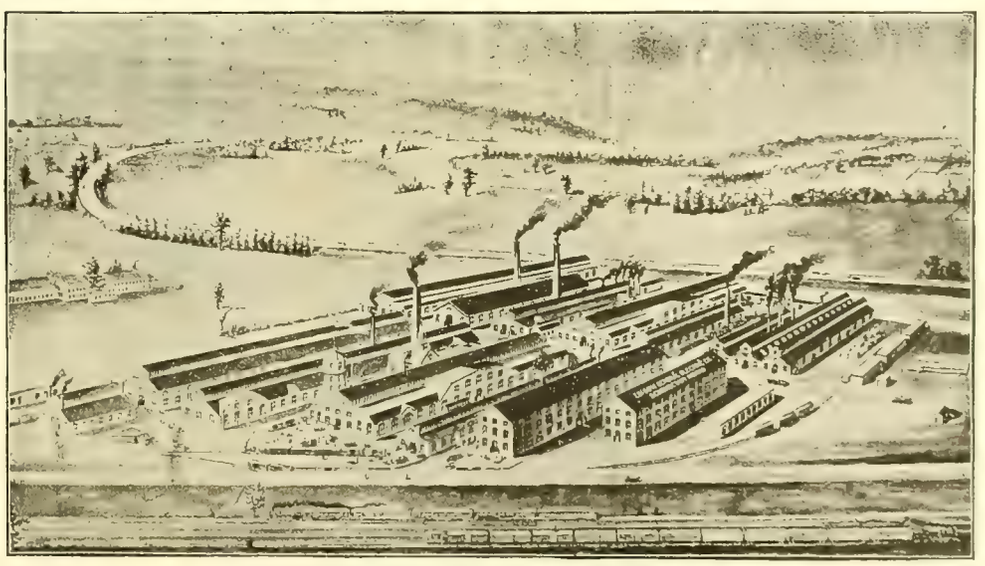
ONLY successful method of distribution covering a large area WITHOUT swamping the plant with INTEREST on Copper Wire or cost of FUEL.
Transformers or Converters are a CONSTANT source of TROUBLE and EXPENSE, will cost MORE for repairs in a year than to renew the Lamps by our system.
Our PLANTS can be operated with success ELECTRICALLY and FINANCIALLY where no others can.
Plan of wiring SIMPLE, CHEAP and EFFICIENT.
LAMPS from 16 C. P. up, noted for BRILLIANCY and BEAUTY of the light.
ALSO SERIES LAMPS of any C. P. for Arc Light Circuits.
Gold Medal, Paris Exposition, 1889.
Estimates furnished on application, for erection of plants in any section. Correspondence solicited.

HEISLER ELECTRIC LIGHT CO., Drexel Building, PHILADELPHIA, PA.

Send for Circular.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

WESTERN ELECTRIC COMPANY,

CHICAGO,
NEW YORK,
LONDON,
ANTWERP,
BERLIN,
PARIS.

MANUFACTURERS AND DEALERS IN

Arc and Incandescent Electric Light Apparatus, Patterson Underground and Overhead Cables, I. C. Weather-proof Wire, Washburn & Moen's Hard Drawn Copper Trolley and Galvanized Iron Wires, House Goods, Testing Apparatus, District Telegraph Apparatus, Line Supplies, Tools and all other Electrical Appliances.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

PATENT "K. K." LINE WIRE

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

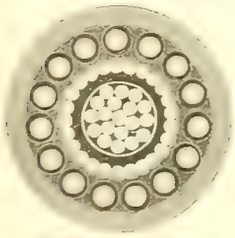
THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

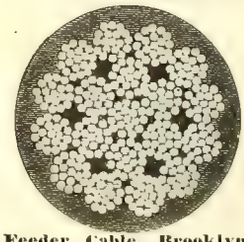
THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.

THE RUBBER USED IN

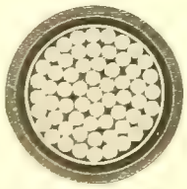
HABIRSHAW INSULATION

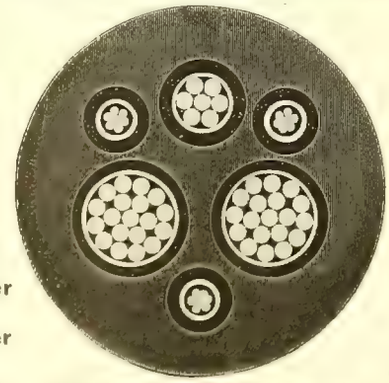
IS PURE PARA.

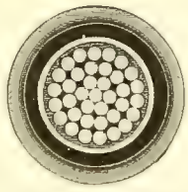

Underground Core.

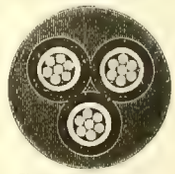

Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa


Naval Core, United States s. s. "Chicago."


Portable Cable, Broadway Theater.

Marine Core, used on Government Cruisers.

Naval Marine India Rubber Covered Wires.

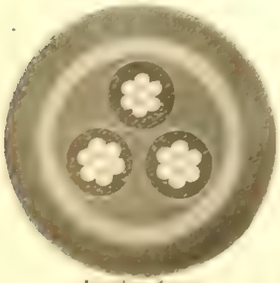
Naval Land India Rubber Covered Wires.

PROMINENT INSTALLATIONS.

STANDARD INDIA RUBBER COVERED WIRES.

Feeder Conductor, "Dryplaces," Grand Central Depot.

Adopted by the Navy Department and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.


Feeder Core

SOLID AND STRANDED CONDUCTORS, TAPED, BRAIDED, FLAME-PROOF.

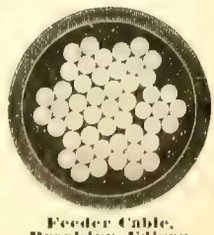
The Habirshaw Insulation fulfills all requirements in places demanding the "Best," and in that field finds no successful competitors.

FACTORY: GLENWOOD, YONKERS, N. Y.

WM. M. HABIRSHAW, F.C.S.,
GENERAL MANAGER.

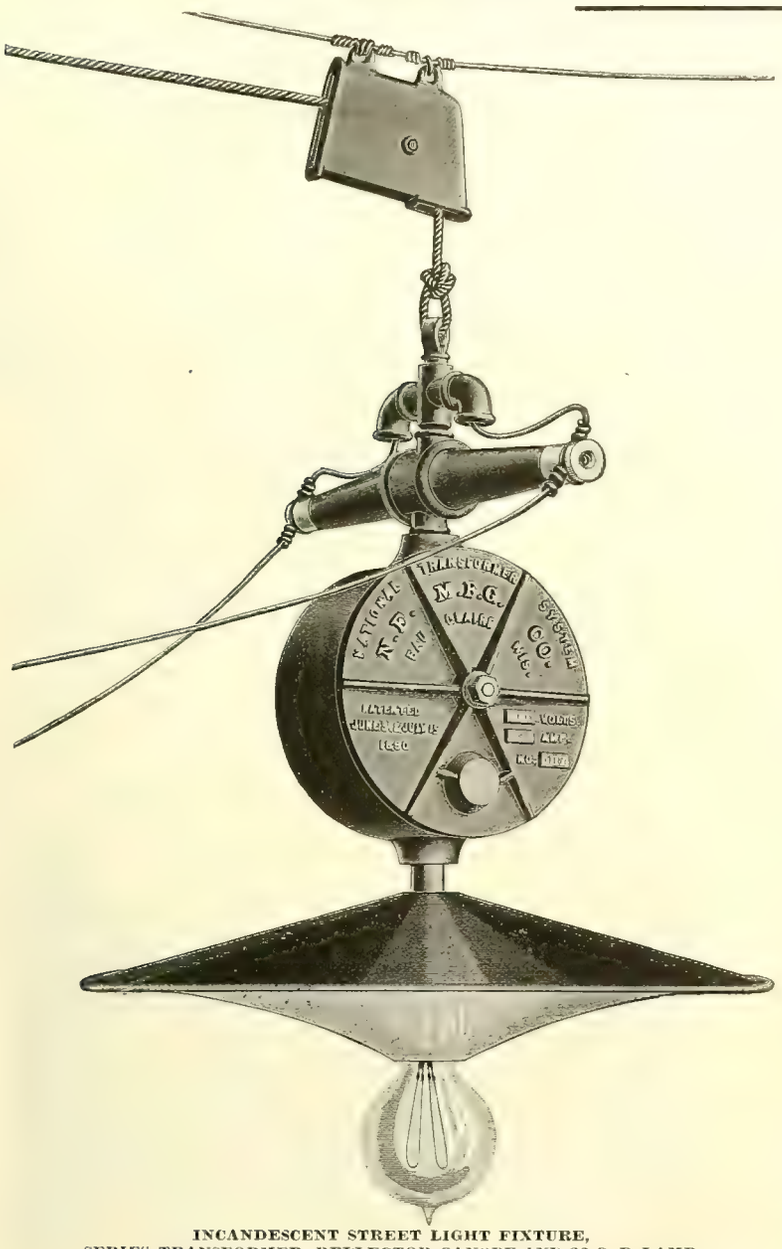
OFFICE:
315 Madison Ave., Cor. Forty-Second St.,
NEW YORK CITY.

THE ELECTRICAL SUPPLY CO., Western Agents, 171 Randolph St., Chicago, Ill.


Feeder Cable, Brooklyn Edison Electric Light Co.

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



INCANDESCENT STREET LIGHT FIXTURE,
SERIES TRANSFORMER, REFLECTOR CANOPY AND 32 C. P. LAMP.

WHY

USE ARC LAMPS

WHEN THE

NATIONAL

SERIES TRANSFORMER

ENABLES YOU TO DO

STREET LIGHTING

ECONOMICALLY
EFFICIENTLY
SATISFACTORILY ???

Send for Circulars and Prices.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

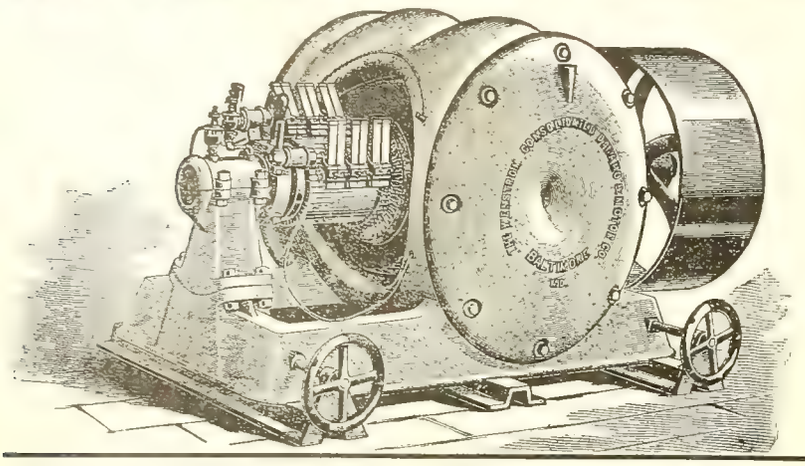
AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.
LINCOLN, NEB.,	Lincoln Electrical Mfg & Supply Co.
SEATTLE, WASH.,	Chas. H. Baker & Co.
ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
DETROIT, MICH.,	Commercial Electric Co.
DENVER, COLO.,	The Mountain Electric Co.
WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
SAN FRANCISCO, CAL.,	National Electric Development Co.
KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St
DULUTH, MINN.,	The Electrical Eng. & Supply Co

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

WM. HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

16 C. P. Less than 100 lots, 55 Cents.
" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

MONITOR CARBON BATTERY

Unsurpassed in Strength and Durability.

LIBERAL DISCOUNT TO THE TRADE.

Write for Quotations.

C. A HARMOUNT, M'gr,

Monitor Electric Company

149 WABASH AVENUE,

. . . . Chicago, Ill.

Western Agents Alfred F. Moore's Wires and Cables.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS.

WIRES.

You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

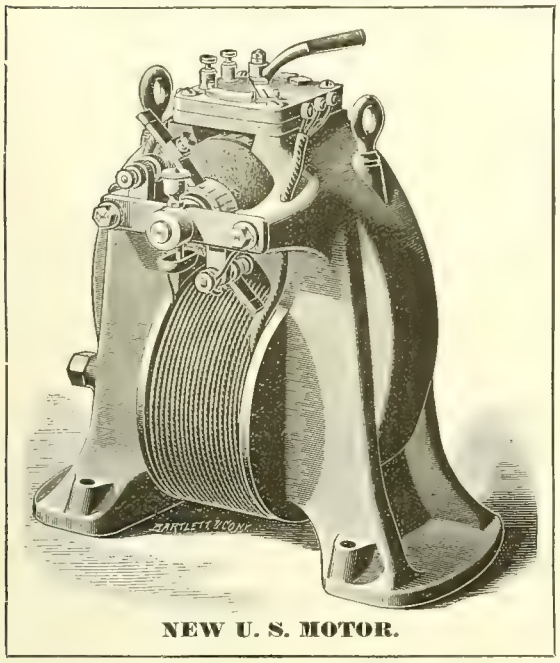
MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK.

G. H. MEEKER, Western Manager.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos. — Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

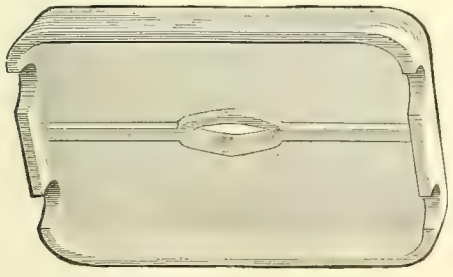
MOTORS and GENERATORS

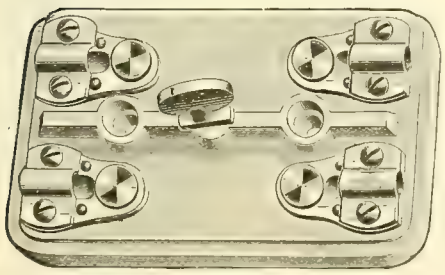
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

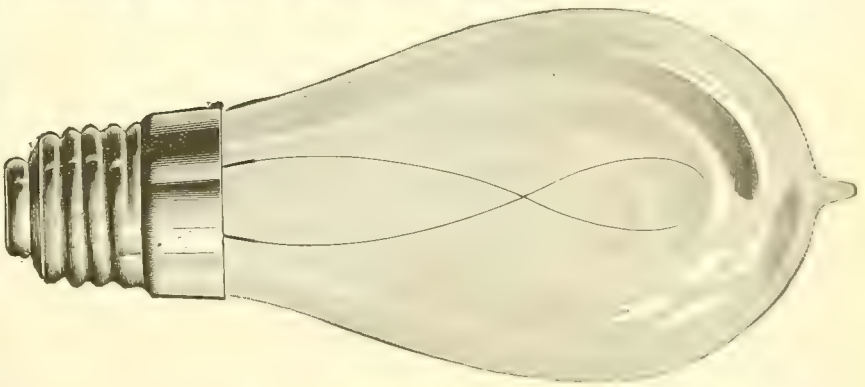
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

ROCKFORD ELECTRIC MFG. CO.,

ROCKFORD, ILL.,

MANUFACTURERS OF

ELECTRIC MOTORS, (Stationary and Railway,)

Incandescent Dynamos and Generators,

(MAYO SYSTEM.)

These Dynamos are specially adapted to Isolated Plants, as they are self-regulating, thoroughly reliable, and any one can run them. The Motors are the most efficient now in the market.

☞ Agents Wanted in Unoccupied Territory. ☜

FOR SALE.

STREET CARS.

ONE HUNDRED 12-FOOT CARS,

Built by the John Stephenson Co. and Jones, one end type, with fare box, in good order; gauge, 4 ft. 8½ in.

Six Hundred Tons 38-lb. Tram Steel Rails and One Hundred 30 ft. Steel Poles.

ROCHESTER RAILWAY CO.,

ROCHESTER, N. Y.

PURDUE SCHOOL —OF— ELECTRICITY.

New Laboratory, fitted with best appliances, dynamos, alternating current plant, storage batteries and apparatus from best makers. A complete and thorough course in general machinery and electrical engineering. Send for catalogue.

PURDUE UNIVERSITY,

La Fayette, Ind.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

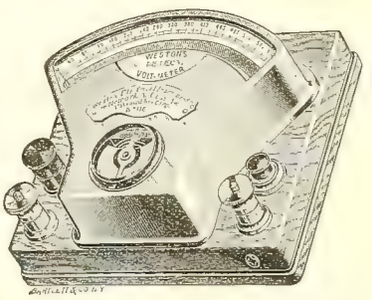
CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, Newark, N. J.

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

THE BALL & WOOD CO.,

OWNERS OF BALL PATENTS AND BUILDERS OF

Improved BALL Engines.

Office 15 Cortlandt St., New York.

W. B. PEARSON & CO., Agents, - Home Insurance Building,

CHICAGO, ILL.

The new Slow Speed 36-inch Railway Dynamos built by

The Short Electric Railway Co.

for the Rochester Power Station are now in daily operation.

SEE THEM IF POSSIBLE

before purchasing.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

H. T. PAISTE,

Paiste Electrical Specialties.

241 THE ROOKERY, CHICAGO, ILL.

1201 MARKET ST., PHILADELPHIA, PA.

PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.

P. AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, AUGUST 15, 1891. No. 7

Bridges Operated by Electric Power.

One of the latest applications of power transmitted by electricity is in the operation of swing-bridges. There are two installations of this character in the West, and in both instances the bridges are moved easily and swiftly and readily controlled. The case of the Rush street bridge, Chicago, may be accepted as a particularly severe test, as the structure is unusually large and heavy, weighing about 800 tons. Three or four men, in charge of Bridgekeeper John F. Martin, have hitherto been constantly employed on it. The bridge is located not far from the mouth of the Chicago river, and is the medium of a very heavy teaming traffic between the North and South sides. During the navigation season vessels are passing and repassing almost constantly, and for all of the larger craft the bridge has to be turned. Mr. Martin's position is considered so important that he is under bonds to the extent of $10,000 for the satisfactory performance of his duties. He now occupies the unique position of tender of the largest draw-bridge in the world operated by electricity.

Heretofore power has been obtained from an engine and boiler perched twenty feet above the roadway of the bridge, between the main trusses. When these and the heavy gearing connected with the steam mechanism shall have been discarded, it is estimated that the saving in weight will amount to about forty tons. The bridge was operated for the first time last week, and so far the motor has worked with great success. The bridge is turned fully as rapidly as by steam, and is even under better control. A noticeable improvement is the absence of the shaking and jarring caused by the overhead engine. The absence of coal, ashes and smoke is also a great advantage, and the nuisance caused by hoisting coal up to the boiler will soon be a thing of the past, although, of course, the steam plant will not be removed until electric power has had several months' trial. The cost to the city of the electrical equipment on the bridge will be about $3,000, and it is estimated that the cost of running the plant will be less than $150 per month. It is likely that in time all of the draw-bridges in Chicago will be operated by electricity.

Rush Street bridge is 240 feet long and 59 feet wide, resting on a turn-table 48 feet in diameter. Formerly the power from the steam engine was transmitted to the turning gears by means of a vertical shaft passing down through the center of the bridge and connected with a horizontal shaft on the turn-table by means of mitered gears. This shaft has now been replaced by one continuous horizontal shaft 3½ inches in diameter, on the ends of which are small pinions which mesh into large bevel gears attached to the vertical key shafts. To get the proper direction of rotation these pinions engage with teeth on the lower face of the gear on one shaft, and on the upper face of the gear on the other. To this horizontal shaft is attached the motor, so geared as to give the desired speed. This mechanism is shown in Fig. 1. On the deck of the bridge is a little house, in which are the devices by which the bridge is controlled. Directly in front of the bridge-tender is a 10 inch hand wheel, connected with a rheostat by a link belt, while at the left hand is a lever, by which the direction of rotation is controlled.

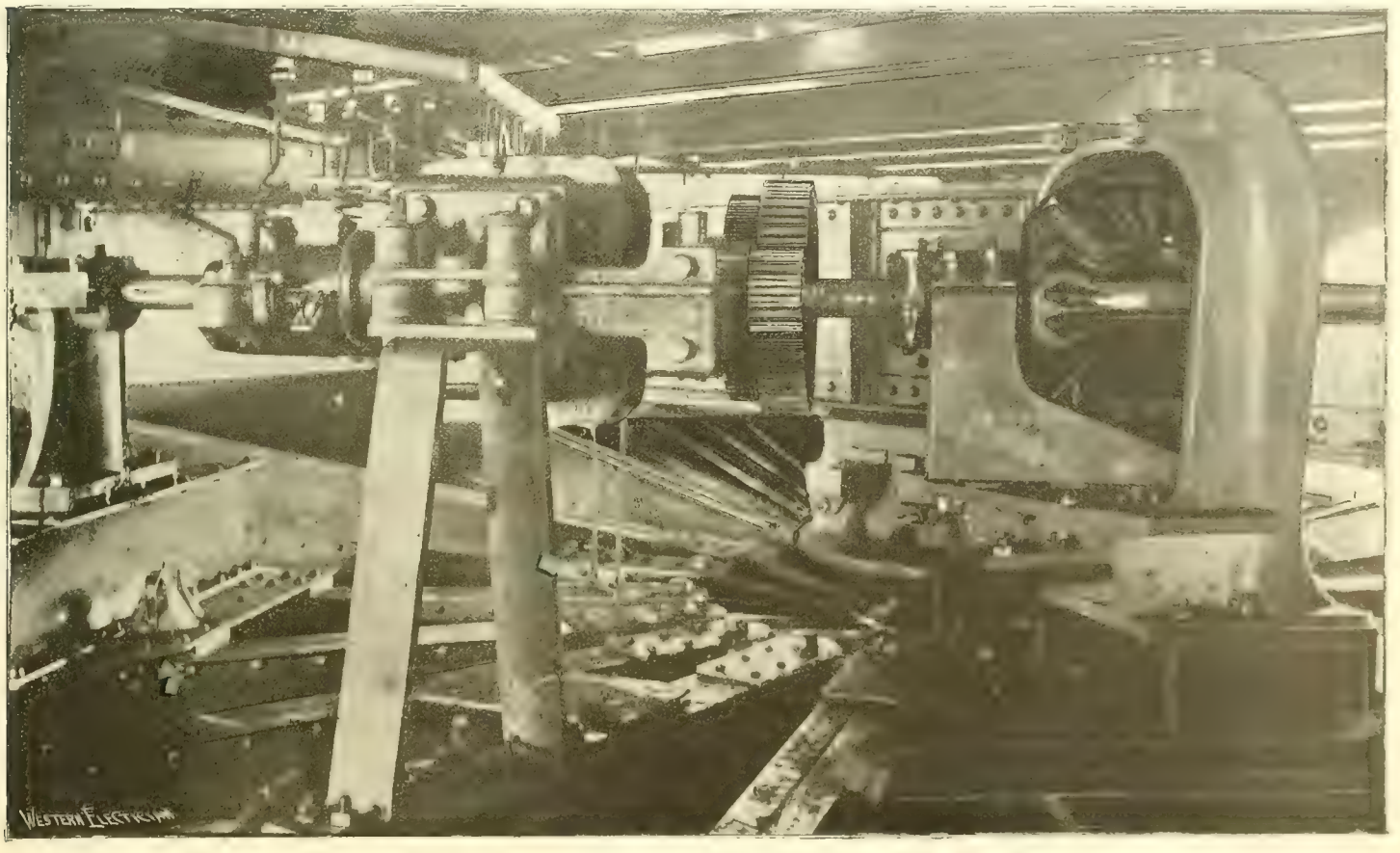


FIG. 1. BRIDGES OPERATED BY ELECTRIC POWER.

The most difficult part of the work consisted in connecting the motor with the terminals of the cables from the shore. The cables at the shore end are connected with the main current by a switch, so that they can be easily disconnected. They pass down the side of the south abutment, drop into a trench dredged in the bottom of the river, then up to the center of the bridge protection, into a channel cut in the masonry of the center pier, passing under the turn-table track up to the center of the pier. Here, firmly fastened by an [illegible] is turned true, forming a pivot holding the bridge in proper position. About ten inches from the bottom of this cone is a sheet iron disc, which fits exactly on to a shoulder turned on the cone, and to this is attached the spokes which run out radially, and form the axes for the rollers on which the bridge rests. Two straight slots are cut in this cast iron cone so as to bring the cable up back of this disc. Above this disc, and below the top, on which the bridge turns, is a space of about two feet. Here is attached a split ring, to which are screwed six T shaped insulator holders. These insulators are heavy composition bell-shaped devices. One is screwed on the branch projecting up, and the other to the branch below, the knob of the bell pointing up in each case. The top of the upper bell, and the bottom of the lower are two round angle irons, to which are screwed brass ears, which hold the copper rings, to which are attached the ends of the cables, so that these two rings make relatively the positive and negative terminals of the shore cables. Especial care and [illegible] were required to get the highest degree of insulation possible, as the current used is 500 volts by the metallic return system. To the turn-table of the bridge is attached a vertical rod, on which turn [illegible] carries a trolley, and by means of [illegible] trolley is brought against the wire [illegible] pressure. From the trolley arms two main wires are carried up, and are connected [illegible] ling device above described on the deck of the bridge.

The current is [illegible] from the [illegible] Arc Light & Power Company [illegible] South Market streets. The conductor between the station and the bridge, a distance of [illegible] wholly underground, and between the bridge and the station not one foot of the wire can be seen except at the

[illegible] and as the wire is several times in excess of what will ever be required, and is placed underground, it is entirely free from any danger of derangement. The motor has been throughly tested under every circumstance, and has proved satisfactory in every respect. In starting there is a noticeable absence of the sudden jerk and the constant jar and rumble while running.

The motor and connections were put to a severe test by the violent thunder and rain storm of last Sunday. The mechanism was entirely unaffected, however, showing the excellence of the insulation.

The other draw bridge alluded to at the beginning of this article as operated by electricity is the Grand avenue bridge in Milwaukee. This is 180 feet long and 35 feet wide, weighing 200 tons. Before the introduction of electricity this bridge was operated by hand, and it could not be swung to allow a vessel to pass in less than five minutes. As the bridge had to be turned for even the smallest vessels it became essential to employ some quick-working mechanism. Previously it was turned by three, and some-

FIG. 2. BRIDGES OPERATED BY ELECTRIC POWER.

[illegible] the operation [illegible] make a [illegible]

[illegible] commissioners. The entire mechanism is completely out [illegible]

manner by hand after midnight, when the current is cut off from the power station. A band brake, operated by the foot, is added as an easy check for the bridge.

In Milwaukee also difficulty was experienced in connecting the motor with the submarine cable so as to supply current at all times during the revolutions of the bridge. It was accomplished by attaching a wire to the submarine cable, passing first through a fuse box, then through a lightning arrester, next through a hole drilled in the masonry of the center pier, and finally to a swivel trolley stand. As there are two distinct rotating parts to the bridge—the roller frame, which revolves at half the speed of the bridge, and the turn-table of the bridge itself—a double movable connection to convey the current from the end of the cable wire to the motor on the turn-table was required. To accomplish this two circular copper bands are attached on the roller frame—one above, the other below, connected together electrically, but insulated as a whole from the iron work of the bridge by the use of bell insulators, which give the copper bands a very high degree of insulation, making a ground practically impossible. The swivel trolley on the pier bears against the lower band, while a similar swivel trolley, inverted, bears against the upper band, and is connected by a suitable conductor to the motor. Particular care was given to the insulation of every part of the system, the motor being run from the wires of the electric railway, one of which is connected with the ground return, and any flaw in the insulation would result disastrously to the working of the system.

The entire equipment of both bridges, both mechanical and electrical, was designed and erected under the personal supervision of George P. Nichols, manager of the stationary motor department of the western department of [illegible] Thomson-Houston Electric company, Chicago. From the moment the switch at Milwaukee was first thrown [illegible] about two months, the mechanism has [illegible] manner without a stoppage of any kind. This was the third draw-bridge in the country equipped by electric motors, but the plan of this one is entirely different from those before equipped, and it seems well adapted for this class of work.

Electricity at the World's Fair.

Several meetings of Col. Clowry's committee on electricity were held last week. The relations of the department of electricity and construction, as detailed in last weeks WESTERN ELECTRICIAN, were exhaustively discussed, and various solutions of the vexed problem of authority were advanced. No definite conclusion was arrived at, however. The matter was to have been brought up at last Monday's meeting of the committee on grounds and buildings; but after the meeting Secretary Sawyer said that nothing had been done relating to the department of electricity.

The contract for installing the electric lighting and power plant on the World's Fair grounds, for temporary use, has been awarded to the Edison General Electric company for about $2,900. This company offered to furnish the machinery required, except motors, until January 1, 1893, for $2,000. This was for a plant capable of supplying 100 arc and 250 incandescent lights, together with the lamps, an 80,000 watt generator, a switch-board and the necessary appurtenances. The company also offered to supply motors for the period named at 30 per cent. of the selling price, which would be about $900 for 100 horse power, thus making $2,900 for the total installation. The Western Electric company offered to put in the plant for $3,250 with $15 per horse power additional for motors, making a total of $4,750. The bid of the Thomson-Houston company for the entire installation complete was $8,600. In all cases, of course, the plant was to revert back to the manufacturers after Jan. 1, 1893.

Chief Barrett left Chicago on Sunday for an eastern trip. While he is away the chief will confer with a number of representatives of eastern electric companies.

Over $4,151,300 is invested in electrical concerns in Detroit.

It is reported that the Chippewa Falls Milling & Elevator company will soon begin the building of an electric light plant for street and house lighting. Positions for eighty arc lights have been located.

New Electric Road at Kankakee, Ill.

Pretty Kankakee, 56 miles south of Chicago, on the Illinois Central railway, is now the proud possessor of an electric railway system which is probably unexcelled by that of any town of similar size in the country. The city itself has a population of about 8,000, and is charmingly situated on the Kankakee river. It has a number of manufacturing establishments, and the indications are that several more will be added within a year, as the enterprising citizens of the town are determined that the advantages of cheap fuel and excellent shipping facilities shall not go unrecognized. One of the Illinois state asylums for the insane is located here, and its fine gray stone buildings, surrounded by handsome grounds, form a pleasant sight from the verandas of the Riverview, a well kept summer hotel, which is just across the river. The asylum is a very large institution, having some 1,700 patients and 200 attendants. It is conducted both on the ward and detached systems, and has the appearance of being admirably managed. The buildings are handsome and substantial and are kept spotlessly clean. They are supplied with incandescent lights and a number of arcs illuminate the grounds. Current is obtained from an isolated plant installed by the Western Electric company.

NEW ELECTRIC ROAD AT KANKAKEE, ILL.

Although the electric road had no predecessor of any sort in the way of street cars, it starts out with every prospect of success, and there is no doubt that the traffic will justify its construction. The first car was run on July 19th, and the formal opening was on the 26th, when a party of ladies and gentlemen from Chicago, headed by W. R. Mason, general manager of the Electric Merchandise company, and J. Livingston Barclay, manager of the western railway department of the Westinghouse company, inspected the line. The road is owned by the Kankakee Electric Railway company, which operates about five miles of track on Court street, Harrison avenue, East avenue, Merchant street, Greenwood avenue and Jeffries street Four Pullman cars are now running, and more will shortly be added. Each car is equipped with a twenty horse power Westinghouse motor of the four-pole single reduction type. These motors make but little noise, and work very satisfactorily. They are mounted on McGuire trucks. The line equipment was furnished by the Electric Merchandise company of Chicago, and is of excellent workmanship. W. W. Hatch had the contract for building the line, and the track work was sub let to C. E. Loss & Co. The road bed is exceptionally good, and the cars ride very easily. One branch of the line crosses the Kankakee river on a bridge 500 feet long, shown in the illustration. The distance between the floor of the bridge and the iron girders overhead is only twelve feet, but yet the trolley passes safely underneath, although bent down almost to the roof of the car. Insulators are placed on the girders to prevent leakage at the points where the conductor is pressed upward against the iron beams. Most of the overhead work is of bracket construction, although center poles are used on one of the principal streets, where there are double tracks.

The power is furnished from a Western Electric 80 horse power generator driven by a 90 horse power Payne automatic engine. Hazelton upright boilers are used. The power plant is at present located in the Kankakee electric light station, but the railway company will ultimately have a power house of its own.

Already the company is contemplating extensions to various parts of the city not yet reached by the electric lines, and before long Kankakee will possess rapid transit facilities in as great a degree as the most progressive of its citizens could desire. The Kankakee Electric Railway company is officered as follows: President, T. F. Andrews; secretary, W. M. Carpenter; treasurer, T. W. A[illegible] manager, C. H. Cobb. The road is conducted on a liberal and enterprising basis and deserves to succeed.

Burning of Wiman's Electric Light Plant at St. George, Staten Island, N.Y.

On the night of August 3d the station of the Richmond Electric Light, Heat & Power company at St. George, Staten Island, N. Y., was totally destroyed by fire. This is the plant in which Erastus Wiman is so largely interested, his son, W. Dwight Wiman, being general manager of the company. The fire, the cause of which is unknown, started shortly after 8:30 P. M. in the boiler room. Owing to a lack of water, the flames made great headway, and it was not long before the plant, with the exception of a small annex office building, was reduced to ruins, as will be readily seen from the accompanying cut showing the scene after the fire. The buildings were one-story brick structures 60 by 50 feet. In the dynamo room was apparatus to supply

BURNING OF WIMAN'S ELECTRIC LIGHT PLANT AT ST. GEORGE, N. Y.

From the Richmond plant almost the entire island was [illegible] once to rebuild, but this time nearer the shore. This move has been contemplated for some time, but the fire will hasten the building of the new plant.

[illegible] ately to the left in the view, but only partially represented in the photograph, is the site where once was located the electric fountain of the Staten Island Amusement company, [illegible] know of Yerkes' electric fountain, but few of them are aware that the electrical paraphernalia, lamps, etc., for the display was bought by Mr. Yerkes from this amusement company and transplanted to Lincoln Park, Chicago.

Chicago Electric Club.

The Chicago Electric club gave the first of a series of dinners at the club rooms Thursday evening, Aug. 6th. Twenty-two members were present. The dinner was prepared and served in excellent style and was thoroughly enjoyed. After the dinner Fred E. Degenhardt called the members to order and called upon several gentlemen for speeches. It was generally agreed that W. B. Pearson, chairman of the house committee, was entitled to the thanks of the club for the efforts he had made in arranging the entertainment, and a vote of thanks was tendered him for his efforts.

The members passed a pleasant evening in the club parlors. It was agreed that the dinners should be continued, and it is quite probable they will become one of the most attractive features of the club.

Street Railway Convention.

It is estimated that three hundred delegates will attend the tenth annual meeting of the American Street Railway association, which will be held at the Monongahela house, Pittsburg, October 21st, 22d and 23d. For exhibition purposes the committee of arrangements has chartered for the week of October 18th to 24th a [illegible] excursion boat, which will be moored at the wharf, alongside the Monongahela house. Heavy supplies can be shown on the lower deck and [illegible] The boat will be suitably decorated, and lighted in the evening, and so far as possible will be made a pleasant and profitable place for exhibition. If still more space is needed, the committee will in some way make due provision for the requirements [illegible] coming.

Single Reduction Motors for Street Railway Work.

In the accompanying cuts are shown an improved method of applying comparatively slow speed motors to street railway cars by means of single reduction gearing. Fig. 1 shows a side elevation of the truck on which the motor is mounted and Fig. 2 gives a plan view. The motor frame forms part of the field magnet frame, which is journaled upon the axle, and has projecting arms furnishing bearings for the armature of the motor. The motor consists of an outer magnetic mass or frame comparatively flat and shallow in order to adapt it to its position beneath the car-body. As seen in the figure, the armature projects well into the field coils and even through them for a short distance. Hence the field coils surround both the field magnet poles and the armature of the motor. In this equipment it is practicable to dispense with the usual counter shaft and one set of gears, and the pinion on the armature meshes directly with a gear wheel fastened on the axle. The gear wheel is split into two parts secured together by bolts. Surrounding the pinion and gear wheel is an oil casing made in halves fitted together by a gasket to prevent leakage of oil which is placed inside of the casing for the gears to run in. The motor is upheld in position by a nose piece, elastically supported from a transverse bar of the truck. The equipment is the invention of Elihu Thomson and E. W. Rice, jr.

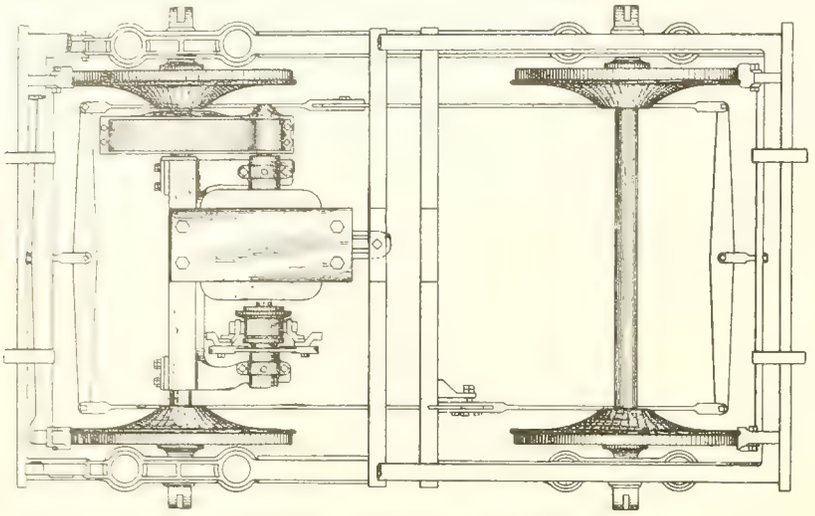


FIG. 2. SINGLE REDUCTION MOTORS FOR STREET RAILWAYS.

In both motors the armature is composed of a soft-iron strip provided with bobbins of insulated wire wrapped about the ring in notches in the edges. The armature is not only axially placed with reference to the car axle but it is mounted so as to turn without requiring any journal bearings.

It will be noticed that the armature of one of the motors is fastened to the hollow shaft which surrounds the car axle, an insulating sleeve being interposed. This sleeve may be of soft vulcanized rubber constituting a buffer or spring support as well as an insulator. In the other motor the armature is mounted directly on the car axle. In the latter case the direct driving connection is made by arms on the shaft, engaging forks, projecting from a collar on the hub of the car wheel. Spring pads of, say, soft vulcanized rubber, are interposed between the arms and the forks, the ends of the pads being protected by metal caps. The spring pads of rubber insulate the armature shaft from the forks, and at the same time furnish a yielding connection for driving. The construction of the driver permits the movement of the armature and shaft relatively to the car axle on account of the yielding nature of the sleeve. In the other motor the direct driving connection is through the mechanical means by which the armature

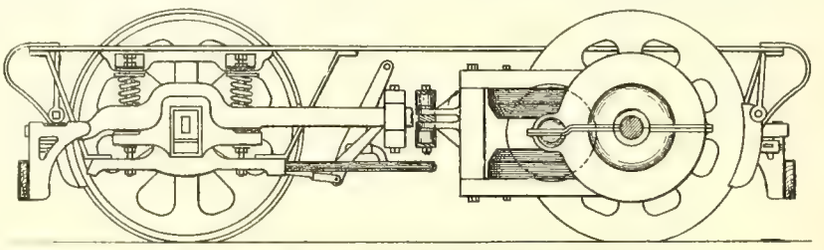


FIG. 1. SINGLE REDUCTION MOTORS FOR STREET RAILWAYS.

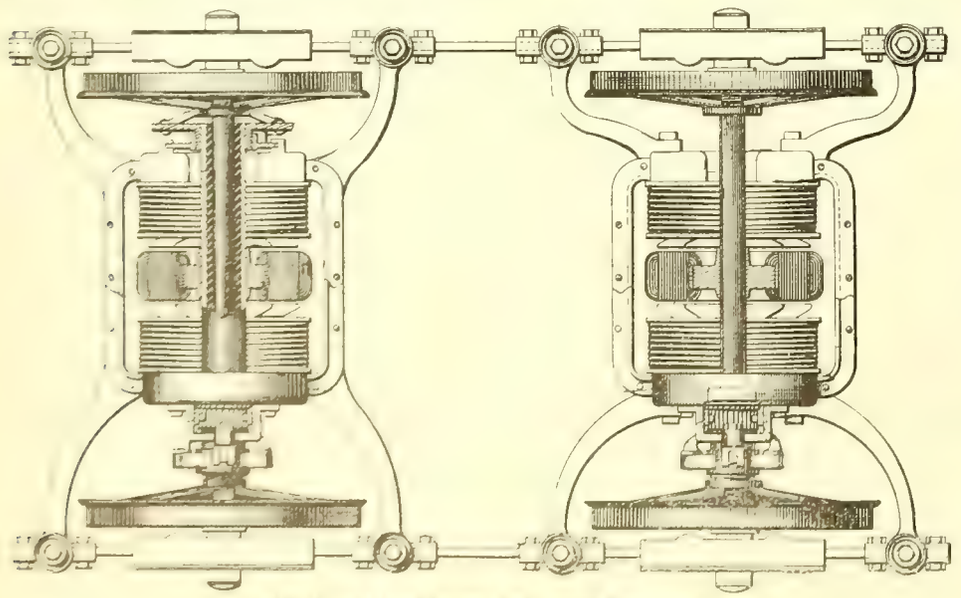
poles, each pole being constituted by the two magnets in line with each other on opposite sides of the armature. These field magnets are so arranged that the four lowermost magnets are equidistant from the lowest part of the armature, those of one polarity in front and those of the opposite side in the rear. The field magnets project from yokes, which are mounted on side bars of the truck frame, supported by the ordinary journals of the car. As shown, the side bars are secured to the journal boxes, so that they do not partake of the vertical movements of the car body. The yokes have openings in the middle for the passage of the car axle, and they are joined by connecting arms. To facilitate the placing of the field magnets in position, the frame is made in two parts. The supports by which the field magnets are mounted on the side bars are attached to the lower half of the frame. They may be made integral with the motor frame, or they may be fastened if desired.

To prevent the motion of the field magnets relatively to the armature and at the same time permit transverse movements, a collar is shown on the hollow shaft, engaging the grooved or forked ears on the yoke. A similar collar could of course be used on the car axle in the other motors whether the field magnets are or are not spring-mounted. The collar is shown as screwed on its support and may be turned to regulate the position of the field magnets relatively to the armature by adjusting said magnets lengthwise of the armature axis A pin is shown for preventing the accidental turning of the collar after an adjustment has been made.

The commutator is adjusted on the hollow shaft or on the car axle and rotates in contact with brushes. The brushes are mounted on a collar which is journaled on the hollow shaft or on the car axle, and has an arm which works in a slot in a wrist pin pivoted in the bracket on the yoke.

Gearless Motors for Street Railways.

The tendency toward gearless motors for street railway work has been particularly noticeable during the last year. Several types have been introduced and they have been generally successful in operation. Since their first appear-



The Minneapolis Cable Contract.

The closing of the contract for the underground conductors for the Minnesota Brush Electric Light company of Minneapolis was announced exclusively in the WESTERN ELECTRICIAN last week. The successful company was the Standard Underground Cable company of Pittsburg. The contract was in all probability the most extensive one of the kind ever let, and the competition was of course keen. The details of the transaction are given in another column by our Minneapolis correspondent.

F. E. Degenhardt, who secured the contract for the company, was naturally highly elated over his success, and has since been receiving congratulations from his friends and associates in business. During the last three months while the representatives of the Brush company were considering the matter Mr. Degenhardt labored unceasingly to keep the claims of his company before the Minneapolis people. The result bears the best possible evidence of his ability.

Throughout the contest Mr. Degenhardt received the hearty co-operation of J. W. Marsh, vice-president and general manager of the cable company. Both of these gentlemen are to be congratulated.

Projected Chicago Electric Roads.

The Jefferson Urban Transit company has been incorporated for the purpose of constructing an extensive West Side electric road. The company has a capital of $1,000,000. Edward D. Hosmer being president and Frederick A. Soule secretary and treasurer. It has been working quietly but effectively for about a year and already has an ordinance drawn up ready for presentation to the council when it reconvenes in September. The route it proposes to traverse is as follows: Commencing at the intersection of Canal and Monroe streets, thence west on Monroe to Morgan, north on Morgan to Fulton, west on Fulton to Western avenue, north on Western avenue to Grand avenue, northwest on Grand avenue to Armitage avenue. The promoters say that probably a storage battery or conduit system will be used.

It is reported that an electric line will be built to connect Chicago with the race track at Hawthorne. It is said that

the new road will either connect with the Ogden avenue cars or with the Cicero & Proviso electric line and the Madison street cable.

Large Wiring Contract.

General remark is excited by the imposing appearance of the new sixteen-story Monadnock and Kearsarge buildings at the corner of Dearborn and Jackson streets, Chicago. The buildings are to be lighted throughout by electricity, and the Chicago Edison company has secured the contract. They will be wired for 4,500 lights, current being supplied from the Adams street Edison station.

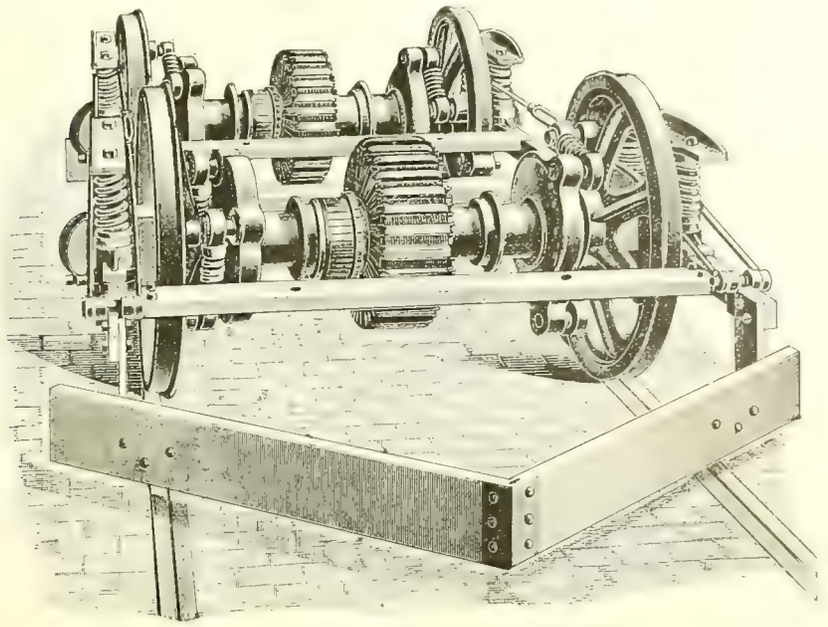


FIG. 2. GEARLESS MOTORS FOR STREET RAILWAYS.

Electric Light Plant in the New York World Building.

The home of the New York *World* is undoubtedly in the most imposing building of which the metropolis can boast. Towering above the other huge office buildings among which it stands, the gilded dome, visible even from the decks of vessels miles from the city, invariably excites curiosity. It is almost needless to say that it was Mr. Pulitzer's aim to make the *World* building the most thoroughly equipped newspaper edifice in existence, and there can be found few who would be willing to assert that he had not been successful in accomplishing his purpose.

To those interested in electrical matters there are about the building a number of interesting features. Every room is wired and piped, and the two kinds of illumination are combined in the same fixtures. In the composing room an ingenious device combines gas and electricity under one shade. The fixtures throughout the building are of special design, protruding from brass hemispheres upon the wall. Under th Park Row sidewalk and adjoining the press room is the dynamo and pump room. The illustration, which was obtained through the courtesy of E. A. Grozier of the *World*, will give the reader an excellent idea of the general arrangement of the lighting plant. Four United States Electric Light company's dynamos with a capacity of 3,500 incandescent lights, supply the current for the building. These machines also furnish the motive power for several electric motors for the proof-press and matrix table in the composing room and for other purposes.

The engines from which the lighting plant takes its power are four of the Watts-Campbell Corliss type. One pair of engines is of 300 horse power and the other pair is rated at 175 horse power. These engines can be used separately or together for the presses, dynamos, stereotyping and wetting machines. The two high-speed engines—100 horse power each—of the New York Safety Steam Power company's make are particularly intended for the dynamos, but can be utilized for the presses in an emergency.

Three large boilers generate steam for the whole establishment. Each is eighteen feet long by seven feet in diameter. They are of the horizontal tubular variety, and can develop 750 horse power. One of these boilers is always kept in reserve. All the latest and most approved appliances are found in this boiler room, including a Hoppes heater, which is placed in the flue to re-heat the exhaust steam before it goes into the heating system.

It is estimated that there are about 48 miles of wires in the Pulitzer building. All these wires come up one central shaft, especially designed for the purpose. This shaft is four feet square, and it rivals the one in the Chicago telephone exchange, containing, as it does, a veritable forest of wires. There are three big cables each made up of 12, 20 and 30 wires respectively. In addition there are over 250 wires from all sources, and others are being added almost daily. Every wire is conduited in non-combustible material, and all leave the building underground.

There are wires for the messenger call boxes in every room. The electric light system requires another wire in each apartment. The telephone system necessitates additional wires all over the building. It may be mentioned that there is, beside the public telephone, a private system for the use of the *World*, connecting all departments. There are two score or more stations with a central office. Every cable and telegraph company has its wires running up the shaft to the news desks in the dome, bringing the editors in direct communication with the news centers of America and Europe.

ELECTRIC LIGHT PLANT IN THE NEW YORK WORLD BUILDING.

The Edison Convention.

On Tuesday, Wednesday and Thursday of this week the annual convention of the Association of Edison Illuminating companies was held in the Murray Hill hotel, New York. The programme was published last week. A full report of the proceedings will be given in the WESTERN ELECTRICIAN next week.

Forging Steel by Electricity.

[illegible] of steel an inch in diameter and twelve inches long in [illegible] bar was cut into the required length, the pieces passed through the electric machine, where one end is heated, and then to a die which shapes the head on the heated end, the point being compressed into shape without heating. These were turned out by the process at the rate of six per minute. Another exhibit was the forming of an auger screw, the flat bar of iron being fastened in the machine at the ends and heated almost instantly and then twisted into the required spiral by the automatic turning of the machine. The spiral is of absolute uniformity; beyond the points of the electrical current the metal remains cool, the process occupying so short a period of time that the heat is not communicated to the ends. The hardest metals were treated as easily as the softest were by the old process, and a perfect thread shaped on the hardest tool steel as readily as upon the most pliable iron.

A little machine is devised for making spherical ball bearings, such as are used for bicycles etc. While the exhibit was in progress it was reported a cablegram was received from the Krupps, the great gun makers of Germany, in furtherance of negotiations for the rights of the invention in Germany and other countries of the European continent.

The Postal Telegraph.

The subject of placing the telegraph service under control of the postoffice department receives from a Washington correspondent the following attention in a review of the work of the present administration: "The postmaster-general's tireless advocacy of a limited postal telegraph was even more daring than his attack upon the lottery, and for several reasons. It was not an attack upon the telegraph company, pure and simple. It was merely a proposition to fit the two great machines of the telegraph company and the free-delivery service of the postoffice department into each other, so that each should help the other, thus making the use of the telegraph cheaper, and bringing it within the reach of ten or twenty millions of people instead of but one million. That is, as the postmaster-general believes, while it would offer that great benefit to the people, it would also not interfere with the vested rights of any telegraph company, a thing which he believes no patriotic person has a right to do. It might even add to the revenues of the telegraph companies, he believes, but if it did the telegraph companies would be earning their dividends not upon watered stock, but for work actually performed for millions of the people; but the telegraph company had an excellent chance to misrepresent him in this, and an immense special interest had a good chance to antagonize him. This it did not fail to do. Here again the attacks upon his financial as well as his public and personal credit were carried on with ever-increasing virulence, but they had no effect, simply because they could not have any.

"The telegraph people have taken no pains to conceal the fact that a real fight for postal telegraph would [illegible] until the last session of congress, though the semblance of a fight has been going on for the last twenty-five or thirty years. A favorable report was unanimously made by the senate committee in support of the postmaster-general's bill; a favorable report from the house committee was defeated only by one vote, and that after a series of desperate skirmishes, which at all times were sure to result in the postmaster-general's favor."

Boston capitalists are reported as intending to build an electric road in Hillsboro, Tex.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - Editor and Publisher

J. B. O'HARA, - - - - - - - - }
F. L. PERRY, - - - - - - - - } Associate Editors.
W. E. KELLY, - - - - - - - - }

J. L. BAKER, - - - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers, in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.
Bridges Operated by Electric Power. Illustrated........85, 86
Electricity at the World's Fair........ 86
New Electric Road at Kankakee, Ill. Illustrated........ 87
[illegible] Wiman's Electric Light Plant at St. George, N. Y., Illustrated........ 87
Chicago Electric Club........ 87
Street Railway Convention........ 87
Single Reduction Motors for Street Railways. Illustrated........ 88
Gearless Motors for Street Railways. Illustrated........88, 89
Minneapolis Cable Contract........ [illegible]
Proposed Chicago Electric Roads........ 8[illegible]
Large Wiring Contract........ [illegible]
Electric Light Plant at the New York World Building. Illustrated........ 89
[illegible] by Electricity........ [illegible]
The Postal Telegraph........ [illegible]
[illegible]
Electrical [illegible] Works. Illustrated........ 91
A London Electrician's Opinion on Electrical Advancement in England........ 91
Frankfort Electrical Exhibition........ 91
[illegible]........ 91
[illegible]........ 91
[illegible] Telephone Exchange System. Illustrated........ 92
[illegible]

DEPARTMENTS.

[illegible]

[illegible]

[illegible]

[illegible] financial success. This is indicated by the complaints of [illegible] as it is styled in England. In one case, indeed, the directors of another company assert that a loss of over 250,000 passengers is directly attributable to the new electric line, which has become very popular. The underground road appears to have opened the eyes of the British public to the advantages of electric railways, and it is probable that progress in this line will hereafter be more rapid in Great Britain. The City and South London railway was carefully designed, and it deserves the success it has achieved. It has many admirable features that may be studied with advantage by the Rapid Transit Commission of New York, for instance.

IN this issue an article on "Arc Lighting and Hazards" by George P. Low of San Francisco is presented. The subject is considered from the standpoint of the insurance companies. Mr. Low believes that with proper construction work the danger of fire from electric wires is far less than from any other system of artificial illumination. This position is sustained by the experience of those who have taken advantage of the improved methods of construction. The popularity of the system has been greatly advanced by the willingness of the electric companies to make use of all improvements in the art.

JOSEPH PULITZER has erected an enduring monument to his indomitable energy in the magnificent *World* building in New York. The structure is fitted up in a manner commensurate with its imposing appearance, and the electric plant, illustrated in this issue, is not the least interesting portion of the equipment. The statement that the building contains 48 miles of electric wire shows that the installation ranks among the largest of the isolated plants in the office buildings of the country. Undoubtedly the *World* establishment has the largest electrical equipment of any newspaper in the world.

THERE is a good deal of interest manifested in the controversy over the cause of the destruction of the big balloon at Chicago recently. It was stated at the time that the balloon was struck by lightning and for a time nothing was thought of the matter, but since then it has been charged that it was destroyed by one of the men in charge. The balloon was not struck by lightning, nor was it destroyed maliciously if the statements of an eye witness and one who was personally interested in the success of the enterprise are to be credited. The explanation offered is that the balloon was improperly secured at the time the big storm came up. It flapped about at the mercy of the wind, and pounded against the sharp corner of a post. After a time it wore a hole in the cover and the gas was forced out. When the balloon was turned over by the wind the hole was in such a position that the jet of gas in escaping was forced directly to an arc lamp, igniting the gas, and resulting in the explosion. This is the explanation of one of the men most deeply interested in the enterprise. He said the balloon had been too hastily constructed and the necessary precautions to secure it had not been observed. The greatest mistake appears to have been made in filling the balloon with illuminating gas.

THERE is a reckless disregard for accuracy manifested by sensational metropolitan dailies that leads ordinary observers to doubt everything that appears in the newspapers. The electrical interests have more than once had reason to complain of this failing. The wholesale invention of falsehood that appeared to rule the daily papers of the metropolis during the early days of the crusade against overhead wires caused no end of trouble to the electric companies. There are still frequent evidences of the inclination of newspapers to sacrifice the truth for sensationalism. The latest exhibition of this kind is found in the New York *Press*, which evidently considered that it was saying a very bright thing when it printed the following paragraph: "Several hundred experts of electricity might be found to-day who are willing to swear that 400 volts of electricity are not sufficient to kill a human being, but Henry Bartels, the athletic young German bartender for Theodore Feldstein of Grand street, is dead just the same."

The electric companies contended at the time of the accident that there was no current passing through the motor [illegible] to have received the shock, and so positive were their statements that many of the "funny" men took the matter up and proceeded to grind out stock jokes on the subject. The official autopsy, however, put a different construction on the accident. In the same issue of the *Press* from which the clipping already [illegible] following news item: [illegible] on the body of Henry [illegible] dropped dead Wednesday night in Feldstein's saloon, No. 226 Grand street. Dr. Conway decided that death was caused by uræmic convulsions, and that electric shock had nothing to do with it. Dr. Conway said that all the usual symptoms noted in cases of death by electric shock were absent."

This is not the first time, and in all probability not the last, in which the newspapers wrongfully charged fatalities to the electric current. Yet irresponsible scribblers, who disgrace their profession, persist in attributing everything to electricity about which there is any possibility of doubt.

AN English electrical engineer who is visiting in this country was interviewed at Chicago last week on the relative advancement of electrical enterprises in this country and in England. The comparison he drew was favorable to this country though by no means discreditable to the English electricians. It was the people at large, he said, who failed to take advantage of the progress made in electrical matters. "The public has been slow," he added, "to recognize in electricity anything but a force with which imaginative inventors and cranks could experiment in laboratories and lecture rooms."

This is indeed a most lamentable state of affairs, and it is not to be wondered that little progress has been made in the general application of electricity in the face of this ignorance. The successful operation of the underground railway in London by electricity has awakened the people to a certain degree to the practicability of electrical machinery. It is believed that the subway has done more in a few months than years of lecturing to prepare the minds of the people for the utilization of electricity in other ways. This gentleman has evidently a better idea of the application of electricity to the operation of heavy machinery than some of his "learned" brothers who have visited this country. He says: "It will not be long before companies will be ready to use rock drills, mining pumps, drilling machines, ship cranes, portable cranes, and other kinds of machinery operated by electricity. Electricity has been perfectly applied to all machinery of this kind for some time, but the public was afraid to take hold of it."

In this country where a more progressive spirit obtains all of these advantages have been recognized and the people have not been slow to make use of them, but in conservative England they are just now being convinced against their wills.

AN event of much interest to all electricians in Chicago took place last week, when the large Rush street drawbridge over the Chicago river was turned for the first time by electricity. This is undoubtedly the largest swing-bridge in the world fitted up for operation by electric power. Indeed, it is probable that all the bridges of whatever size turned in this manner could be counted on the fingers of one hand.

As yet the electric system may be said to be on trial, so far as the Rush street bridge is concerned, as it has not yet been officially accepted by the city authorities. But so far it has worked to the entire satisfaction of all concerned, and nothing but expressions of admiration have been heard from all who have examined it. The motor turns the bridge easily and quickly and is readily controlled. All the mechanism is under the floor of the bridge, which obviates the tremor and vibration formerly caused by the engine, which was located on the level of the top of the bridge trusses, 20 feet above the roadway. With the bridge either light or crowded with vehicles the motor has so far never failed to respond to any demand made upon it. Neither was it affected by the severe electric storm of last Sunday. In the case of the Milwaukee bridge electricity has been successfully used for two months.

The trolley devices above the pedestal of the bridge, described on another page, are very interesting. Some persons have the idea that a slack cable is used in installations of this character, but as it may be necessary for the bridge to be turned an indefinite number of times in one direction this idea would be impracticable. Instead Mr. Nichols, the engineer in charge, devised the circular double trolley arrangement alluded to. By this means the bridge can be turned freely in either direction without the slightest embarrassment from the conductors, both trolley-wheels pressing firmly against the wires at all times. Current is taken from an underground cable, coming up through the pier of masonry in mid-stream.

As may be imagined great care had to be taken with the insulation. Everything points to the complete success of the installation, and it seems altogether likely that the Rush street bridge will but prove the pioneer in the method of operating large bridges of this character. Many of the features of the two plants described in this issue are entirely new and reflect much credit on Mr. Nichols' engineering ability.

Electrically Driven Ship's Winch.

In the accompanying cuts is shown a new form of electrically driven ship's winch recently placed upon the English market by R. Bolton & Co. of London. In this device it is said the object is to secure a great range of speed in order to adapt a constant potential current to the varying loads. Figs 1 and 2 show a plan and elevation of the

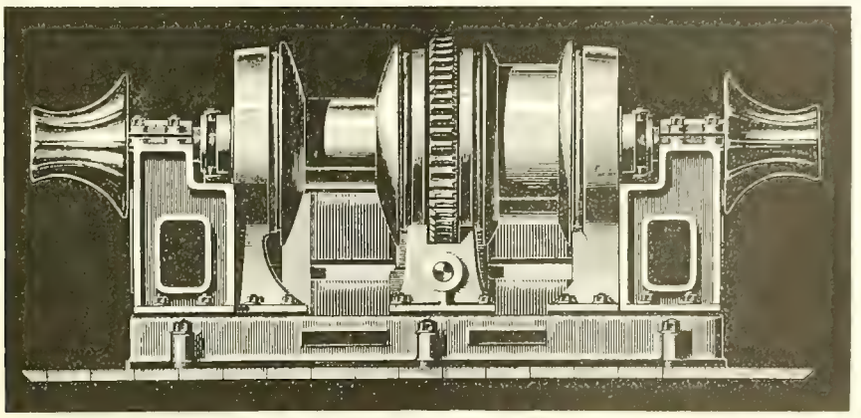


FIG. 1. ELECTRICALLY DRIVEN SHIP'S WINCH.

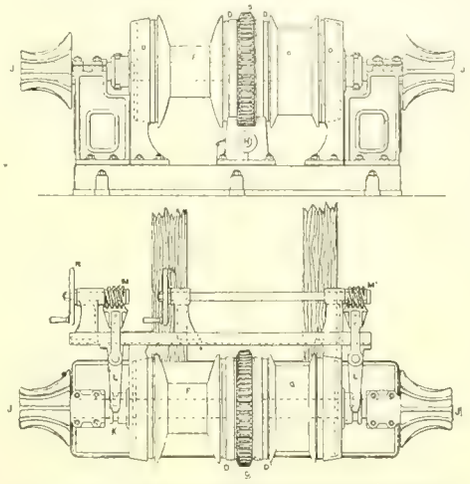
principle applied to a ship's winch, and Figs. 3 and 4 are explanatory drawings. There are two winding-drums, *F* and *G*, in line with each other and independent of each other. They may be of the same or of different diameters. Only one rope is used; the ends are wound in the same direction round the two drums, and pass up over two idle pulleys in the same pulley block, and the loop thus formed passes round the pulley supporting the weight to be lifted. The motion of the armature shaft is transmitted through a worm on the shaft *H* to the central worm wheel *C*. The friction cones *D* D^1 are attached to either side of the worm wheel, and corresponding external cones are formed in the winding drums *F G*.

These winding barrels are loose on the main shaft, but can be brought independently into frictional grip with the wheel *C* by means of the hand wheels $N N^1$, worms $M M^1$ and forked levers $L L^1$, which fit in the grooves *K* of the bosses of the barrels. Motion can thus be transmitted at will to either or both of the warping barrels *J*. There are also two fixed brake rings $O O^1$, into whose inner surfaces the corresponding rings on the drums *F G* take when the hand wheels $N N^1$ are turned in the opposite direction. The greatest lifting speed is when both barrels are attached to the wheel *C*; reduced speeds are obtained by having one drum only geared with the wheel *C*, and the other one braked. During descent either wheel may be braked or neither braked. This principle is of course equally applicable to derricks, portable jib cranes and traveling cranes. The cuts are reproduced from the *Engineering Review*, London.

A London Electrician's Opinion on Electrical Advancement in England.

James Fairfax, a London electrician, who is visiting Chicago, talked quite freely concerning electrical affairs in England, to a representative of a local daily. He said: "The people in the United States are educated far in advance of the English people in regard to the various uses of electricity. "It's not the fault of the electricians—they are well informed on all the latest inventions—but the trouble is with the people, who are slow to take hold of a new thing. Americans will give a new invention general use much quicker than will the English. As an illustration of the extent to which electric locomotion is taking hold in America, I am told that motors are being turned out of four large shops, employing in all something like 2,000 men. And the motors are being turned out as fast as they can be made. Now, the manufacture of motors and electric appliances in England will not begin to compare with that.

"The opening of the electric subway in London exceeds everything else of importance. It was put in operation last December. Although the engineers recognized at the time the full importance of the opening of the subway, they did not dream that it would make so deep an impression on the public mind. So far as the engineers are concerned, there is nothing new in what has been done in London; but, as engineers, we are simply servants of the investing public, and the public has been slow until now to recognize in electricity anything but a force with which imaginative inventors and cranks could experiment in laboratories and lecture rooms. The English people heretofore had no idea generally of the practicability of electrical machinery. But the application of electric power for the purposes of practical engineering has received a wonderful impetus since the opening of the electric subway. The great fact of the day in England is the conveyance of a million or more passengers through the London electric subway. The impression this has made upon the minds of the educated public who are not scientifically informed has been of great advantage to the electricians and engineers. The subway has done more in a few months than years of lecturing to prepare the minds of the people for the utilization of electricity in other ways. It will not be long before companies will be ready to use rock drills mining pumps, drilling machines, ship cranes, portable cranes, and other kinds of machinery operated by electricity.



FIGS. 3 AND 4. ELECTRICALLY DRIVEN SHIP'S WINCH.

Electricity has been perfectly applied to all this machinery for some time, but the public was afraid to take hold of it."

Frankfort Electrical Exhibition.

Herr Von Stephan, imperial postal secretary of Germany, has accepted the presidency of the international electro-technical congress, which will be held in Frankfort-on-the-Main, September 7th to 12th, in connection with the electrical exhibition. Delegates will be present from all European countries and the United States.

Consul General Mason has made a report on the electrical exhibition at Frankfort to the state department at

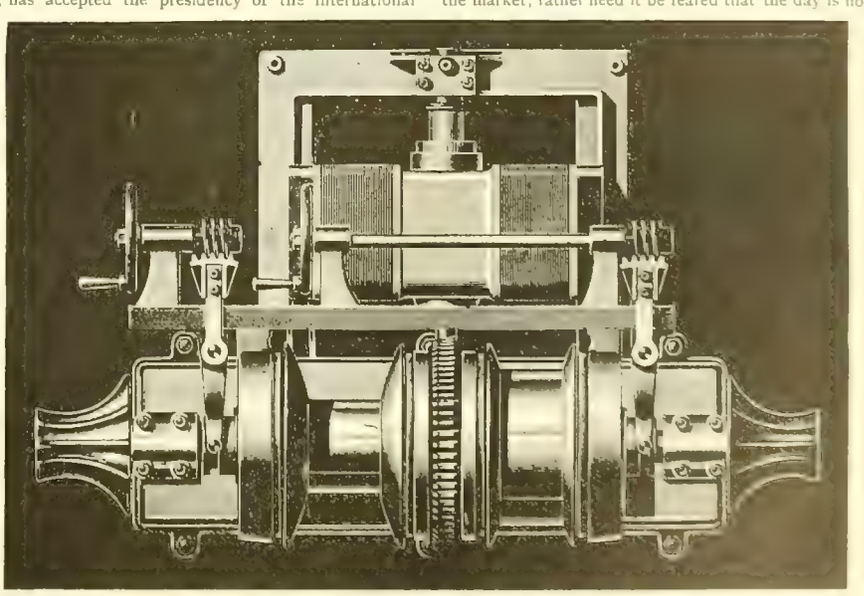


FIG. 2. ELECTRICALLY DRIVEN SHIP'S WINCH.

portant characteristic—it all means something. Nearly

London's Electric Lights.

R. P. Sellon read a paper on the progress of electric lighting in London before the Institution of Electrical Engineers. He said the progress of electric lighting in London was largely affected by the electric lighting act of 1888, which hampered the industry of electric lighting by its stringent conditions. A clause in this act gave the local authority the option of purchasing the whole of the plant of any electric lighting company at the end of 21 years at its market value. The electric lighting act of 1888 extended the period to 42 years, and provided that no provisional order should be granted except with the consent of the local authority. During the past three years electric lighting has become well established in London. Nine private electric supply companies and one local authority, the St. Pancras Vestry, are now supplying electricity in London, the aggregate capital of these companies being over £3,000,000. The equivalent of more than half a million incandescent lamps of 8 candle power are distributed over London, and more than 100 miles of conductors are laid in the streets. The Metropolitan Electric Supply company is now supplying 60,000 incandescent lamps, as against 14,000 in December last. The St. James and Pall Mall Electric Light company supplies 30,000 lamps as against 12,000 lamps last September. The Westminster Electric Supply corporation supplies 38,000 lamps, having more than trebled its production in the past five months. In these three companies the high-pressure, the low-pressure, and the accumulator systems are represented. Mr. Sellon commented on the contract between the Commissioners of Sewers of the city of London and the Brush company. In 1883 the Brush company had lighted some of the streets by arc lamps, but this was afterward abandoned at the request of the city commissioners. The present contract with the Brush company involves the abandonment of all other illuminants in favor of the electric light, and was the first instance in Great Britain of a public authority having adopted this course. Arc lamps are to be placed in the main thoroughfares, and incandescent lamps in the side streets. The advantages of the electric light as a means of protecting property were also described. The cost of lighting houses might be estimated to be greater by one-half than that of gas on the basis of 7d. per Board of Trade unit, but electricity afforded greater comfort, cleanliness, and a purer atmosphere.

What the Copper Men Think.

Evidently in no part of the land is the question of the great and increasing need of electricity of equal interest to what it is here, for the more extensively it is used the greater will be the prosperity of the copper country. If the new methods of lighting, heating and propelling machinery are as promising as they appear to be, the demand for copper must necessarily be very great, and production will find it hard to keep up with consumption. We have no fears that copper will ever again be a drug in the market; rather need it be feared that the day is not far distant when it will be difficult to supply the rapidly increasing demand.

A stock company has been organized to construct an electric light plant at Quanah, Texas.

O'Connell's Metallic Telephone Exchange System.

An important question among telephone men is how to simplify the switching apparatus on large multiple switch-boards. J. J. O'Connell, electrical engineer of the Chicago Telephone company, believes that the repeating coil must play an important part in accomplishing this result and that with a coil of 100 per cent. efficiency, or even 95 per cent. efficiency, a multiple switch-board for metallic or ground circuits may be made more simple in construction and at less than one-half of the cost of the present system. This sys em is especially designed for service in those districts where previous telephone systems have failed, owing to the disturbing effects of electric light and electric railroad currents.

The new system differs from the old in the application of a repeating coil for each line, whether single or metallic, and in the substitution of single for double cords and plugs for the connection of two subscribers' lines. The switch-board circuit is absolutely metallic no ground

O'CONNELL'S METALLIC TELEPHONE EXCHANGE SYSTEM.

connection being necessary, even on the operator's or test battery circuits.

A bunched common return connects one side of all the repeating coils, or, in other words, each wire has its own return, so that no induction takes place between the inside exchange wires. The subscribers' annunciators are thrown by induced current from the repeating coil and are shunted out when connection is made on their lines, so that only the clearing-out annunciator can be thrown. A glance at the cut which is self explanatory, will give the reader a general idea of the working of the system.

Electric Heating.

In the course of an editorial on "Electric Heaters on Railroads," *Age of Steel* says: "The time honored stove, dependent on the prompt service and close attention of [illegible]

Use of Mathematics.

Over in England they are discussing the value to electricians of a comprehensive knowledge of mathematics, and the admission of Edison, at the recent trial before Judge Wallace, that he did not understand Ohm's law, is accepted as a pertinent, though curious, contribution to the discussion. A correspondent of London *Industries*, who signs himself D. Sc., comments on the great inventor's confession in this interesting fashion:

"A self taught genius like Edison makes his discoveries by a kind of instinct, and mathematics would only be an incumbrance to him—at least, if it had been taught in the ordinary manner—for schools and colleges very often turn 'a free meandering brook into a straight cut ditch.' But that raises the whole question, Is mathematics properly taught? It cannot be doubted that it is possible for a man to obtain a thorough knowledge of mathematics without dwarfing his originality. The most brilliant example we have of that is Sir William Thomson, who is a profound mathematician, a distinguished physicist, and a most inventive genius. No one would think of comparing Sir William Thomson with Edison in almost any respect, but Sir William has lived in most advantageous conditions all his life. His father was a distinguished mathematician, so that his mathematics were bred in his bone; he had the advantages of a systematic training at Glasgow and Cambridge Universities, and he has had ample opportunities for carrying on his experimental work in Glasgow, and notwithstanding it all he is a most inventive man.

"If Edison had had such opportunities it is impossible to say what he might have been. He has the mathematical instinct, and he works in mathematics. Faraday knew no mathematics, and yet all his writings are mathematical in spirit, and he taught the mathematicians the meanings of their symbols. The mistake in all mathematical training has hitherto been that it has been too formal, a mere matter of logic chopping or formulæ grinding. The students should, whenever that is possible—and it is possible in very many cases—be shown the physical meaning and applications of their mathematics as they proceed, and they would not only have a more thorough knowledge of the subject, but also be more intelligent men. If that were so, very few of them would turn out dead failures, and many of them might even be improvements on Mr. Edison himself. I have great faith in the improvement of human nature in every respect, and I believe that our defective educational methods are the main cause of our slow progress."

Chicago Edison Company's Operations.

The proposed increase in the capital stock of the Chicago Edison company from $750,000 to $1,000,000 is not, according to the *Economist* of Chicago, to provide means for the erection of a new central building, but to raise money needed in the extension of its lighting system. One of the most active directors in the company states the case in this fashion: "The truth is, we are growing faster than our present means will permit, and we need more cash. We have spent $100,000 more on the South Side than we had, and there are other large expenditures in sight, and next year it will be found necessary to increase our capital stock again, probably to the extent of $500,000 and possibly $[illegible]. Our down town quarters are getting too cramped, and we must have more room. We have not gone far into that matter yet, however, as we have no intention of doing anything about it this year. We may sell out our building and leasehold on Adams street or we [illegible] building and [illegible] for a sub station. We [illegible] pay [illegible]. The leasehold has increased in value since it came into our possession, but it may be [illegible] to anybody else. You see it would be an expensive matter for us to move the machinery to [illegible]. I have always cheerfully taken any increased allotment of Edison stock and will continue to do so because I believe it to be a good thing."

Improved Signal Oilers.

In the accompanying cut is shown the latest form of Powell's improved signal oiler, introduced by the William

IMPROVED SIGNAL OILERS.

Powell company, Cincinnati, O. In this device the flow of oil can be instantly stopped or started, without changing the feed, as the operation of the signal lever is independent of the feed regulator. The quantity is regulated by a milled screw just under the signal lever, and when set to the desired position is secured by the winged jamb nut The filling hole in the top cap is covered by a snap lever, which can be moved either to the right or left.

Phonograph Batteries.

In the accompanying cut is shown a battery devised for phonograph work. It has a capacity of twenty amperes at 1.9 volts This battery is also well adapted to operating fans, miniature incandescent lamps and small motors. It is of the Edison pattern. The Electrical Supply company, Chicago, has the exclusive sale of this battery.

City and South London Railway.

The London correspondent of the *New York Times* cables the following: "Although it has been opened to the public for some eight months only, the underground railway constructed on the Greathead tunneling system, and operated by electricity from the city of London to Southwark, on the south side of the Thames, has already begun seriously to affect the short traffic receipts of the other railway companies. At the half yearly meeting of

PHONOGRAPH BATTERIES.

the London, Chatham and Dover company Mr. Forbes, the chairman, attributed the notable falling off of passengers on the short trips entirely to the competition of the City and South London Railway company. He said that his company had lost from this cause 38,482 first class, 57,000 second-class, and 160,000 third-class passengers. These figures, unwillingly extorted from the chairman of the directorate of the company, speak well for the hold which the new system has already obtained over the public mind. It must be noted that the distance covered by the City and South London line is as yet only three and a half miles. With an extension of the system a much heavier blow to the existing companies must be expected."

Arc Lighting and Hazards.[1]

By George P. Low.

With the advent of the incandescent electric lamp the fire underwriter believed he saw the dawning of the day when the hazard attending the production and use of artificial light would be greatly reduced, if not entirely eliminated. The idea of a minute thread-like substance, completely encased in glass and maintained at an intense luminosity with no application of external heat, without recourse to the use of inflammable or explosive oils and gases, and without open flame, at once impressed its utility upon his mind, and nearly all pronounced the new light to be simply perfection Though this first impression is now verified, it was not long before it became discredited, and with the comparatively great number of fires that occurred in the early days of incandescent lighting the fire underwriter was not slow in appreciating the fact, for the time forgotten, that artificial light, no matter what its form, can be produced at present only through agencies that are convertible into heat, for human ingenuity has not yet devised a commercially successful light without accompanying heat. In all existing methods of illumination heat is produced that it may give light, and wherever heat may occur there the fire underwriter recognizes a source of danger and at once sets about to eliminate the hazard, or to devise means that will reduce it to a minimum. It is hard to understand why insurance interests and not municipalities should have been called upon to enforce requirements that would effect the safe installation of electric circuits. Probably it is because the underwriter is quick to perceive a danger and equally ready to avert it, but be this as it may, and aside from the laudable efforts of a few of the leading electrical concerns, the only endeavors made to restrict the dangers in question have been put forth by insurance people. City governments have enforced fire ordinances and sanitary and health laws, but, singularly enough, they have done virtually nothing toward enacting electrical laws, even though they are equally important to the public safety. All this has fallen to the fire underwriters, and from ocean to ocean their requirements are looked to as authority.

It is admitted that insurance people have made mistakes in the efforts they have made, in partial proof of which it is only necessary to refer to the action of a prominent eastern board in adopting an asbestos fiber or a covering of cotton soaked in lead paint as the standard insulation, simply because it would not burn. This covering is yet known as underwriter's insulation, though in electrical circles it is facetiously termed "undertaker's wire," and but a few brief experiments were necessary to prove its unreliability for general use. Considering the fact that the board in question was reaching out into a new field explored as yet by no one, the mistake was natural, and is easily pardoned. One can have no appreciation of the magnitude of the task of framing requirements to meet any or all cases until he has tried it, and the longer he works the stronger will grow the conviction that it is impossible to draft a set of rules that shall cover even every ordinary case that may arise. Some application of electricity has worked itself into every branch of industry, and the conditions under which the electric current is used are, therefore, as diversified as the channels of human existence Different surroundings may exert widely different effects upon electric apparatus which may in turn give rise to various troubles.

With the exception of a new system of alternating current arc lighting, all systems of arc lighting are operated by continuous currents, and from their very nature continuous currents carry a hazard unknown to alternating currents. I refer to what is known as electrolysis or electrolytic action, which is most easily described by referring to an electro-plating bath. Take silver plating, for instance. A sheet of silver is connected to the positive pole of a suitable battery, such as a storage battery, and is then immersed in a solution of silver called the electrolyte. The article to be plated is connected to the negative pole of the battery, when through a peculiar electro-chemical action particles of silver are taken from the anode—as the silver sheet connected to the positive po'e is called—and deposited upon the cathode or the article to be plated. There is, in fact, a constant taking away of metal from the anode, and an equally great deposition of it upon the cathode. It is evident, therefore, that the anode must gradually wear away until it is finally consumed, in which case its entire volume will be transferred through the e'ectrolyte and distributed over the surface of the article to be plated. Accurately speaking, there is not a transfer of solid particles of metal, but what does occur amounts to the same thing, hence for the purposes of this paper the transfer of metal through an electrolyte may be considered as actual. Let us see now what figure electrolysis cuts in creating a hazard from fire. Take, for instance, a small store that is lighted with four arc lights. The wires enter through an awning and are separated the regulation ten inches. There being four lamps within the store, the potential difference of the wires at the point of entrance is consequently 200 volts. The insulation covering the wires, though sufficient for all purposes in dry weather, is not water proof, and the wire is not protected from the awning by water-proof tubes of glass or hard rubber. A shower of rain comes up, the awning and of course the wires become wet, and does not it occur to you that a plating bath, as complete as any ever devised, exists there on the awning? One of the wires is the positive pole or anode, equivalent to that of a 200 volt dynamo. The other wire forms the negative pole or cathode, and between them is the moisture on the boards or cloth of the awning which forms the electrolyte. For every hour during which the lamps burn a definite amount of copper is taken from the positive wire, transmitted thence electro-chemically through the poor insulation of the wire—insulation in name only—and the wet awning, and is deposited upon the negative pole. The copper is merely carried along with the current as it leaks through the conducting medium of moisture. True, the amount so carried across is extremely small, so small indeed that it may take years to make a visible effect upon the positive wire, but the time will surely come when the anodal wire will be so reduced in size that the current it must carry will maintain it sometimes at a white heat, then finally it will break and an arc will be maintained across the terminals. The hazard of a red hot wire resting against woodwork is too obvious to require more than merest mention, but in an electric arc is found the most intense artificial heat, in which many of the most refractory substances readily yield. The hazards attending their accidental existence and maintained is inestimably great; indeed, the many "awning fires" from electric lights that occurred until comparatively recently with alarming frequency were all directly attributable to unlooked for heating or arcing due to electrolysis. It took years of experience to learn the nature of this trouble, and now it may be entirely obviated by devoting proper care to the insulating and running of conducting wires

Electrolysis may occur, as I have said before, in all continuous current circuits, whether in arc, in incandescent or in power systems. It is most far-reaching in its action, and if you will recall the illustration given in explaining the personal hazard from arc circuits, where a fireman was supposed to have received a 250 volt shock through a "ground," on the circuit a mile away, I shall find pleasure in showing you another of the dangers of "grounded" circuits. We will presume, as in the example referred to, that an arc circuit of fifty lights is grounded at a point near the tenth lamp, and that at the point beyond the fifteenth lamp the wire passes unprotected through an outer brick wall Different gas, water and soil pipes are against the wall, which renders it an excellent ground during the wet season. Is it not plain then that the wire passing through the wall becomes as one pole of a 250 volt dynamo—the positive pole, for instance, while the metal piping referred to becomes the negative pole through the ground existing at the tenth lamp and that the moist brick wall forms the electrolyte? It is immaterial whether the ground at the tenth lamp be ten inches or ten miles distant, the positive wire will be slowly worn away until finally it parts, an arc is formed, and another possibility of a conflagration exists. Frequently I have met electric lighting men who in opposing the suggestion of better protection to wires run in places liable to dampness have retorted that "the wires have been the way they are for three years and if they will ever give trouble they would have done so in that time." Here let me offer a word to my electric lighting friends. The competent insurance inspector for electric lighting, in addition to the knowledge gained from his own researches and labors in the electrical field, holds a position that gives him a personal acquaintance with each and every electrician of note in his section of the country. He periodically visits each and every plant he avails himself of the opportunity to familiarize himself with all manner of dynamo electric machinery and accessory apparatus, and above all he adds to his stock of knowledge by bits of priceless information garnered from the experience of every electrical concern in his territory. Whether that experience be profitable or disastrous, the insurance inspector is one of the few who learns its moral, and the fire underwriter is the one who gratuitously extends this information, so carefully gathered, to all who have use for it. Our friend whose installation is defective, yet who has had no trouble for three years and who argues therefore that the occurrence of a fire from his circuits is an impossibility, falls into a fatal error from which he must some day extricate himself as best he may. I have seen wires originally half as large as a lead pencil reduced to one third or one-quarter of their cross section, and even severed altogether by electrolytic action. Other wires which were originally between one-sixteenth and one-eighth of an inch in diameter, I have seen reduced to the diameter of a thread, others to that of a hair, others completely worn away and the severed ends reduced to needle-like points, others to needle-like points from which globu'es of copper depended showing that an arc had existed, still other cases where the wood-work around the globule-tipped terminals had been burned for a radius of twenty inches or more, proving conclusively that electrolysis, the incendiary, had started its work well. In one of the last named cases the wires merely rested against plaster, and the origin of the fire is only traceable to—what do you suppose? Simply to the moisture absorbed by the plaster from the air, to the use of a non-moisture proof insulation and to electrolysis. Some may contend that this wearing away is simply corrosion or verdigris. If such is the case, why is it that only one wire is reduced in size, why is it that that wire is always the positive, and why is it that alternating circuits are not so affected? It may occur to some that water, universally esteemed as the natural enemy of fire, indirectly becomes its origin through electrolysis. For the time this may appear singular, but not more so than in a number of cases familiar to all fire underwriters in which water causes spontaneous combustion. In unslaked lime, all that is needed to raise it to a temperature sufficient to ignite wood is the application of a sufficient quantity of water. The moral is, then, keep water away from unslaked lime. If two bare wires, separated say two inches, run parallel through a piece of dry wood, if the wires carry sufficient potential, all that is necessary to ignite the wood is to wet it. Apply the same moral: Keep moisture away from the wires and the danger is effectually averted. Indeed no rule is more conducive to safety in installing all electric circuits than that of avoiding places where dampness or moisture may possibly exist. A well-known local electrician, fully appreciating the importance of this rule, recently expressed an impromptu opinion that, electrically speaking, "everything that is waterproof is fireproof." Though not literally true the saying is worth remembering.

Before leaving the subject of constant current circuits it may be well to mention a few pernicious practices which are yet prevalent and which should be discouraged by

common wire, called for convenience the negative pole.

group of lamps be introduced in series into an arc circuit

we have what is commonly, though erroneously, called a multiple-series of incandescent lamps. The object of the multiple-series system is to furnish incandescent lights from arc circuits where incandescent circuits proper do not exist, and there are several reasons why the system is extra hazardous. In the first place the public is educated to believe that an incandescent lamp, merely from the fact that it is such, is perfectly safe. The property owner sees the multiple series incandescent lamp, believes in its harmlessness, handles it with the carelessness or impunity of ignorance, and some day after he has been brought back to life by the vigorous administration of restoratives, or perhaps during a conversation with the fire marshal upon the mysterious cause of the fire that cleaned him out, he may learn that an incandescent lamp which burns on a 3,000 volt arc circuit is not perfectly harmless. Every respect is paid to an arc lamp. No one who is not familiar with it cares to even approach it, yet each multiple series incandescent lamp is at the same potential and the group carries precisely the same current that operates its more majestic brother, the formidable arc lamp. Another form of incandescent lighting equally hazardous with the multiple-series system is the plain series incandescent system. The system is identical with arc systems as to the arrangement of the circuit, the only difference being that incandescent lamps are inserted into the circuit direct in lieu of arc lamps. In the Heisler series incandescent system an alternating current of five amperes is driven serially through each incandescent lamp. As each of these lamps absorbs approximately fifteen volts, if 300 lamps are in the circuit, as sometimes may occur, the line will have a potential of about 4,500 volts. When it is remembered that an alternating current of 1,800 volts was used in the electrocution of the four murderers at Sing Sing, I think no one will dispute the assertion that an alternating circuit of 4,500 volts potential is a good thing to let alone in more ways than one, for wherever the hazard to life is great, the hazard to property is equally so. In my opinion, multiple-series systems and series incandescent systems should be generally excluded from all insured buildings. There is now no legitimate reason why multiple-series lights should be found in any city, and I note with satisfaction that they are rapidly going out of use. As to series incandescent, their proper sphere is for street lighting. Doubtless some one is asking how these systems can be distinguished from the ordinary and safe incandescent systems. If a single wire comes into a building and goes to one lamp, then to another, then to another, taking in each lamp in the premises serially, one by one, you may know that the system is a simple series system, like an arc-lighting system. Being a series system, and inasmuch as incandescents are burned from it, you may be sure that it is a series incandescent system. The ordinary incandescent system has many wires of different sizes, but consists essentially of two wires, across which are placed the lamps as rungs are placed in a ladder. This is called the multiple or multiple arc system of wiring, and lamps so arranged may be turned on or off singly, or in any manner desired, and they may be of any number. In the multiple series, however, they are always run in groups, and the total number of lights in a certain place is always some multiple of a given number. Most multiple series lights are burned from the Brush system, and the number of lights in a group is generally eight. It is impossible to extinguish any light without dimming the remainder. A further identification for the Brush multiple-series system is a little black iron box with three incandescent lamps on top of it. This box is generally put up against the wall in some out of the way place. In addition to the regular group characteristic the Thomson Houston multiple-series system may be known by its abnormally large and well ventilated socket.

In many cities electric motors are placed in constant current circuits in series and operated in just the same manner as arc lights. It follows then that when this is done the entire electrical energy of the circuit goes through each motor regardless of its size. In other words, if a constant current circuit is operated by a dynamo that puts electricity to the equivalent of fifty horse power into the circuit, the entire fifty horse power goes through the little sewing machine motor and the big pumping motor with equal facility. The difference is that the resistance of the sewing machine motor is such that, in addition to carrying the ten amperes for instance of the circuit it absorbs sufficient voltage to give it the electrical energy requisite to produce the necessary mechanical power required to drive the sewing machine The pumping motor also takes the ten amperes, but the voltage it absorbs is far more than that of the little motor referred to, because of the greater amount of electrical energy it must utilize in order to return its full power. As in arc lighting, the dynamo supplying current for series motor circuits is so constructed that it automatically increases its pressure to generate the voltage which is absorbed or which ceases to be absorbed the instant any motor is started or stopped. The voltage of such power circuits is therefore constantly changing One moment it may be 2,000 volts, the next minute sufficient motors may have been started up to raise the potential to 3,000 volts. It is evident then that arc lighting circuits and constant current motor circuits are

1. Abstract of paper read before the Pacific Underwriters' association at San Francisco.

practically the same and their hazards are, therefore, about identical. I have found some credence given to the belief that constant current motors and dynamos of the same horse power have the same physical hazards. The error of this [illegible] when it is remembered that though the brushes of the motor may show a pressure of say 75 volts, still the ten amperes that are flowing through its coils are being driven by a potential of possibly 3,000 volts. As a dynamo, the arc the machine would maintain would be insignificant indeed compared with the wicked two or three inch stream of electrical fire that would be maintained across the broken terminals of the motor circuit. As with arc lamps it is well to keep at a respectful distance from these motors which, by the way, are the only kind now in use in San Francisco. Wires leading to them must always be put up with care, and in no instance should they come in contact with wood work or anything except their proper insulators, nor should they be run in any place liable to handling or where they may be possibly interfered with by merchandise, individuals or otherwise. Each such motor circuit entering a building should, moreover, be provided with an absolute break switch, through the use of which the current in the building may be instantly diverted from the motor and out of the building.

Before bringing this paper to a close I find myself tempted to mention a few of the many pernicious practices which are forbidden in insurance requirements, and which, if indulged in, will certainly occasion no little annoyance or pecuniary loss to the owner of the plant, if they do not cause fire Among these condemned practices is the use of soft rubber tubing, which cracks and becomes incapable of repelling moisture. It was once a frequent practice to secure wires in place by the use of metallic staples, but it was found that they cut the insulation and became "live" —that is, they form an exposed part of the circuit by coming into contact with the conductor. Porcelain knobs are unsuitable for outside work, for the reason principally that they afford a competent insulation only in dry weather, when it is least needed. Hard rubber hooks, which were once well thought of by many for inside arc work, have dropped into disuse because of several unfortunate characteristics. It is seldom safe to permit the suspension of arc lamps by leads—that is, by the wires which supply them with current, the objections being that the swaying of the lamp is liable to wear through the insulation at the points where the leads are secured, while the weight of the lamp may pull a lead from its proper contact piece, thereby occasioning its heating or else a very dangerous arc. Arc lamps, if used indoors, are never safe unless furnished with glass globes, and if placed in show windows or elsewhere in close proximity to easily ignited fabrics or other similar materials, the lamps should have the further protection of a spark arrester. The use of such an appliance is seldom required. The precaution of a globe is necessary, however, to prevent the falling of heated flakes or particles of carbon or copper that continually drop from a burning lamp. One never knows when or where dampness may occur in a building, and when so much depends on the keeping of moisture from conductors, it is essential that all inside high potential wires be covered with an insulation that is absolutely waterproof, and an additional safeguard is assured if each high potential circuit entering a building is provided with an absolute break switch, which, when thrown "off," will leave the interior wire as harmless as a clothesline. To say more in this direction would be to repeat what is fully set forth in the requirements of the fire underwriters governing the installation of high potential circuits.

It must not be judged from what has been stated that I am an alarmist or that I believe the electric hazard to be great compared with the hazards of other more familiar agencies. To the contrary, I wish it to be understood that the danger or the absolute safety of an electric lighting or power plant depends entirely upon the manner of its installation, and to bring about a thorough understanding of the hazards of constant current systems in order that they may be provided against, is the aim of this paper. If I have succeeded in doing so, if only in part, I am satisfied.

Flying by Means of Electricity.

Despite the repeated failures of attempts made to solve the problem of aerial navigation, there are many who believe that the accomplishment of the feat is only a question [illegible] advance in the progress of the world is not so great as some that have been made. It now appears to be generally conceded by all who have carefully investigated the matter that if there ever is a [illegible] practically. This [illegible] knowledge of Hartion to the literature of this fascinating subject An [illegible]

[illegible]

tage of the steamship—free to go through a wide stretch of air unhampered by conditions of stability of roadway or limitations of curves and gradients. It is true that it would have currents of air and head winds to contend against. These obstacles the steamship on water also encounters.

To the believer in the possibility of flying, however, this method we have outlined seems humiliating. It is not flying in the pure sense. It is telpherage. The aeronaut wishes to cut loose from the earth entirely, and to compete with the birds in an element which has been theirs for countless ages.

The method, however, which is thought to be the coming one, is that based upon the employment of storage batteries. In brief, it is this: A light storage battery capable of containing at least one horse power is to turn an electric motor in a suitable air ship, and by the means of a light source of power and a light motor the problem is to be solved.

It is generally conceded, however, that if we are to fly by electricity we must first be shot off from some suitable height in order to attain the requisite initial velocity.

Now let us examine the condition of a light storage battery. Great hopes were excited when the Faure storage cell was invented. Here was something which the world had been long waiting for and many prophesied that it would revolutionize methods of locomotion. Unfortunately these hopes have not been realized.

The lead battery answers admirably for laboratory use, where the plates can be readily repeated after they disintegrate. The faults of the Faure lead storage cell are its weight and its rapid disintegration when a severe demand is made upon it. Much invention has been wasted upon this cell. It has been modified in numberless ways to overcome the defects of weight, of the buckling of the lead plates of the cell, that is the yielding and deformation of their shape. Fairly powerful batteries are now made and are supplied to the public. In certain cases the companies take entire charge of the batteries, assuming the loss from the inevitable deterioration, charging ten per cent. a year on the cost of the battery. In a certain limited sense, therefore, the lead storage battery can be said to be a success.

The weight of the average commercial lead storage battery is about 100 pounds per horse power per hour. If one wishes to run a motor for six hours the battery should be charged for ten or twelve hours, and under the most favorable conditions, 80 per cent. of the current which is used to charge the battery can be recovered by its performance.

I have said that numberless attempts have been made to decrease the weight of the lead plates of the Faure accumulator, or storage cell. My experiments lead me to believe that moderately thick lead plates are more economical than thin light ones. The expansion and contraction of the oxides of lead which are pasted into holes and irregularities in the lead plates lead to deformation of the plate. The paste thereupon drops out of the recesses or holes which contain it and the battery loses its charge. I have replaced the lead plates by porous carbon ones containing holes for reception of the lead paste and a thin backing of lead for electrodes.

This last form of storage cell was very light and would receive a strong charge; but the plates rapidly deteriorated. Apparently we must be content in the lead storage battery with comparatively heavy lead plates. Since the weight of this form of cell is so great, and since there is apparently little prospect of the weight being reduced, it seems to be out of consideration in the question of flying.

A new storage cell has recently attracted much attention and it bids fair to compete successfully with the lead battery, certainly in the problem of flying. This cell is a modification of the alkaline storage battery or accumulator invented two or three years since in France by Desmazures. This cell weighs in rough terms only about half as much as a lead cell of the same capacity. One pole of the alkaline storage battery is of iron, while the other is finely divided copper. The liquid is potassium zincate. The zinc is deposited upon the iron, while the copper, being finely divided, can be readily oxidized.

Two American inventors, Waddell and Entz, have modified the original Desmazures cell in certain slight but important particulars. The result of the endeavors has been the production of a remarkably efficient accumulator. The saving in weight of this battery over the lead storage battery is about 1,500 pounds per car. A car furnished with this battery together with its motor weighs somewhat less than the electrical car of the ordinary trolley system.

There seems to be more hope for aeronauts in this new battery than in the lead batteries, but this hope is a small one, for although the weight of the storage battery has now been reduced to nearly one half, it is still very great; and the weight of the motor has still to be considered.

It is not probable that the future bicyclist of the air can support himself and progress with less than one horse power at his command. If he employs electricity he will find it difficult to construct an electrical motor which will yield a horse power and which will weigh under 100 lbs. With 100 lbs. in his battery and 100 lbs. in his motor, to say nothing of the weight of the gears, wings, and rudders of the flying machine, the electrical aeronaut will be heavily handicapped even for a short trip. If an initial velocity could be gained by some species of send off, like a toboggan slide, it is improble that a flying machine with such a heavy electrical equipment could be made to soar, and the unlucky experimenter would speedily find [illegible] among the debris of the machine.

Even if a lighter storage battery should be invented, of which there is increasing probability, the weight of an electric motor still will remain necessarily great. What invention may accomplish in the way of lightening electric [illegible] power. At present electric motors are too heavy to be seriously considered for the propelling agents of flying machines which are not in part balloons.

We therefore return to the first method we have described, that of a balloon ship driven by an electrical motor, which is driven by a current fed to the motor by a trolley wire, in short a modified telpherage system. This method of flying, although ignominious to one who desires to cut himself entirely free from all connection with the earth, still seems to be a possible solution of the endeavor to use the air as steamships now use the water. The new method of step up and step down converters would enable comparatively fine wire to be used to convey the electrical current from the wires on the earth through the trolleys to the balloon ship. The latter could therefore be at a height sufficient to move freely without any fear of touching housetops or trees.

The step up transformer is merely the old Ruhmkorff coil. The primary of this is supplied with a powerful alternating current, a very high electromotive force is thus generated in the fine coil of the Ruhmkorff coil, and this electrical pressure can be transmitted along comparatively fine wires to the machine where it is desired to obtain electrical power. At the machine the high pressure current passes into a step down converter or transformer, which is simply another Ruhmkorff coil, and the quantity current with low pressure is taken off the inner coil of the Ruhmkorff.

This, in brief, is the method of the step up and step down transformers. And it is possible that we may step up into the air by such a system on the telpherage plan. The stepping down can be accomplished electrically, but the problem of stepping down safely from flying machines still puzzles the aeronaut, whether he proposes to employ electricity or some other source of power.

CORRESPONDENCE.

New York Notes.

NEW YORK, August 8.—The burning of the station of the Richmond Light, Heat & Power company of Staten Island is the most important item of news to be chronicled this week. The destruction of this plant, which furnished current for all but a few lamps on the island, leaves the residents in a position to appreciate now, if never before, and to the fullest extent, what New York proper had to suffer when Mayor Grant first began that work which has led to such an extensive development of the underground system. The conflagration from an æsthetic standpoint was a magnificent sight—your correspondent was on the island at the time—but those who have since had to resort to the miserable gas jets, or worse still, candles and oil lamps, are not as enthusiastic now about the "beautiful fire" as they were on the night of August 3d. The town of St George turned out en masse and witnessed the conflagration from the hillside. Both Erastus Wiman and his son, W. Dwight Wiman, who is general manager of the Richmond company, were on hand directing their men in an effort to save a small annex office building. This was only partially burned. The Staten Island "fire department" was there also, but the fire went on just the same. Perhaps it may be an injustice to some one to mention also that a man was seen on one of the poles just outside of the building sawing the "deadly" wires about thirty minutes after the lights went out. A lesson will be drawn from the Richmond company's fire, and doubtless the new station, which is to be built immediately on another site closer to the water's edge, will be constructed according to modern ideas. President Wiman has issued a circular in which he states that it is the hope of the company to be able to continue the regular service in about sixty days. Just after the fire the Fort Wayne Electric company came to front with an offer to furnish ten or twelve dynamos and deliver them in forty-eight hours. The offer was accepted. It is probable that these machines will be set up at different points on the island, if extra power is available, and will be employed in this manner to feed the system. A number of the New York papers quoted General Manager Wiman as stating the company's loss to be $75,000 to $100,000, but on the night of the fire Mr. Wiman estimated the damage at $50,000 with full insurance.

Staten Island is nothing if not progressive. Unless the Richmond county supervisors display to an extraordinary degree that characteristic so peculiar to rural boards, the island, before long, will have its electric railway. A petition has been presented by a Brooklyn syndicate for permission to operate an overhead system. It is stated that negotiations for the purchase of the franchise of the Belt Line street railway running from Fort Wadsworth to the New Brighton and Port Richmond road, have been completed, and the syndicates desire to begin work as soon as possible after the board's permission has been secured. It is expected that the syndicate's plans will meet with the approval of the supervisors.

The White Squadron returned to New York from Fisher's Island, the scene of the naval reserve maneuvres, on Tuesday last. The fleet is now anchored in the North river and the officers have already begun active service in the metropolis with a breakfast at the Lawyers' Club. The New York Naval Reserves reached home the Sunday before. The Reserve roll carries the names of a number of

electrical men. S. Dana Green of the Edison company and Robert T. Lozier, manager of the lamp department of the same concern, pulled in the first battery's boat in the race between the first, second and third batteries. Both Mr. Lozier and Mr. Green, it will be remembered, have been identified with the electrical interests of Chicago.

The Rapid Transit commission has adjourned until August 14th. As two members of that august body have left the city no important moves by their colleagues may be expected during their absence. It is announced that the commissioners desire to obtain a consensus of the best available engineering opinion before the board makes a decision. The opinions are to be embodied, along with specifications and detail plans, in a report to the common council.

District Attorney Nicoll, it seems, has begun with a rush his effort to indict all the New York papers which published accounts of the electrical executions at Sing Sing. The grand jury brought in indictments against the following named gentlemen Joseph Pulitzer of the *World;* John A. Cockerill, editor of the *Advertiser;* George W. Turner of the *Recorder;* William F. Laffan, publisher of the *Sun;* Bradford Merrill, managing editor of the *Press;* Albert H. Hceckley, city editor of the *Journal,* and Charles R. Miller, managing editor of the *Times.* The only morning publication exempted from indictment was the *Tribune.*

"The *Tribune* was not indicted," said Assistant District Attorney Lindsay, "for the reason that it has not shown any disposition to go into the matter. It would be impracticable to get these indictments without the concurrence of the newspapers, because any one connected with a newspaper would be excused from testifying, and for the further reason that in these cases the prosecution is compelled to prove the truth of the published accounts, which is almost impossible without the concession of the newspapers."

As a matter of course the New York journalists are up in arms on the subject of the freedom of the press, and from the amount of space which has been devoted to interviews, etc., one is led to believe that the editorial heart is secretly gladdened at the thought of what will follow in the natural course of events. It may be mentioned that the *Sun's* interviews with leading statesmen of both parties showed four Democrats and four Republicans emphatic in their remarks in favor of a repeal of that section of the law restricting the liberty of the press. Chauncey Depew, as usual, covers himself with glory—that is, as far as the newspapers are concerned—by one pertinent and comprehensive remark: "The clearest light should be shed upon the taking of human life by law," says Mr. Depew, and "Hurrah for Chauncey Depew!" says the *Sun.* Had Mr. Depew only been politic there would have been electric lights in his tunnel, and then the WESTERN ELECTRICIAN might have added "Bravo, Chauncey."

Etymologists will be interested, no doubt, to learn that the New York *Manufacturer and Builder,* in deference to the *Times,* has decided to use the word 'electrothany" instead of "electrocution." The aforesaid journal deems "electrothany"to be the proper thing—"properly significant and etymologically correct."

Alas, word juggling will do no good now. "Electrocution," it is to be feared, has come to stay, both as a word and as a horrible reality.

George Francis Train is in New York. Chicagoans will be glad to know this, for Mr. Train once passed through Chicago on his way to smaller and less progressive cities. Mr. Train feels kindly toward the Fair. He had heard of it when abroad. He would gladly save it from ruin. It would please him to give to the world the benefit of a preliminary fair by taking 1,000 persons around the world in the Majestic. Electricians will be glad to know of Mr. Train's plan: "I propose," said Mr. Train, "to have 1,000 American flags on the ship, and whenever we enter a port each of the 1,000 passengers will be waving a flag. That will advertise America. On board the vessel we will have our phonograph, our electrical appliances, and specimens of all the important American inventions. It will be a fair such as will attract and interest the people of every nation. They will eagerly pay to come and see it. They will talk in our phonographs. A lot of money will be made, and the success of the World's Fair be assured." Unless the people come right forward—Mr. Train talks plainly—he will abandon further attempts to help them out of their troubles. He will go back to silence in Madison Square. He says he once went for fourteen years without speaking to man or woman, and can do it again. It is earnestly hoped that the Chicago Electric club will take immediate action to prevent this catastrophe.

The plausible Pennington of Mt. Carmel air ship fame has also turned up in New York, bringing his model along with him. The reader will remember that this alleged air ship was described in the WESTERN ELECTRICIAN when it was on exhibition in the Exposition building, Chicago. The article appeared in the issue of Feb. 14, 1891. Dr. Warren C. Spencer is master of ceremonies in New York city, and on last Tuesday he gave an exhibition of the marvelous machine to a favored few at the Academy of Music. "Mr. Pennington will reach here in about six weeks," said Dr. Spencer. "He is going to sail the ship from St. Louis He gave me his word of honor that he would be here in that time, and I know he will."

Dr. Spencer is probably from St. Louis.

The United States Electric Light company on August 2d filed the indemnity bond for $50,000 in the United States circuit court. The company was required to file under the order of Judge Wallace granting an interlocutory decree staying the order of injunction secured by the Edison company. The sureties are Marcellus Hartley and Anson P. Stokes. The United States company has also taken an appeal from the recent decision in favor of Edison, to the new appellate court. On August 4th the United States people filed an assignment of errors.

At a meeting of the Board of Electrical Control on Monday last the Empire Subway company was ordered to build subways on a number of streets for the use of the Edison company. The work must be completed by September 15th.

If Chicago was New York, instead of being only the "Windy City," or was inclined to be retaliatory, the civilized world would perhaps by this time be thoroughly posted as to the most recent innovation in the way of "New York's midsummer plague." Only one irrepressible reporter yields to the temptation, however, and in a short paragraph lets the cat out of the bag. It seems that the electric lights fed from New York stations are just as alluring to the bug species as those in Chicago. The lamps up town are attracting vast numbers of bugs, called here "hawk moths," especially when the lights are in the neighborhood of ailanthus trees, upon which the insects are supposed to feed. The pavements on some parts of Eighth avenue are so thickly covered in the evening by the dead moths that the trampling of pedestrians over the dead bodies covers the flags with a slippery green scum. New York and Chicago are quits now. Chicago may have its sand flies, but the metropolis will have to sympathize.

The United States Railway, Equipment & Construction company of New York has purchased the system of the Lockport, N. Y., Street Railway company. The work of equipping the line for electric motive power has already been commenced. The capital stock of the new organization will be $100,000.

It is understood from a representative of the Phonograph company that a new type of phonogram is soon to be introduced. The improved cylinder will be much smaller than the bulky ones now in use. It is to be no larger than a man's little finger. The recording stylus is made to do much finer work. These small cylinders will undoubtedly lead to a much more extensive introduction of the phonograph, especially as an aid in general office work and correspondence. F. L. P.

Minneapolis, Minn.

MINNEAPOLIS, Aug. 8.—The Minnesota Brush Electric company has just let the contract for putting its entire system of wires underground in the underground district. This is the first complete contract of the kind for power, arc and incandescent lighting ever let in the United States. The company securing the contract is the Standard Underground Cable company of Pittsburg. The grand total of the cost of the plant with extensions completed will be about $120,000, and the cost of the work to be completed this year will approximate $92,000. Some idea of the magnitude of the work may be gathered from the fact that 82¼ miles of cable, with all the accessories, are necessary to put in the plant. The contract requires that the system in the underground limits shall be completed and in working order by Dec. 1st of this year, the company securing the contract having put up a $50,000 bond to that effect. F. E. Degenhardt, the representative of the Standard Cable company, is highly elated over his success, having practically defeated every electrical construction company in the country in an open field. In June of last year the Brush company let a contract for 60 miles of underground cable to the Cobb Vulcanite Rubber company, which, after completing 20 miles, became bankrupt. The Brush company, after investigating the field, advertised for bids for putting in the entire plant, which resulted in the Pittsburg company's triumph.

The street car company has started another of its lines. The Western avenue and Second street N. E. extension just completed has been formally connected, and ten large motor cars have commenced their duties. There now remains

world.

arc, alternating or incandescent circuit. The brushes rotate instead of the armature. Mr. Scott thinks that the

pole he would have a flexible cord, thus doing away with the elaborate iron support on the top of the car. The trolley would be behind the car in sight of the conductor. Several experts have examined the cord and it is soon to be tested on the Lake Harriett line.

The street car company is defendant in two damage suits. The first one is brought by William Solomon for $5,000 damages. His complaint is that while riding on an electric car in North Minneapolis a couple of young men called him names and one of them struck him in the face, thereby impairing his eyesight. The conductor and driver were both witnesses to the incident and failed to come to his relief The other suit is brought by Charles Reller, to recover for the loss of a horse. Several months ago, one of his horses was killed by contact with a trolley wire on Cedar avenue and another one seriously injured.

The chief of police has issued an order regulating the members of the force in their street car riding. After this no policeman will be allowed to ride free unless he has his star displayed on his left breast. This will apply whether the officer is in full uniform or in citizen's dress. The order is made at the request of the street railway company, whose conductors have rung up passengers and have found when they came to collect the fares that they were policemen, the stars being hid under the lapels of the coats.

In St. Paul the improvements of the Consolidated company are going on with much the same vigor that is noticeable in Minneapolis. Material is now being hauled for the extension of the electric line from Tuscarora street to Fort Snelling, the bridge across the Mississippi having been completed for the purpose. The West Seventh street electric line is likely to become the next inter-urban line. When this line is completed to the Snelling bridge it will be only a short distance from the Minneapolis line running to Minnehaha. Another bridge will probably be erected at the fort, as the present one is too narrow and of too weak construction to warrant the traffic of the popular inter urban line. It is officially stated that Mr. Lowry will co-operate with property owners in building the bridge necessary. The route would be peculiarly favorable for an inter-urban line, as for much of its distance there is a high bluff on one side and lowlands on the other, effectually doing away with cross streets. The motors can make very fast time on such a line, and probably reduce the running time between the two cities to something near half an hour.

General Manager Goodrich, of the Twin City company announces that he will within a few days issue orders for all electric trains on the First avenue and Bloomington lines to swing around the Union depot loop instead of switching at Washington avenue and First avenue south.

This is an important order, and will be hailed by the traveling public with much delight. All the principal lines of the city will upon issuance of this order carry passengers to and from the Union depot without change of cars. The Western avenue division will in a few days be consolidated with the Second street, N. E. line, and these cars will pass the Union depot, crossing the steel arch bridge into East Minneapolis. For some time there has been a continuous blockade of cars in front of Temple Court on Hennepin avenue, where several lines have been required to use a turn table. The new arrangement will obviate all this. The company has surprised the gay public which frequent the lake resorts by illuminating its line between Lake Mendota and

lamps, which gave a

to the dark woods in that neighborhood. The company has also

musical

immense

awaits the

operation.

between the lake and the city. When this line is open the street

in the city limits of Minneapolis, over half of which are

pleted will be over 500 coaches and motors. All motors will carry trailers, thus making the system as convenient as it is complete.

The vexed question of transfers is again disturbing the street railway company. Under the present plan of issuing transfers good on all lines for half an hour after the time of issuance the company has been subjected to glaring frauds and abuses and has unquestionably lost thousands of dollars through the petty meanness of many of their customers. It is announced that some restrictions will be placed upon the system immediately, but just what it is has not yet appeared There is no question but that the general public would be very willing to see some limitation on the present system of transfers, as the injustice of it is apparent. F.

Toledo, Ohio.

TOLEDO, Aug. 8.—The business of the Toledo Electric Street Railway company has increased to such an extent that it has become necessary to have an assistant general manager, and the services of G J. Coleman of Cleveland have been secured for that position. F. B. Perkins, formerly of Pittsburg, Pa., is superintendent. He is popular with the employes.

This company now has in operation twenty miles of track, on most of which a 78 pound girder rail is used. It operates twenty-eight single motor cars out of a possible thirty-one, three cars only being held in reserve in case of repairs and overflow business. These cars make from 135 to 140 miles per day each.

The company employs at present five 80 horse power generators, which are run by one double compound engine, which can be increased to 1,000 horse power. An order has been placed for another generator and another engine of 1,000 horse power, which will increase the capacity to 2,000 horse power. The company's intention is to furnish power for private institutions, which is being done at present to a certain extent.

The Toledo Electric Street Railway company has begun an action to recover $250,000 from the Consolidated Street Railway company for alleged malicious interference with the construction of the plaintiff's lines. The Robisons charge the old company with maliciously and wickedly contriving and conspiring to perpetuate the monopoly of the street railway carrying business in the Consolidated company, and prevent and destroy the inauguration of any competing street railway enterprise in the city. Further, the defendants are charged with striving to impair the credit of the new enterprise, delay, and, if possible, prevent the completion of the road, using for this purpose improper means to induce property owners to withdraw their signatures to the petitions for the road, and also attempting to prevent them from selling the bonds issued, to prevent manufacturers and dealers in iron and electrical supplies from selling them to the plaintiff, and to destroy all possibility of any profit being made out of the operation of the road. From present appearances the litigation has just begun.

Omaha, Neb.

OMAHA, Neb , Aug. 8.—A contract has recently been let by the state authorities to the Lincoln, Neb., Electric Supply company for lighting the state buildings at Peru, Neb. Two hundred incandescent lamps and the necessary machinery and wiring are to be furnished. The same firm also secured the contract for the electrical work to be done at Hastings, Neb., in the new buildings for the Asylum for the Insane.

The Omaha Street Railway company is changing what was left of the old horse car lines to electric lines, and ex-

The work of erecting the lighting plant in Lincoln park, is already giving H P. K.

Pittsburg, Pa.

The Second Avenue Passenger Railway company has broken ground for the foundation of an addition, which the company is building to the power house on Second avenue.

W. E. Stevenson, of the laboratory force of the Westinghouse Electric & Manufacturing company, has gone to Atlantic City for two weeks. B. L. W.

Denver, Col.

DENVER, Colo., Aug. 8.—The electric light question has been settled by the acceptance, with some modifications, of the Consolidated Electric Light company's proposition. Incandescent lights on the all night schedule will be supplied at $2.16 2-3 per month; arc lights in the central part of the city for $12.50 per month, and outside the present incandescent districts at $10.

The combination of water power and the electric motor promises to be a most important factor in the future development of Colorado mines.

Experiments at Gold Hill stamp mill, in the Telluride district, show the feasibility and economy of the scheme. Electricity is conveyed to that mill two and one-half miles from an alternating current dynamo capable of developing 140 horse power, which is operated by water power. L. L. Nunn, general manager of the Gold Hill company, is the originator of the idea of utilizing the hitherto wasted power of the mountain streams.

O. D. Irwin, electrical engineer for the Westinghouse company, put in the motor and wires to the Gold Hill mill. The success of the scheme has stimulated other mine owners and other plants will soon be in operation in the Telluride district.

A street car line will be built by Denver capitalists in Laramie, Wyo. The Laramie Tramway company has secured a franchise giving it the privilege of furnishing railway transportation for the city either by cable, electric or horse car lines. The officers of the company are: F. M. McHale, of Denver, president; G. W. Griffith, Jr., of Denver, secretary and treasurer; directors, R. A French, F. M. McHale and G. W. Griffith of Denver and James Vine and W. B Travin of Laramie. The company has a capital stock of $100,000. E. C. D.

PERSONAL.

Geo. W. La Rue, secretary and general sales agent of the Crocker-Wheeler Motor company, New York city, was in Chicago last week.

John I. Beggs, manager of the central district office of the Edison General Electric company, is in New York attending the Edison convention.

John D. Challar of Washington was in Chicago last week. Mr. Challar will visit the Pacific coast, where he is interested in electric railway enterprises.

Eugene Cowles, president of the Cowles Aluminum company of Lockport, N. Y., is spending a few weeks at the Thousand Islands and in the Adirondack mountains.

W. S. Andrews of the Edison General Electric company, New York, was in Chicago last week. Mr. Andrews had been visiting the stations in Rochester, Detroit, Minneapolis and St. Paul, and reported the Edison interests in good condition.

NEW INCORPORATIONS.

Penn Yan Electric Light & Power company, Penn Yan, N. Y.; capital stock, $100,000; manufacturing electricity for light, heat and power.

Brighton Water and Electric Light company, Brighton, Colo.; capital stock, $20,000; to supply the town of Brighton with water and electric light.

Highland Electric Light & Power company, Highland, Ill; capital stock $8,000; to furnish electric light and power; F. Wild, Highland, Ill.

Edison Electric Illuminating company, Atlanta, Ga.; capital stock, $10,000; generating electricity and furnishing it for all the purposes to which it may be applied.

Continental Development company, Richmond, Va.; capital stock, $800,000; machinery and electric equipments, general manufacture, real estate and improvements.

Maryville Electric Light & Power company, Maryville, Mo ; capital stock, $25,000; to supply the city of Maryville with electric light and electric power; Wm. A. Ross, Maryville, Mo.

Wagner Electric Manufacturing company, St. Louis, Mo.; capital stock, $25,000; to manufacture, hire and sell electric apparatus, machinery, supplies, etc.; Henry Digby, 322 Pine street, St. Louis, Mo.

Steubenville Railway and Electric company (incorporated in West Virginia), Steubenville, O.; capital stock, $100,000; operating electric street railway in Steubenville, O.; also supplying light and heat; Donald B. Toucey, 261 Broadway, New York, N. Y.

Crescent Insulated Wire & Cable company, Trenton, N. J.; capital stock, $50,000; to manufacture an insulated compound for the covering of wires and cables, and the manufacture of electrical appliances; Murray, Murray Trenton, N. J.

Cotton Compress Co. and Manufacturing company, Brenham, Washington Co., Tex., capital stock, $150,000; ginning, baling and compressing cotton, manufacturing cotton seed oil, operate electric plants, manufacture and sell etc. [illegible], jr., Brenham, Tex.

ELECTRIC LIGHT.

At Louisville, Ky., the Light, Heat & Power company has just been organized for the purpose of operating an electric light plant.

The city council of Brownwood, Tex., has granted the Brownwood Improvement company permission to erect an electric light plant.

The installation of an electric light plant is being discussed in Milton, Fla. J. B. Crossland of Pensacola is investigating the subject.

It is stated that the city of Newnan, Ga., has signed a contract with W L Dresser of Albany, N. Y., for the erection of an electric light plant.

N. E. Whitaker, Thomas O. Brien, R. Stainaker and others will organize a stock company at Wheeling, W.Va., for the erection of an electric light plant.

The California state authorities will put an isolated electric lighting plant in the capitol at Sacramento. The building will be wired for about 800 lamps.

The Fort Wayne Electric company, through W. J. Morrison and A. J. Corriveau, is about to present an arc lighting plant to McGill university, Montreal.

The Electric company of Virginia has recently erected an additional building 38x68 feet at Norfolk, put in new machinery, and increased the capacity of its electric light plant.

The Brighton Park Mutual Home & Investment company of Baltimore, Md., has been incorporated to erect electric light plants, gas works, deal in real estate, etc. The capital stock is $250,000.

Contract has been let for the erection of an electric light station for the Carolina Light & Power company at Cotton Shoals, on Little Horse creek, near Graniteville, S. C. Water power will be utilized.

A bill was recently introduced in the legislature of Georgia to appropriate $10,000 for the establishment of an electric light plant and a heating plant at the State Deaf and Dumb asylum at Atlanta.

Two new electric light plants have recently been incorporated in Atlanta, Ga.—the Georgia Electric Light company, with a capital of $600,000, and the Edison Electric Illuminating company, capitalized at $10,000.

According to report, not only will all the streets and public buildings, but the majority of the private dwellings, be lighted by electricity at Shenandoah, Va. The town is a comparatively new one, and has a population of about 2,500.

The St. Catherines and Welland Canal Gas Light company, of St. Catherines, Ont., has applied to the city council for the privilege of erecting poles and stringing wires on the streets of the city for the purpose of supplying illuminating and heating power.

The Iron Cross Investment company has been incorporated at Basic City, Va., with W. V. Kirk of Paw Paw, W. Va , president; E. P. Cahill of Hancock, Md., vice-president, and J. N. Kirk, secretary, to erect electric light plants, gas works, deal in and improve real estate, etc. The minimum capital stock is $20,000, and the maximum capital $50,000.

The town of Marblehead, Mass., has decided to establish an electric lighting plant of its own. A committee was appointed, and it has located the lights, drawn up the contracts, fixed upon a site for the station, and ascertained the cost of the plant. The selectmen will soon be asked to call a town meeting for the purpose of acting on the recommendations of the committee, after which, if they are accepted, it will not be long before the plant will be in operation.

Work has been commenced in connection with the municipal central station at Dublin, Ireland. The site is about one-quarter of an acre in extent. The private lighting plant will comprise three 300-horse power engines, each of which will drive a 2,000 volt alternator. The public lighting plant will comprise three 60-horse power engines, and three 55 light dynamos. The cables will be laid in iron piping. The public lights will probably be started in November.

Reports have been in circulation for some time to the effect that the Thomson-Houston Electric company of Boston and the Fort Wayne, Ind., Electric company had purchased a controlling interest in the Municipal Electric Light company of St. Louis, Mo. James Campbell, the broker, who has been in New York for some time in connection with Municipal Electric Lighting company matters, is reported as saying that the Thomson-Houston company and the Fort Wayne company are seeking to gain a very substantial interest in the St. Louis company, but not the control.

A prominent dentist says: "We now have the electric light to aid us in our dental operations, and I find by its use I can discover imperfections in cavities I have prepared that had previously escaped my attention. Why? Because the electric light gives a paler white light, and it is more intense than daylight. This is particularly so in that form of decay known as the white decay. You may prepare the cavity with the ordinary care, having it seemingly perfectly dry, and a magnifying glass will show you no imperfections, but with the aid of the electric light you can find them."

At the government dockyard at Port Adelaide, Australia, there is in course of construction a traveling electric light plant for use on the railways. It consists of an ordinary locomotive engine, a truck upon which is fitted a portable engine and the dynamo, and the weed stripper, which is used for clearing the railway lines of undergrowth. The

plant, when completed, will be used to enable the navies to carry on their work as much as possible at night, when their operations will be less hampered by the train traffic than during the day. Telegraph poles, upon which the wires are carried and the lamps hung, will be erected at each halting place where their services are required.

Locomotive No. 34, which has been rebuilt in the Chicago and Alton shops at Bloomington, Ill., is unlike any other in existence, except one at Bay City, Mich. This locomotive will, it is said, consume its smoke and condense the exhaust steam, similar to a marine engine. It is provided with electric dynamos, and the headlight and the numbers of the engine and train will be illuminated with electricity. The entire train drawn by this engine and the signal lamps will likewise be illuminated by electricity. The headlight sits low on the front of the engine, the dynamo standing where the old headlight was, and the view from the cab is entirely free from obstruction. It is reported that if this locomotive, thus equipped, proves a success, similar improvements will be introduced upon all the passenger engines of the Chicago & Alton road.

ELECTRIC RAILWAYS.

Lockport, N. Y., is going to have an electric street railway.

It is stated that electricity will be the motive power of the new street railway of North Danville, Va.

The Chattanooga, Tenn., Union Railroad company is said to be investigating a storage battery system.

The Hagerstown, Md., Electric Railway company has been granted a franchise to build an electric railroad.

The Capital City Land company of Raleigh, N. C., lately organized, will probably build an electric railroad.

H. V. B. Smith is said to be making efforts to secure the building of an electric railroad from Crossville to Harriman, Tenn.

The Dandridge, New Market & Indian Cave Railway company of Dandridge, Tenn., will, it is reported, build an electric railroad.

The Macon City & Suburban Street Railway company of Macon, Ga., is reported as about to erect an electric power plant at a cost of $35,000.

Paul W. Smith and others have applied to the city council of Montgomery, Ala., for a franchise to build a street railway to be operated by electric or other power.

The Dallas, Tex., Consolidated Traction Railway company reports that it has changed a portion of its line from horse to electric power, and will continue in the same direction as fast as practicable.

The employes of the Newark, N J, Passenger Railroad company employed on the electric line which that company recently acquired struck against a reduction of wages last week. The company was not greatly embarrassed.

A syndicate has applied to the city authorities of Christiana, Norway, for permission to construct an electric line through the streets. Experts have been dispatched to Berlin, Halle and Frankfort to investigate the workings of electric tramways in those cities.

The Villard interests in Milwaukee, according to a press dispatch from that city, are in a fair way to control the entire street railway interest of the Cream City. Negotiations are pending for the purchase of the roads not now in the control of the Villard syndicate.

The Detroit *News* reports that at a recent trial in that city of a new storage battery invented by Charles Logan of London, England, a 70-ton car was easily propelled eight miles at the rate of 14 miles an hour. It is claimed that the battery is good for a day's work at a speed of 13 miles an hour.

The Boston *Journal* is authority for the statement that Edison is at work on an electric motor for Henry Villard. The machine is to be introduced into railway work, and will, according to the same authority, "develop at least 1,000 horse power." When it is completed it will no doubt be an object of interest.

The highway committee of the Paris Municipal Council has decided in favor of the construction of a subterranean electric tramway from the Bois de Boulogne to the Bois de Vincennes, passing under the Boulevard Diderot, the Rue de Rivoli, the Place de la Concorde, and the Avenue des Champs Elysees. The project as outlined by M. Bertier provides for an underground tubular road eleven kilometers in length, and similar to the South London line. It would be lighted by incandescent lamps.

The Cicero & Proviso Electric Street railway company has had reason to complain of its night patrons. P. H. Quade, its superintendent, was before Justice Hall at Austin recently, charged with assault on Charles H. Hitchcock, Jr. When he was dismissed he began suit for $10,000 damages against Hitchcock on the ground of false imprisonment. Mr. Quade's attorney, Judge Prendergast, said that his client's arrest was due to an attempt to maintain order on one of the trains of the road. Hitchcock and three other men were involved, and all of them will be arrested, the counsel said, on a charge of assault.

The Washington correspondent of the *Chicago Daily News* announces that an important contribution to the literature of street railway locomotion is about to be submitted to President Harrison by the commission which he named to examine into the question of rapid transit for Washington and the district. The commission visited the principal cities in the United States and secured reports from leading capitals of Europe. The report is exhaustive of its subject and will fill 500 printed pages with elaborate illustrations. The commission favors a subway system for electric railways, lighting, telephone and telegraph companies. The storage battery system is regarded as the ideal one, although the committee thinks it is not above the experimental stage.

The electric railway at Sissach, Switzerland, has recently been opened for general traffic. It is about two miles in length, narrow gauge, and almost level, the worst gradient being only 1.2 per cent. The line runs through a fine broad highway. A sufficient waterfall furnishes power to a low-pressure turbine, which drives a 35 kilowatt dynamo, giving 50 amperes at 700 volts. The current is led to overhead conductors and returned by the rails. Fluid insulators fixed on wooden posts carry the conductors five metres above the ground. The rolling stock consists of one motor car weighing 6,000 kilograms, four passenger cars and four freight cars. The motor car is driven by two series-wound motors, each of which drives one axle at a mean speed of 17 kilometres per hour. The entire cost of line and equipment was $75,000. The Oerlikon Works supplied the whole of the plant.

ELECTRIC MINING.

The Main Jellico Mountain Coal company, of Kensee, Ky., intends to put in an electric light plant at its coal mines.

The Virginius company of Colorado has contracted with the Edison General Electric company for the erection of a plant for the transmission of 95 horse power, three and a half miles over the range, 14,000 feet high. Electricity will also supersede steam in the working of both the Virginius and Monarch mines this summer.

TELEPHONE.

The Bell Telephone company of Canada has absorbed the Federal Telephone company, and again enjoys a monopoly of the telephone business in that country.

The chamber of commerce of Breda, Holland, has asked the government to introduce a bill providing for the purchase by the state of all telephone lines. If the government should not be prepared at once to carry out these proposals, the chamber suggests that the state should at least exercise such a control over the telephones that contracts detrimental to the public interest may be prevented.

At Grand Rapids, Mich., two youths of sixteen and eighteen years respectively, sons of Rev. Charles Fluhrer and E. A. Mosely, became interested in electricity through studying it at home. By using a Bell telephone as a model they constructed three instruments and put up a wire. Their line was recently discovered by a lineman of the telephone company, which has commenced suit against the fathers of the boys for infringement of the patent.

A portable telephonic apparatus for use in coal and other mines has been devised by M. Berthon. It is contained in an oak box with handles. The box contains a magnet in connection, a "call" arrangement, an alarm bell, an induction coil, switch for the microphone battery, three cells in ebony cases, terminals for making connection with a wire conductor, and the Berthon-Ader apparatus. The whole is placed in a leather case provided with straps for convenience in carrying. With a well-insulated conductor carried down the shaft, and with the employment of "flying" or portable wire, communication with those on the surface is possible from any part of a mine.

TELEGRAPH.

Fire recently destroyed the two-story frame building at Colorado avenue and Forty-sixth street, Chicago, occupied by the belt line of the Wisconsin Central railroad as a transfer telegraph station. The loss is estimated at $2,500.

Messrs Hosmer and Skinner, representing the Canadian Pacific railway, have been elected directors of the Halifax & Bermuda Cable company to represent the controlling interest recently secured by the former company. It is intended to extend the line to Jamaica and the British West India Islands.

MISCELLANEOUS.

There are now running in Brockton, Mass., about 130 electric motors for shoemaking and other purposes.

The Thomson-Houston Electric company has declared its usual quarterly dividend of $1 per share for common stock.

Over $4,000 has been pledged for the Plymouth, N. H., proposed electric light plant. The intention now is to raise the amount to $10,000.

A rapidly revolving brush, which gets its motive power from a small electric motor, has been found to operate practically in the grooming of horses.

The Edison General Electric company is adding four new buildings to its plant in Schenectady, N. Y. When completed, the plant will consist of twenty-one brick and thirty-five frame buildings.

It is said that a new cane has been brought out with a tiny incandescent lamp at the top, supplied by a miniature storage battery. It would be useful for reporters looking for street numbers at night.

Searle Hill, a prominent farmer and horseman of Warren, Wis., was out driving with his two sons one day last week, when he was struck by lightning and instantly killed. The boys were fatally injured. Both horses were killed by the shock.

Thomas Edison has received many honors and titles in his lifetime, says the *Chautauqua Assembly Herald*, but it

[illegible] enter the technological institutions which devote especial attention to electrical engineering.

[illegible] obtaining ideas for local use, has submitted a report favoring a subway for electrical railways, for lighting apparatus and for telegraph and telephone companies.

The [illegible] ports 281 new, completed corporations in the United States for the week ending July 31st, with a total capitalization of $88,023,750, including 16 light, heat, power and trans[illegible]

L'Eletricita states that a project for the construction of an electric railway from Aosta to the borders of France and Switzerland at Pre Saint Didier, a distance of between 20 and 30 miles, has been laid before the Italian minister of public works. This would be by far the longest electric railway in Europe. Water power would be employed.

Electricity may revolutionize leather tanning. Two tanneries, one in Paris and the other in London, are successfully employing the invention of Worms and Bale. The principal feature is the circulation of an electric current through the tanning liquor. By this method it is said that an operation is completed in four days which ordinarily requires from seven to eight months.

The *Chicago Herald* finds occasion to praise the rearrangement of the electric fountain at Lincoln Park: "The streams ascend in parallels," it says, "and when curved fall from agreeable heights or rise at pleasing angles. The color schemes now displayed indicate a true sense of beauty and the manipulation of both lines and hues shows dexterity and knowledge. The effects are weird, fantastic and beautiful. Thousands watch the prismatic play with delight."

A large and interesting power transmission plant has been in successful operation at Oyonnax, in the east of France, since March, 1890. Power is obtained from a cataract five miles from the town, where two 105 kilowatt 2,000 volt Thury machines are coupled direct to two horizontal turbines. The current is transmitted on the three-wire system to two 120 horse power 1,800 volt motors, driving direct on to two 125 volt 600 ampere dynamos, which supply current to the town on the three-wire system. The commercial efficiency of this system is said to be 76.2 per cent.

A recent statement of Dr. Stephen H. Emmens of Emmens, Pa., is to the effect that he has perfected a process for converting pig iron into wrought iron by means of electricity. The process is simply an elaboration and adaptation of existing methods of electrical deposition, and by this means Dr. Emmens claims to be able to produce from any grade of pig iron a ductile malleable iron of almost chemical purity, which only needs washing, heating and rolling to make it equal to the best quality of Swedish iron. The inventor of this novel process claims that he can produce wrought iron by this method at a lower cost than the ordinary process of puddling, and still further economy results from the use of low grades of pig iron made from ores that are too impure to be used by existing process of conversion.

During a thunderstorm at Aylesbury, England, on July 27th, nine persons attending a flower show were struck by lightning, and three of them were killed. On July 24th a violent thunderstorm passed over Carlisle, Pa. During the progress of the storm lightning struck a shoe factory. At the time there were 300 hands employed in the building, most of them being women, and when the shock came a panic-stricken crowd rushed for the doors. Several of the young ladies were slightly shocked, while three fell to the floor unconscious, thus adding to the confusion. Misses Spangler and Johnson were severely injured. Six other young lady operators were seriously injured, beside being bruised in the rush. The lightning also [illegible] cut two shoe machines [illegible] other injury to the building, though no fire resulted.

The $10,000,000 Pennington Air ship company of Burlington, Ia., has dissolved in thin air. Not a [illegible] stock could be sold to the general public, and hence the scheme collapsed. The *St. Louis Globe-Democrat* reports, however, that the construction of the large air ship has been quietly going on in the fair grounds in that city, and that the ship is now nearly complete. The machine is cigar-shaped and nearly 70 feet long by 20 in width. The sections are of aluminum and are about three feet in length by about two in width and turtle-backed. These have all been completed, and all that remains to be [illegible] them together, which will be done in two large circus tents. The machine is designed to carry several persons, and the first ascension will be attempted early in August. The machine is designed only for exhibition purposes, and is controlled by a number of St Louis gentlemen, foremost among whom is Rolla Wells. The exhibition flights will be confined entirely to the fair grounds, and at a height not exceeding 50 feet.

TRADE NEWS.

T. J. Murphy has removed from [illegible] avenue, New York, to the Electrical Exchange [illegible] Liberty street, New York.

The Star Head Light [illegible] Rochester, N. Y., has recently received an order from the Spokane Cable Rail

way company of Spokane Falls, Wash., for 32 brass electric headlights.

[illegible] who claims to have discovered what electricity is, announces that he will be at the Grand Pacific hotel Tuesday, August 18.

F. P. Little & Co., constructing and electrical engineers, 111 East Seneca street, Buffalo, N. Y., report the prospects for fall business as very flattering. They have just secured a $15,000 contract for wiring at Albany, and have a number of other important contracts on hand.

E. T. Orne, 112 Randolph street, Chicago, has secured the contract to fit up the new *Herald* building in this city with his electric speaking tubes. He has decided to introduce the Partrick & Carter company New King annunciator and will use one hundred or more of this pattern.

The Western Electric company has just issued a new and handsomely illustrated catalogue of over 300 pages. The book forms a comprehensive record, with descriptions, of the goods sold by this great company, and its size and the variety of its contents well exemplify the magnitude of the business of the house. It is supplied with a carefully arranged index and can not fail to be of great value to any one desirous of purchasing electrical supplies of any kind.

The catalogue just issued by the Milliken Brothers, New York and Chicago, is handsomely illustrated by half tone reproductions of photographs of buildings in which Phœnix columns of iron and steel are being introduced, and also street railway and electric light poles, of which this company makes a specialty. The catalogue will prove interesting to all who are interested in iron work, to builders, architects and engineers. An able article on the use of iron and steel columns is one of the best features of the catalogue.

The R. D. Nuttall company of Allegheny, Pa., has purchased the business of the Electric Railway Specialty company of 29 Broadway, New York. The capital stock of the R. D. Nuttall company will be increased to $500,000 for the purpose of extending the business. J. F. Porter, manager of the Electric Railway Specialty company, will remove to headquarters at Allegheny and take charge of the business department, leaving Mr. Nuttall more time for the supervision of the manufacturing and designing branch of the business. Messrs. Carey & Moyer of the Specialty company will travel for the company.

The Ball Engine company of Erie, Pa., has issued a new illustrated catalogue, showing its simple, tandem compound, cross compound and triple expansion engines for electric lighting and power and general manufacturing. In the introduction the company says: "The points of value to which we especially invite attention are simplicity and compactness; the solidity and strength of the bed; the unusually large bearings and wearing surfaces; excellence of material and workmanship; economy, durability, good regulation, smooth and quiet running. We spare no pains in the inspection of our work, using first class material only, and confidentiy assert that these engines are unsurpassed. Our past experience has suggested improvements, of which we have availed ourselves, to bring our engines to a high state of perfection."

The announcement is made of the formation of a new corporation under the title H. Ward Leonard & Co., whose principal office will be in New York city, and whose business will be that of electrical engineering generally, giving special attention to electric motor appliances, the transmission of power, the installation of central station lighting and power plants, the concealed wiring of large office buildings, hotels, etc., and plants in which advantages can be obtained by the combination of apparatus of various companies, such as alternating current systems, storage batteries, arc lights, etc. A feature of the business of this concern will be supplying expert information regarding engineering matters, the operation of different plants and the best methods and system of accounts in connection with the operation of electrical plants. Such information will be supplied by correspondence at a very moderate charge per annum. The company will be actively in business before [illegible] in the [illegible]

BUSINESS.

[illegible]

capacity for the new power station of the Davenport, Rock Island & Moline Electric railway. This is one of the largest heaters ever built for this purpose, but its successful operation is assured. Baragwanath & Son report a very active business in prospect, already having booked a sufficient number of orders to keep their factory employed for several months in the future.

The Chicago Electric Motor company has met with most satisfactory results in the introduction of a new electric motor and fan placed on the market at the beginning of the present season, and in order to keep the factory in operation during the entire year a repair department has been added. Machinery has been purchased and every facility possible has been provided, not only for a line of general repair work, but for the rewinding and repair of generator armatures of all makes, and for the rewinding and repair of street railway and stationary motor armatures. A number of experienced men have been employed.

ELECTRICAL PATENTS.

Issued Aug. 4, 1891.

456,940. Electro Magnetic Cut-out. Sylvanus H. Cobb, Hyde Park, Mass.

The object of the device is to protect electrical instruments against abnormal currents. The device is capable of being operated by currents of feeble strength, as, for example, what are known as "sneak currents," by means of contacts which are closed and held closed by the current, and which also receive without injury much stronger currents than are necessary to operate.

456,970. Car Propelled by Electricity. Sidney H. Short, Cleveland, Ohio.

456,979. System for Conducting Electric Currents. Edward Britt, Davenport, Iowa.

The described is a series of distinct sectional electrical conductors, which, by means of pressure, are brought into electrical connection with a continuous main electrical conductor, and when relieved from such pressure will automatically become disconnected.

456,997. Coupling for Electric Light Shades. Philip Levison, Chicago, Ill.

457,015. Trolley for Electric Railways. Sidney H. Short, Cleveland, Ohio.

457,016. Electric Car Brake. Edmund Verstraete, St. Louis, Mo.

The armature of the magnets being fixed originally by the wheel, with the magnets themselves being shown to move toward the armature, by the passing of the current through the magnets they are drawn against the armature and by frictional contact serve for the operation of "braking."

457,030. Electric Clock. Walter K. Menns and Walter J. Dudley, Everett, Mass.

This invention relates to an electric clock of that class in which a time-measuring pendulum controls in its vibrations the circuit of an electro magnet, which in turn actuates an impelling device, by which an impulse is given to the pendulum and its oscillating movement thus maintained for an indefinite period of time.

457,036. Electric Motor for Street Cars. Elihu Thomson, Swampscott, and Edwin W. Rice Jr., Lynn, Mass.

457,058. Electric Track Signal. Myron W. Parrish, Detroit, Mich.

This invention consists, essentially, in utilizing the car wheels to form parts of a closed magnetic circuit from one pole to the other of the brake magnet, so as to constitute a part of a closed magnetic circuit armature for the magnet.

457,065. Armature for Dynamos or Motors and Method of Winding the Same. Ferdinand A. Wessel, Brooklyn, N. Y.

457,067. Electric Car Brake. Craig R. Arnold, Sharon Hill, Pa.

457,072. Incandescent Lamp Socket. Waldo C. Bryant, Bridgeport, Conn.

457,090. Rheostat. John A. Mosher, Abilene, Kan.

457,102. Electric Railway Motor. Norman C. Bassett, Lynn, Mass.

457,105. Electric Conductor Support. Eben M. Boynton, West Newbury, Mass.

This invention relates to an overhead continuous electric conductor support for bicycle railways.

457,106. Electric Conductor. Eben M. Boynton, West Newbury, Mass.

This invention relates to the use of the overhead guide beam of a bicycle railroad for the purpose of an electric conductor. By constructing the beam of two separate metallic rails electrically insulated one from another, one can be utilized for the outgoing and the other for the return current. Suitable contacts, either rollers or brushes, conduct the current from one of the overhead rails to the motors, and from the same back to the other rail.

457,109. Socket for Incandescent Electric Lamps. John Criggal, Newark, N. J.

This invention consists of an incandescent electric lamp provided with a base of suitable non-conducting material, said base having a screw threaded shank and metallic eyes at the opposite points of said shank, in [illegible] wires that engage the threaded shank and the eyes of the same, so as to firmly interlock therewith and transmit the current to the filament in the lamp.

457,[illegible]. [illegible] Switch for Electric Systems. Chris. [illegible], Milwaukee, Wis.

457,116. Galvanic Battery. John R. Hard, New York, N. Y.

This invention relates to open circuit dry batteries. The novel features claimed are: A cell in which the positive element is a zinc cup of tubular form, and the negative element is a rod or piece of chloride of silver, this latter being immersed in an excitant mixed with some mucilaginous or gelatinous substance, which renders it too stiff or immobile to flow. The zinc cup constitutes one pole of the cell, and a wire of silver embedded at one end of the negative element and projecting outward through a closing plug or stopper in the cup constitutes the other pole of the cell.

457,127. Electric Hand Fan. William B. Luce, Boston, Mass.

This invention has for its object to provide a portable fan adapted to be operated by electrical means. It consists of a fan comprising a handle or holder, a movable fan or series of fan-blades mounted to rotate in bearings on the holder, an electric motor so mounted upon the holder and arranged to rotate the shaft of the fan and suitable connections between the motor and a source of electricity, whereby the motor may be driven, and a circuit closing and breaking device located within or upon the holder, so that the user of the fan may cause the rotary movement thereof to cease at pleasure by the manipulation of the button connected with the circuit closing and breaking device.

457,135. Railway Signal. William C. Serrell, Bayonne, N. J.

In this invention the batteries are placed at intervals along the line, and are connected in such a manner that the batteries in their normal position oppose each other, and the alarm mechanism upon the engine is only brought into action when the circuit is closed through two trains when they come nearer than the prescribed distance; this system is also connected with the switch mechanism in such a manner so that when the switch is set to the siding a circuit is partially closed, so that a train approaching the switch or siding completes the circuit connections, and indicates that the switch is open.

457,141. Electric Arc Lamp. Xavier Wertz, New York, N. Y.

This invention relates to improvements in the construction of electric lamps, which is based on the formation of a voltaic arc located in a glass bulb or globe in which a vacuum has been established, so that the carbon will burn for a considerable length of time, and the lamp be applicable for use in the same manner as electric glow lamps without requiring any forward feeding of the carbons.

457,151. Coupling for Electric Incandescent Lamps. Isaac J. Flagg, Clinton, Mass.

457,164. Electric Smoothing Iron. Willis Mitchell, Malden, Mass.

This invention releates to tailors' irons and laundry irons, which are heated by removable coils or spirals of wire forming part of an electric circuit.

457,226. Brush Holder for Dynamo Electric Machines. Sidney H. Short, Cleveland, O.

457,239. Printing Telegraph. Henry Van Hoevenbergh, Elizabeth, N. J.

The object of this invention is to provide an instrument capable of printing rapidly from either of two type wheels, which is easily maintained in unison with the transmitter, operates with a small amount of battery power, is not affected by considerable changes in the strength of current, and is controlled by a simple form of transmitter.

457,240. Electric Railway. Samuel E. Wheatley and John W. Schlosser, Washington, D. C.

This invention relates to that class of electric railways in which a working conductor extending lengthwise of the road is divided into short lengths or sections, each of which is fed during the time that the car is passing over it from a continuous main lead or conductor through an automatic switch.

457,296. Electric Fence Station Device. David H. Wilson, Normal, Ill.

457,300. Electric Switch. Waldo C. Bryant, Bridgeport, Conn.

457,301. Electric Switch. L. D. Castor, Philadelphia, Pa.

457,327. Commutator or Contact Brush. Leonard Paget, New York, N. Y.

457,330. Automatic Brush Shifter for Dynamo Electric Machines. Thomas E. Adams, Cleveland, O.

The invention has reference to automatic brush shifters designed for use more particularly in connection with the Brush constant current dynamos and other dynamos of this type.

Reissue 11,123. Electric Elevator. Francis B. Perkins, Boston, Mass.

This invention relates to elevators of that class known as "drum elevators," in which the elevator car or platform is raised by winding the hoisting rope or cable upon a drum set in rotation by means of an electro motor. The present invention has for its object to provide elevators of the class referred to with an electrically controlled brake mechanism in circuit with the motor, and normally operative by the starting and stopping mechanism to release the brake and permit movement of the cars as long as the circuit of the motor is completed, but which becomes inoperative as soon as the circuit of the motor is broken, so that in case of accident to the motor or its circuit the elevator car can not be moved by operating the starting mechanism.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

MICA.

For all Electric Insulating Purposes Best Grade Mica is the Cost on the market

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

WANTED.

F. O. B.

STAR GAUGE GLASS CUTTER.

No. 1. Cut

S. TAUSSIG, 45 River St., Chicago. WESTERN AGENT

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A Thoroughly Reliable and Desirable Wire in Every Respect."

The rubber used in insulating our wires and cables is specially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

ELECTRICAL WOOD.

Telegraph
Telephone
Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

LAW TELEPHONE CO. LAW BATTERY NEW YORK.

The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS FANS

FOR ELECTRIC MOTORS.

MANUFACTURED BY

THE TURNER BRASS WORKS,

4 LaSalle Ave., Chicago.

Write us for prices.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., Brooklyn, N. Y.

THE CROCKER-WHEELER PERFECTED MOTORS.

Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

"MAGNETIC VANE"

AMMETERS AND VOLTMETERS

ARE THE BEST INSTRUMENTS FOR

Central Stations, Isolated Plants,

Marine Installations, Electric Railways.

Correspondence Solicited.

Send for Illustrated Circular 235.

QUEEN & CO., PHILADELPHIA.

McINTOSH, SEYMOUR & CO. ENGINES.

SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION.
One	12½x12	80	Edison General Electric Co., Groton, N. Y.
Two	18½x17	500	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rio Janeiro, Brazil.
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 19x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Rollins & Co., Chicago, Ill.
One	15 and 24x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Leeds, England.
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One	11 and 19x15	150	Fritz Wilen, Helsingfors, Finland.
One	16x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 26x17	400	Baltimore Electric Refining Co., Baltimore, Md.
One	14½ and 23x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, 339 Rookery Bldg., CHICAGO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

DOLBURN ELECTRIC MFG. CO.

No. 180 MAIN St.

FITCHBURG, MASS, U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

What is Electricity?

An Announcement.

By some discoveries I have made I am enabled to give, I believe, the final answer and demonstration to this ancient question. The discussions of this have been mainly before scientific bodies, but as any intelligent audience can be entertained and readily understand the explanations of the telegraph, electric light, lightning and all electrical phenomena, I propose to answer the question and make known my discoveries by a popular lecture delivering the first in Chicago in October.

More statements will be made when the time and place of the lecture are made known.

Trusting that sentence of boldness will be withheld until in future I make known why I was obliged to adopt this method of announcement, I am respectfully,

C. S. PAGE,

CHAMPAIGN, ILL., Aug. 7, 1891.

ALUMINUM

50 Cents per Pound.

THE COWLES

Electric Smelting & Aluminum Co.,

LOCKPORT, N. Y.,

Offer Aluminum guaranteed to be equal in purity to the best in the market at 50 cents per pound for ton lots in ingots.

Aluminum sheet, wire and castings at lowest market price.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence solicited.

Experimental Work in Anything Electrical.

FREEMAN, COLEMAN & CO.,

53 and 55 South Jefferson Street, - - CHICAGO, ILL.

THE MOSHER ARC LAMP

For Direct Incandescent Circuits

BEATS THEM ALL.

Read what a customer says:

BENICIA ELECTRIC LIGHT AND MOTOR CO.,
BENICIA, CAL., June 25, 1891.

MOSHER ARC LAMP CO., CHICAGO.

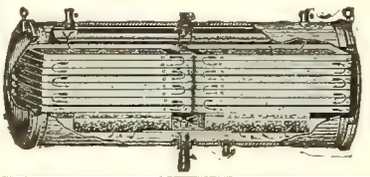
GENTLEMEN:—Yours of 11th inst. received. In reply we have to say the lamp gives satisfaction, and we are well pleased with it. Our superintendent says he has tried two other lamps of different makes, and that one is the best of them all. He wants you to send another just like it to the Dixon Light & Water Co., Dixon, Cal., of which he is superintendent. Inclosed please find check, $26 75, to balance account. Yours truly, S. C. GRAY, Pres't.

Write for Circulars, Prices and Sample Lamp to

MOSHER ARC LAMP CO.,

125 ONTARIO ST., CHICAGO, ILL.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

FOR SALE. WEST END ST. RAILWAY COMPANY, 81 Milk St., Boston. This company having adopted the long car for traffic on its most populous lines, is now able to dispose of a portion of its box and open cars. Roads in want can be promptly supplied at advantageous prices. We invite correspondence, but believe an examination of our stock by a representative of parties in want would be to their advantage. HENRY F. WOODS,
JUNE 19, 1891. Purchasing Agent.

Manufacturers of

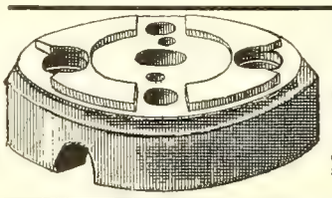
OCTAGONAL AND CEDAR

TELEPHONE & ELECTRICAL

RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

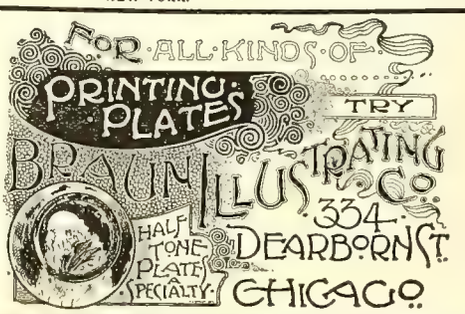
T. J. MURPHY,

Electrical Exchange Bldg. Room 215. **136 Liberty St.,** NEW YORK.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

---



ELECTRICAL ENGINEERING.

OHIO STATE UNIVERSITY,

COLUMBUS, OHIO

A new and commodious building. Dynamos of commercial size, for arc and incandescent lighting, by direct and alternating currents. Motors, storage batteries, etc., etc. A fine collection of standards, testing instruments, etc. Extended practice in well equipped mechanical and physical laboratories. Entrance requirements modified. Special courses given. Send for catalogue.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

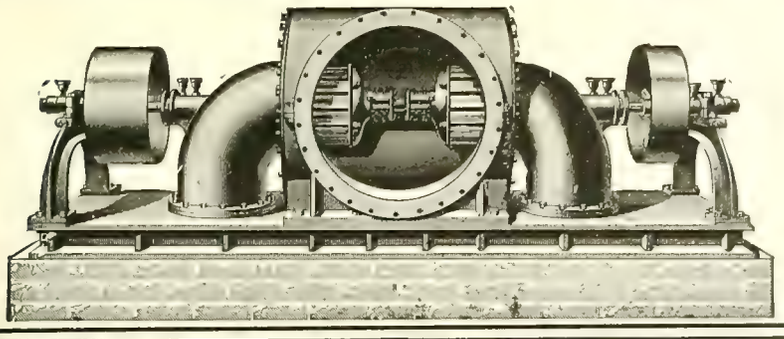
IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

BRANCHES { 164 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St. Chicago. | **St. Louis, Mo.**

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to the **CELEBRATED WATER WHEEL** on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** being **double** the **Power** of [illegible] number of the leading electric companies [illegible] ical use of water it is without an [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no [illegible] are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of [illegible] **VICTOR TURBINES** arranged on a horizontal shaft with [illegible] Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 10, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

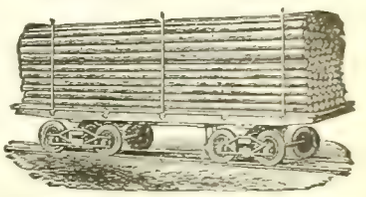
FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing. Will carry two different kinds of material in opposite directions at the same time.

Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

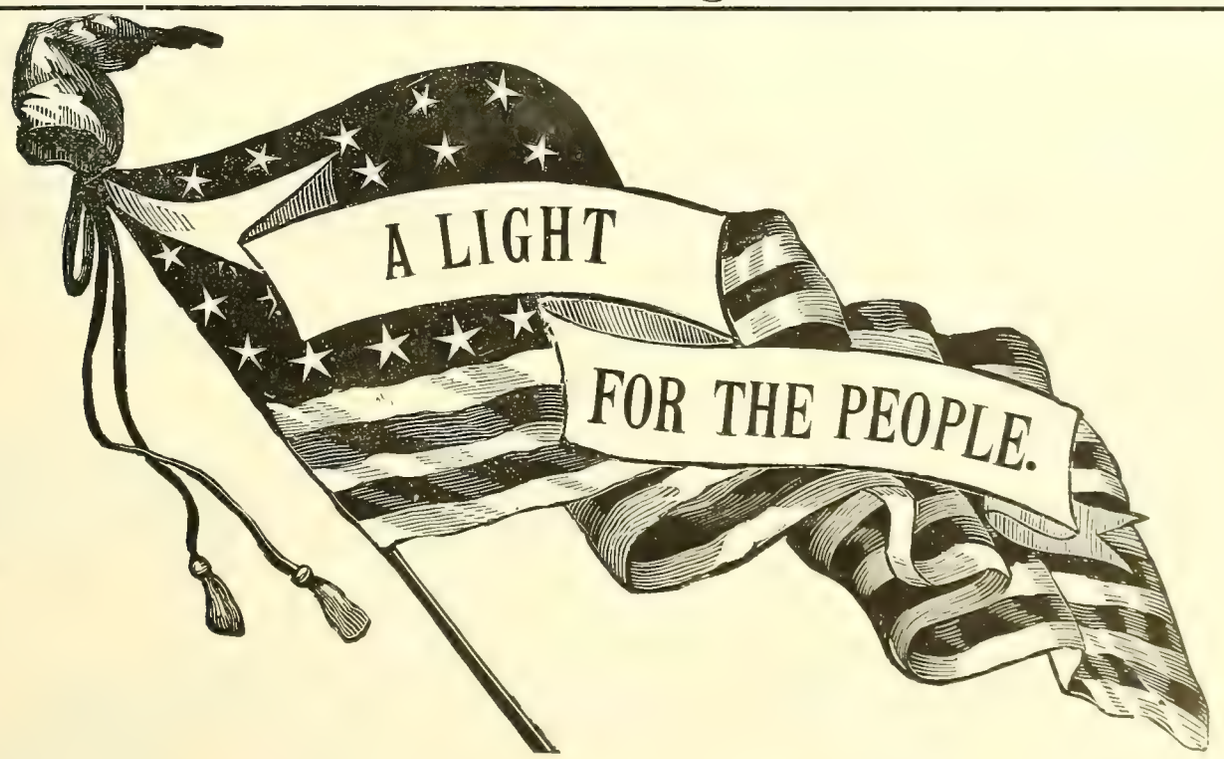
47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.



WRITE US FOR PRICES.

The Sunbeam Incandescent Lamp Company,

CHICAGO, ILLINOIS.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

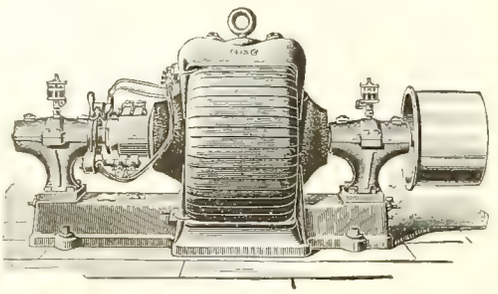
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



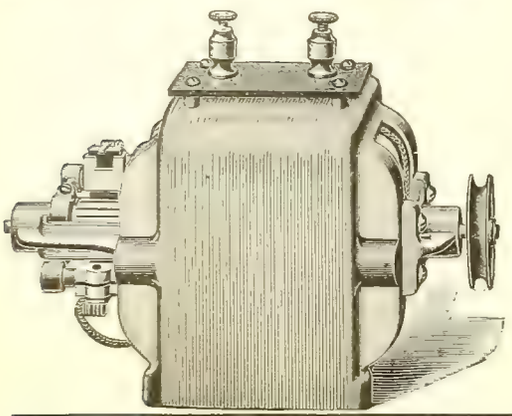
Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

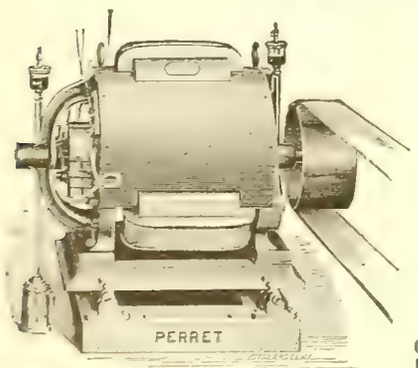
Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.

—MANUFACTURERS OF—



Perret 45 H. P. Motor, Speed 550, Weight 1,300 lbs.

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. *Factories equipped throughout with Electric Power Isolated Plants for Incandescent Electric Lighting.*

—SELLING AGENTS:—

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.

JOHN STEPHENSON CO.,

LIMITED,

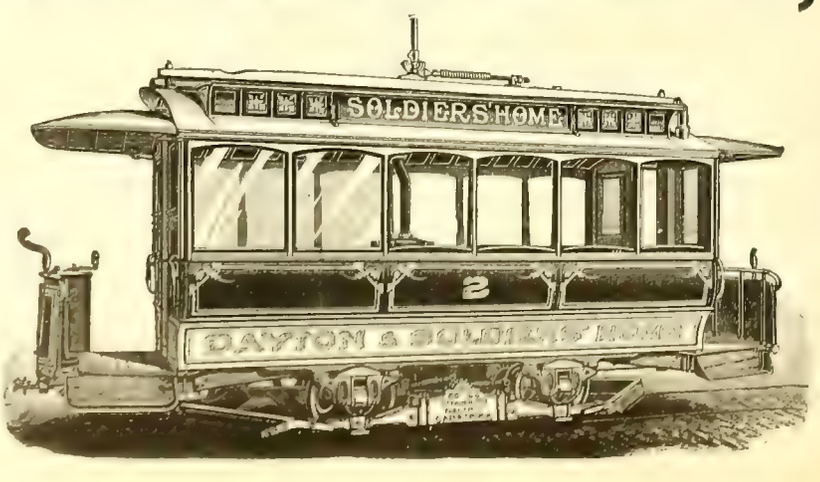
NEW YORK.

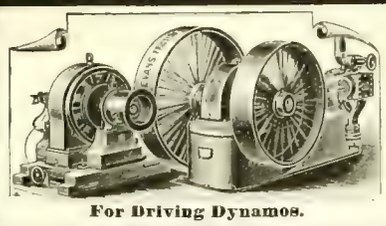
STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.





For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.

Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

A NEW BOOK.

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

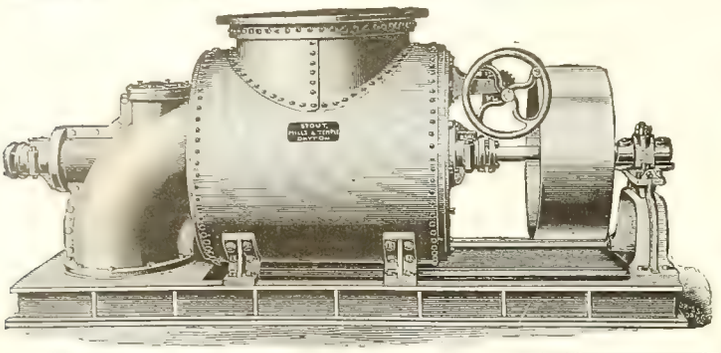
The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus, Electric Motors and Generators,
Alternating Current Apparatus, Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.

STEAM PLANTS

INSTALLED BY

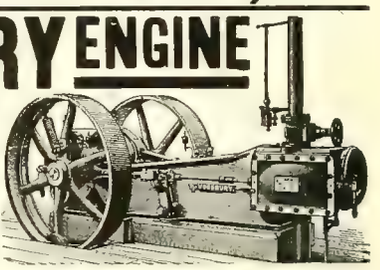
W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

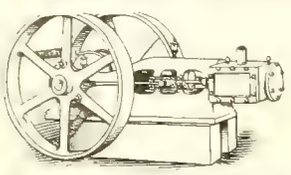
403 HOME INSURANCE BUILDING, - CHICAGO.

THE WOODBURY ENGINE

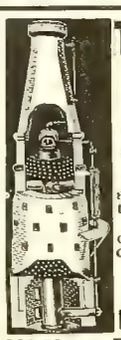
SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application. —



STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
Williams Engine Works, No. 147 North Street, BALTIMORE, MD.



TRIPOD BOILER

Three Points of Superiority Guaranteed: Safety, Economy, Low First Cost

Repeated tests prove that it is absolutely **Non-Explosive** and the most **Durable** ever made.
Strong testimonials from hundreds of users, in all parts of the country.
Sizes 10 to 1,000 H. P.
For full information address,
HAZELTON TRIPOD BOILER CO.
809 Monon Block., CHICAGO, ILL.

Binders

FOR THE Western Electrician $1.00.

WESTINGHOUSE ENGINES

A FEW RAILROAD USERS:

	Engines.	Horse-powers.
Ashland Coal & Iron Railroad Co	1	60
Baltimore & Ohio Railroad Co	6	190
Boston & Albany Railroad Co	2	130
Camden & Atlantic Railway Co	3	75
Central Railway of New Jersey	4	275
Chicago & Erie Railway Co	2	30
Chicago, Burlington & Quincy Railroad Co	3	175
Chicago, Milwaukee & St. Paul Railroad Co	5	100
Chicago, Rock Island & Pacific Railroad Co	4	170
Colorado Midland Railway Co	1	25
Denver & Rio Grande Western Railroad Co	3	75
East Tennessee, Virginia & Georgia Railroad Co	3	325
George's Creek & Cumberland Railroad Co	2	50
Grand Trunk Railway Co. of Canada	12	500
Gulf, Colorado & Santa Fe Railway Co	3	135
Kansas City, Wyandotte & Northwestern Railway Co	2	55
Newport News & Mississippi Valley Co	2	200
New York Central & Hudson River Railroad Co	4	125
New York, Lake Erie & Western Railroad Co	2	140
New York, West Shore & Buffalo Railroad Co	6	340
Northern Pacific Railroad Co	2	45
Pennsylvania & Northwestern Railroad Co	1	25
Pennsylvania Railroad Co	51	2330
Peoria & Pekin Union Railroad Co	1	55
Philadelphia & Reading Railroad Co	7	615
Pittsburgh, Cincinnati, Chicago & St. Louis Railway Co	2	20
St. Louis & San Francisco Railway Co	3	260
Southern Railway Co	1	10
Wabash, St. Louis & Pacific Railroad Co	4	60
Washington & Georgetown Railway Co	1	15

Many foreign railroads unreported.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for New Catalogue. Out August 1st.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

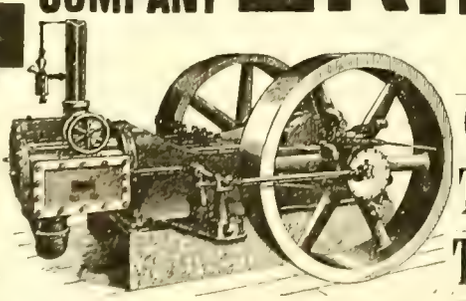
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,
ST LOUIS. CHICAGO. KANSAS CITY.
OMAHA. DALLAS. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER, 38 South Fourth St., Philadelphia, Pa.; COOLEY & VATER 224 Washington Ave. So., Minneapolis, Minn.; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY CO., Tacoma, Wash.

STANLEY ELECTRIC MFG. CO.

TRANSFORMERS.

Compare these weights with weights of other transformers:

5 light,	48 lbs.
10 light,	65 lbs.
20 light,	85 lbs.
30 light,	101 lbs.
40 light,	130 lbs.
100 light,	300 lbs.

A. C. FAN MOTORS.

SMALL,
NOISELESS,
RELIABLE.

Less than 1½ Amperes required to drive it.

Price, $20.00.

PITTSFIELD, MASS.

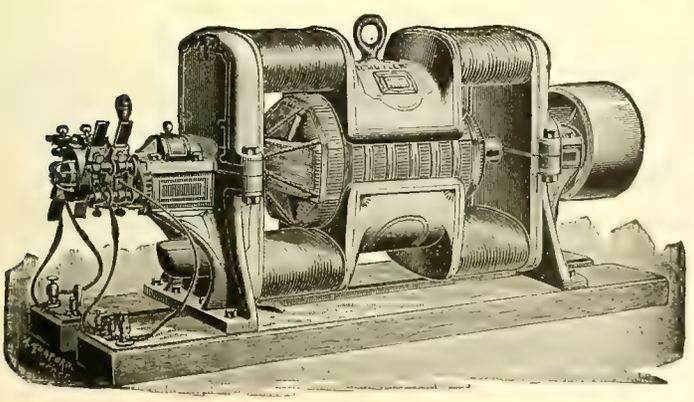
Chicago Agents: THE ELECTRICAL SUPPLY CO., 102 Michigan Ave.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

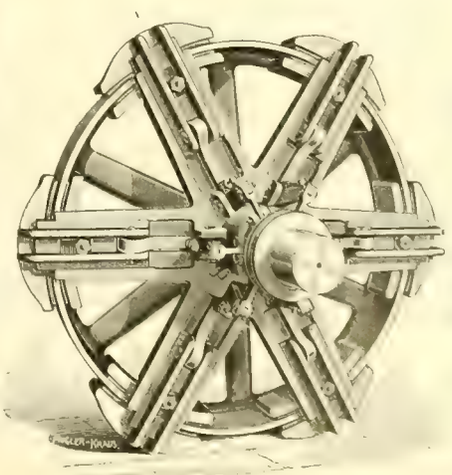
Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office, 176 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 44 Kasota Building.

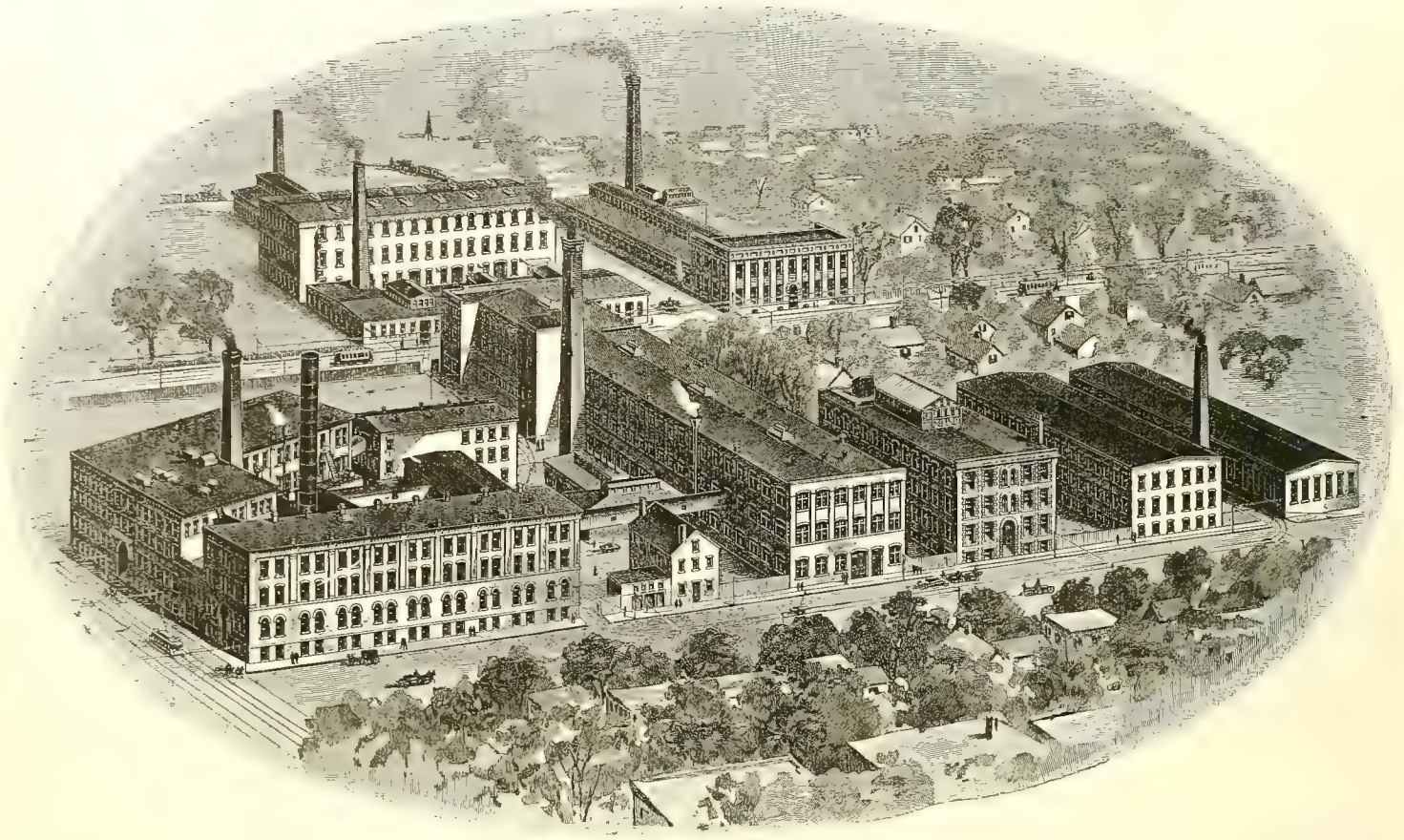
KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Equipped.

Send for new Catalogue Power Transmission Machinery.

THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.

The KNAPP ELECTRICAL WORKS,

GENERAL AGENTS FOR

"SAFETY"

WIRES, CABLES AND CORDS

For Inside, Underground and Submarine Use.

"SAFETY" Fire-Proof House Wire. "ATLAS" Line Wire.

R. B. WATSON & CO., Agts., DETROIT, MICH.

J. W. MASON, Agt., 527 Delaware Street, KANSAS CITY, MO

POST & CO., Agts., CINCINNATI, O.

THE PERKINS ELECTRIC LAMP CO.

LAMPS

TO FIT ANY SOCKET.
ANY CANDLE POWER.
ANY VOLTAGE.
LONGEST LIFE.
HIGH EFFICIENCY.

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

54 and 56 Franklin Street, CHICAGO.

SEND FOR CATALOGUE.

The Electrical Supply Co.,

Corner **RANDOLPH STREET** and **MICHIGAN AVENUE,**

CHICAGO.

Factories: Ansonia, Conn.

50 ft. of Shield Brand Moisture Proof	
At immersion,	200 Million Ohms.
After 24 hours	5,000,000 "
" 72 "	5,000,000 "
" 120 "	4,850,000 "
One week	4,200,000 "

THOMAS STURGIS, President. WM. C. LANE, Secretary and Treasurer. C. P. MACKIE, General Manager. S. S. BOGART, General Agent.

ELECTRIC SECRET SERVICE CO.,

45 BROADWAY, NEW YORK.

Owning the patents of Mosher, Gill, Hatch, Foote, Kintner and Moore for

INDIVIDUAL TELEGRAPH CALL AND CUT-OUT APPARATUS.

OTHER PATENTS PENDING.

The only practical and reliable system of electric selection invented.

Use either ***Morse Key*** or ***Automatic Transmitter.***

From every station selected an ***Automatic Answer back*** is received.

Gong rings until shut off by operator.

Any office on line can be selected without disturbing the others and either called up or cut out. No interference with regular telegraph service. No resistance added to main line. Easily applied. Economical. Convenient. Reliable.

Applicable to arc lights, singly or in groups; fire alarm service; police telegraph; electric motor circuits; railroad signals, etc.

The public is warned against infringing companies and devices.

For terms and other particulars, address as above.

"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

WE GUARANTEE OUR LAMPS ELECTRICALLY AND MECHANICALLY.

In corresponding please give full particulars and state voltage.

ELECTRIC CONSTRUCTION AND SUPPLY COMPANY,

Phenix Bldg., CHICAGO, ILL. 18 Cortlandt St., NEW YORK CITY.

ESTABLISHED 1881.

ELECTRICIAN PUBLISHING COMPANY'S

HAND-BOOK SERIES.

22,000 Copies published to date. An Astonishing Record.

Dynamo-Tenders' Hand-Book.

By Lieut. F. B. Badt.

Fourth Edition, Eighth Thousand.

94 Pages, 70 Illustrations, Flexible Cloth Binding, Type Page 6x3 inches.

The only PRACTICAL Dynamo-Tenders' Instruction Book in the English language. Just the book for Dynamo-Tenders, Linemen, Stationary and Marine Engineers who wish to learn how to operate and care for electric light or power plants. Moonlight schedule for 1891.

Bell-Hangers' Hand-Book.

By Lieut. F. B. Badt.

Second Edition, Fourth Thousand.

106 Pages, 97 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches.

Designed for those engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat regulating apparatus, etc. The only book of the kind published.

Incandescent Wiring Hand-Book.

By Lieut. F. B. Badt.

Third Edition, Seventh Thousand.

72 Pages, 42 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches. Five Tables, 12x18 Inches.

These tables give *at once* and without any calculation the size of wire required in each case for any percentage of loss.

It is a book for practical wiremen and learners, and does not require any previous knowledge of wiring. It differs in this respect from other wiring tables, or computers.

The book contains full illustrations and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, wiring of fixtures, elevators, buildings, etc. The only book of the kind published.

Electric Transmission Hand-Book.

By Lieut. F. B. Badt.

First Edition, Three Thousand Copies.

97 Pages, 22 Illustrations, and 27 Tables. Flexible Cloth Binding. Type Page 6x3 Inches.

This book contains all practical information for power producers, capitalists, agents of hydraulic and electric companies, engineers, motor inspectors and other persons interested in electric power transmission. By means of the tables anybody can find at once cost of plant for least operating expenses, or for minimum first cost of installation.

The book gives all necessary information concerning motors, and rules for ascertaining horse power of motors, driving various classes of machinery, as hoists, pumps, street or tram cars, fans, etc.

Twenty-seven new and original tables give more information on the subject in a small space than any book heretofore published on the same subject.

Each Work Sent Postpaid on Receipt of One Dollar.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

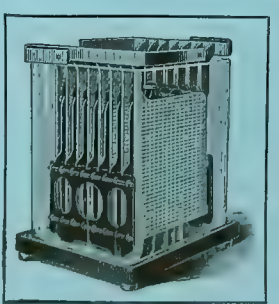
SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

FACTORIES AND GENERAL OFFICES. BALTIMORE, MD.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



- Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
- Central Station and Isolated Lighting.
- Portable Lighting or Power.
- Portable Electric Lanterns.
- Electric Power for Motors.
- Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR COMPANY,

224 and 226 Chestnut Street, Philadelphia, Pa.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 and 226 Chestnut St.
NEW YORK:—TRUEX & VAIL, 44 Broadway. CHICAGO:—WM. HOOD, 239 La Salle St.
SAN FRANCISCO:—THE PACIFIC ELECTRICAL STORAGE CO., 118 and 120 Pine St.
BOSTON:—THE HOLTZER-CABOT ELECTRIC CO., 111 Arch St.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, AUGUST 22, 1891. No. 8

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building, - - CHICAGO.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes
Telephonic transmission through Our Cable an easy
CAME.

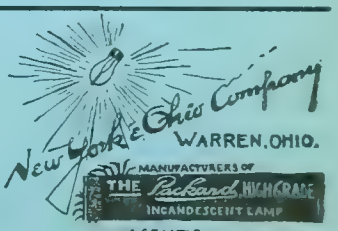
An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices.
Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

THE HOLTZER-CABOT ELECTRIC CO.,
MANUFACTURERS OF AND DEALERS IN
EVERYTHING ELECTRICAL.
SEND FOR 256-PAGE CATALOGUE.
111 Arch Street, BOSTON, MASS.
SPECIAL AGENCIES: CLOWER & HARRIS, Dallas, Texas. PAUL SEILERS ELECTRICAL WORKS, San Francisco, Cal.
A full line of our manufacture can be found at our Agencies.

WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

DO YOU WANT
A THOROUGH INSULATING PIPE?
AN INDESTRUCTIBLE PIPE?
PIPE TESTED SUCCESSFULLY?
THE PATENT INDURATED FIBRE PIPE
Costs less than iron and does better work in electrical subways and elsewhere.
SOLE AGENTS:
Engineering Equipment Co.,
143 Liberty St., NEW YORK.
126 Pearl St., BOSTON.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.
OKONITE TRADE MARK.
INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.
BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.



AGENTS
J. W. PEALE, 1 BROADWAY, NEW YORK.
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.
DAYS KERITE
The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.
Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.
GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.
THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

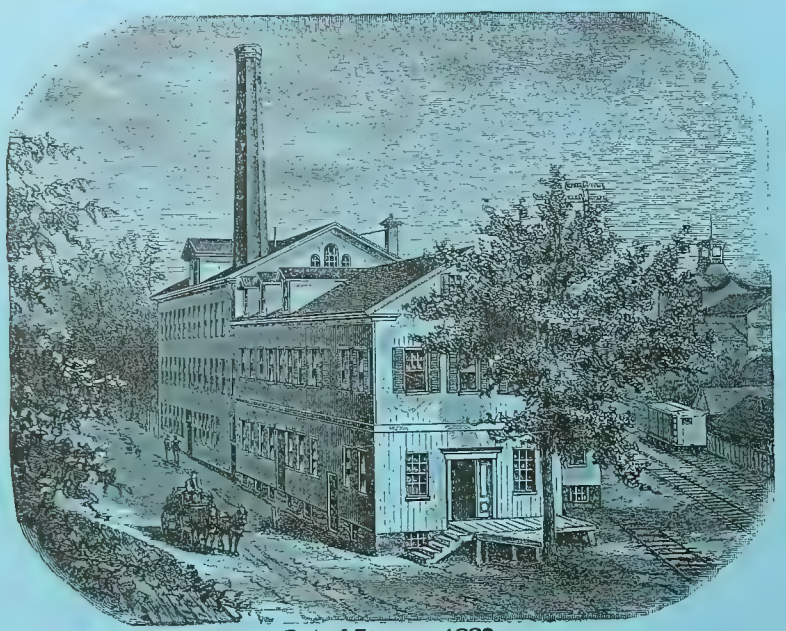
Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.
Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.
STANDARD ELECTRICAL MEASUREMENT APPARATUS.

73-75 W. Jackson St. RELIABLE
WE ARE FITTED WITH
RELIABLE Machinery and Tools,
And Employ **RELIABLE** Workmen.
All Kinds of Electrical Apparatus to Order.
CHICAGO ELECTRIC MFG. CO.

WM. ROTCH, Prest. CHAS. W. NASH, Treas.
CHAS. E. BIRBER, Gen'l Manager.
DO NOT
Equip your Switch-board with cheap Switches.
BUY THE
C. E. M. Jack-Knife Switch.
It is a Record Breaker.
Manufactured Solely By
THE CONSOLIDATED ELECTRIC MFG. CO.,
196 Summer St. and 355 Congress St., BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS.

IS THE THOMSON-HOUSTON ELECTRIC CO.'S SYSTEM OF LIGHTING A SUCCESS?



Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, 1,653 Lamps.	None.	None.

Cut of Factory, 1888.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, 21,840 Lamps.	29 Companies, 11,275 Lamps.	None.

Read the Answer on Page XX.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The........ —
Abendroth & Root Mfg. Co.....xiii
Alexander, Barney & Chapin..... i
American Electrical Works.....xiii
Andrews & Co., A. H..........xiv
Automatic Switch Co........... x
Baggot, E..................xiv
Bain Electric Mfg. Co.........xvi
Ball Engine Co...............xix
Ball & Wood Co., The........ —
Baxter Electric Motor Co......xxiv
Bernstein Electric Co..........viii
Blatz, L.....................xiii
Borden & Selleck Co............xv
Braun Illustrating Co..........xix
Brownlee & Co.................xii
Brookfield, Wm...............xii
Brush Electric Co.............xvii
Butler Hard Rubber Co....... —
C. B. & Q. R. R..............xiv
C. & C. Electric Motor Co.....xvi
Card Elec. Motor & Dynamo Co. viii
Central Electric Co............ v
Chicago Electric Mfg. Co........ i
Chicago Electric Motor Co..... —
Chicago Insulated Wire Co.....xvii
Colburn Electric Mfg. Co.......xiv
Coolidge, Fuel & Supply Co.....xiv
Consol. Elec. Mfg. Co., The...... i
Cowles Electric Smelting and Aluminum Co..........xiv
Crocker-Wheeler Electric Motor Co...................xiii
Day's Kerite Insulation............i
Dayton Globe Iron Works Co...xix
Eastern Electric Cable Co.......xiii
Edison General Electric Co.,— Motor Dept................ vi
Edison General Electric Co., Cable and Wire Department.......vii
Electric Construction & Sup. Co.xxiii
Electric Merchandise Co.........iv
Electric Secret Service Co......xxiii
Electrician Pub. Co.iv, vii, viii, xxiii
Elec. Construction Co., The.....xiii
Electrical Engineering Co........xiii
Elec. Eng. & Supply Co., The..xiii
Electrical Supply Co., The... xxii
Elektron Mfg. Co...............xvi
Empire China Works.........xiv
Engineering Equipment Co........i
Evans Friction Cone Co.......xvii
For Sale................xiii, xiv
Foster, O. A.................. —
Fort Wayne Electric Co.......xxiv
Freeman, Coleman & Co....... —
Globe Carbon Co...............xv
Great Western Elec. Supply Co. viii
Greeley & Co., The E. S..........i
Hale Elevator Co..............xiv
Heisler Electric Light Co...... —
Hill Clutch Works............ —
Hine Eliminator Co.............xii
Holmes, C. H..................viii
Holmes, Booth & Haydens... xvii
Holtzer-Cabot Electric Co.........i
Hood, Wm...................... x
India Rubber & Gutta Percha Insulating Co............. —
Interior Conduit & Insulation Co...iv
International Okonite Co...........i
Kartavert Mfg. Co..............xii
Knapp Electrical Works.........xxi
Law Telephone Co.............xiii
Leonard & Co., H. Ward........iv
Leffel & Co., Jas..............xiii
Loud, H. M. & Sons Lumber Co. xiv
McLaughlin, James.............xiv
Manhatten Elec. Supply Co.....viii
Mason, James H...............xiii
Milliken Bros....................iv
Minneapolis Street Railway Co..xviii
Monitor Electric Co.............. x
Mosher Arc Lamp Co......... —
Munsell & Co., Eugene........xiii
Murphy, T. J.................xiii
National Carbon Co..............iv
National Electric Mfg. Co........ix
N.Y. Belting & Packing Co.......xii
New York Insulated Wire Co.... x
New York & Ohio Co.............. i
N. W. Elec. Specialty Co......xix
Nuttall Company, R. D........... i
Ohio State University.......... —
Ostrander & Co., W. R..........xii
Paiste, H. T....................xii
Page Belting Co.............. —
Partrick & Carter Co.............. x
Payne & Co., Geo. W......... —
Pearson & Co., W. B............xix
Phoenix Glass Co............ —
Pond Engineering Co...........xix
Powell Co., The Wm.............xii
Queen & Co....................xiii
Rochester Railway Co............xii
Rockford Electric Mfg. Co..... —
Sargent & Lundy............ —
Sawyer-Man Electric Co..........xi
Schieren & Co. Chas. A.........xii
Schoonmaker, A. O..............xii
Schuyler Electric Co...........xxiv
Short Electric Railway Co.......xii
Shultz Belting Co............ —
Standard Underground Cable Co....i
Standard Paint Co...............xii
Stanley Electric Mfg. Co..... —
Star Iron Tower Co.............xiv
Stearns Mfg. Co................xix
Stephenson Co., Jno............xvi
Sterling, W. C.................xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co.....xv
Taussig, S................xiii, xiv
Temple, J. C...................xv
Thomson-Houston Electric Co. Lighting Department... ii, xx
Turner Brass Works............xiii
Union Electric Mfg. Co., The...vii
Union Electric Works......... —
Union Hardware Co..............xii
U. S. Electric Lighting Co.... —
Van Nuis C. S............... —
Vulcanized Fibre Co............xv
Wanted........................xiii
Wenstrom Consolidated Dynamo & Motor Co., The.............x
West End Street Railway Co... —
Western Electric Co............vii
Westinghouse Elec. and Mfg Co. xi
Westinghouse Machine Co......xix
Weston Electrical Instrument Co— —
Williams Engine Works........xix
Woodbridge & Turner Engineering Co........................xv
Woodhouse & Rawson, Ltd.... —
Worthington, Henry R........ —

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Manhatten Elec. Supply Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Law Telephone Co.
Manhatten Elec. Supply Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Rochester Railway Co.
Stephenson Co., John.
West End Street Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Edison General Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Engineering Equipment Co.
Fort Wayne Electric Co.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Holtzer-Cabot Electric Co.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Colburn Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball & Wood Co., The.
Ball Engine Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Holtzer-Cabot Electric Co.
Knapp Electrical Works.
Manhatten Elec. Supply Co.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus, Electric
[illegible]

Motors.
[illegible]
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
[illegible]
Elektron Manufacturing Co.
[illegible]
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors
Woodhouse & Rawson, Ltd.

Packing.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
Rochester Railway Co.
West End Street Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James
Stilwell & Bierce Mfg. Co.

Universities.
Ohio State University.
Purdue University.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

ELECTRICAL BOOKS
OF ALL KINDS.
Send for Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building CHICAGO, ILL.

THE MILLIKEN PATENT POLE
For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY **MILLIKEN BROS.**

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

H. WARD LEONARD & CO.

We will do no MANUFACTURING and will do no SUPPLY BUSINESS, neither will we, under any circumstances, act as the selling agents of any concern, directly or indirectly.

We will, however, act for the purchaser, either as Consulting Engineers, Supervising Engineers, Inspectors or Purchasing Agents. When acting in this way we will make the following charges, based upon contract price:

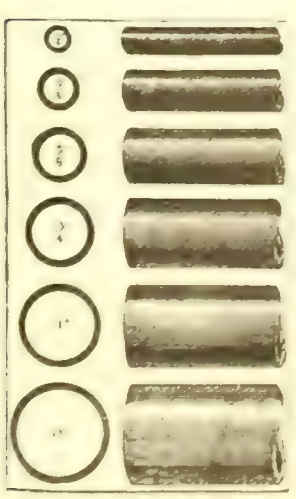
For making preliminary plans, designs, distributions and estimates ..... 1 per cent.
For making final plans and specifications ..... 1 per cent.
For drawing and executing contract on behalf of the purchaser ..... 1 per cent.
For supervising an installation made by another contractor ..... 3 per cent.
For acting on behalf of the purchaser in making the settlement with another contractor ..... 1 per cent.
For acting as the agent of the purchaser, from the beginning to the final settlement of a contract, including the making of estimate plans, determinations, specifications, contract, supervising the installation, final inspection and report and final settlement ..... 5 per cent.

It will be seen from the complete schedule given above that the purchaser will be able to obtain our services for any portion of the work, and under terms which are so reasonable that there can be no question in the minds of those familiar with the subject that any purchaser contemplating the installation of an electric plant would not only save a great deal of his own time and be spared a great deal of annoyance, but would actually effect a very material saving in retaining our services to represent the interest of the purchaser.

FOR DESCRIPTIVE PAMPHLET ADDRESS

Electrical Exchange Building, Liberty St., New York City.

The SOLUTION of the PROBLEM of SAFE GUARDING
ELECTRIC CONDUCTORS
Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.



INTERIOR AND UNDERGROUND
CONDUITS
MANUFACTURED BY
THE INTERIOR CONDUIT AND INSULATION CO.,
WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,
General Offices: 42 & 44 Broad St., New York.

ELECTRIC RAILWAY SUPPLIES
For All Systems.
EXCLUSIVELY.
SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,
11 ADAMS STREET, CHICAGO.
W. R. MASON, General Manager.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 LOCUST ST., ST. LOUIS, MO.

BANNER WIRE.

OKONITE
TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 DELAWARE ST., KANSAS CITY, MO.

A NEW WEATHER-PROOF WIRE.

Double, Triple and Quadruple Braid.

This is the best finished, best insulated, most durable and generally the most satisfactory of all the ordinary weather-proof Wires. Send for samples before placing your construction orders.

PRICES LOW. SHIPMENTS PROMPT.

Also GENERAL WESTERN AGENTS for

OKONITE
TRADE MARK

AND

IMPROVED CANDEE WEATHERPROOF WIRES.

These Wires are positively the best of their respective classes.

BRANCH BLOCKS, SOCKETS,
MAIN CUT-OUTS, PAISTE SWITCHES
AND GENERAL ELECTRICAL SUPPLIES.

CENTRAL ELECTRIC COMPANY,

116 & 118 FRANKLIN ST.,
CHICAGO.

OKONITE
TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., OMAHA, NEB.

Connected by private wire with Postal Telegraph-Cable Company's System.

OKONITE
TRADE MARK.

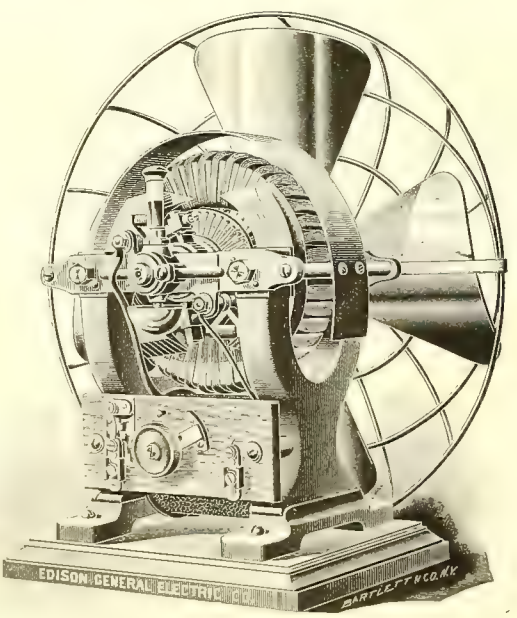
ELECTRIC POWER AND TRANSMISSION CO.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.

ELECTRIC FANS.

These Fans are operated by new Edison Slow Speed Motors, requiring Minimum amount of attention and lubrication.



They are compact and especially suitable for office desks and similar places.

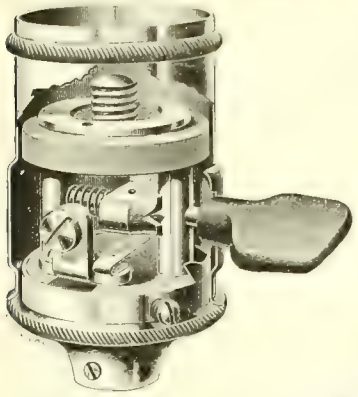
Will operate on any ordinary Lighting Circuit without Wasteful Resistance.

List Price, Motor and Fan, $42.50, less 45 per cent. to Users. Net, $23.36.

For Particulars Address Nearest District Office.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, 173 and 175 Adams St., Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.



THE FACT that COMPETITORS are IMITATING our SOCKET is PROOF ENOUGH for ANYONE that it is the

BEST SOCKET ON THE MARKET.

THE UNION ELECTRIC MFG. CO., BRIDGEPORT, CONN.

NEW YORK: Alexander Barney & Chapin. BOSTON: The Eastern Electrical Supply Co.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

WESTERN ELECTRIC COMPANY,

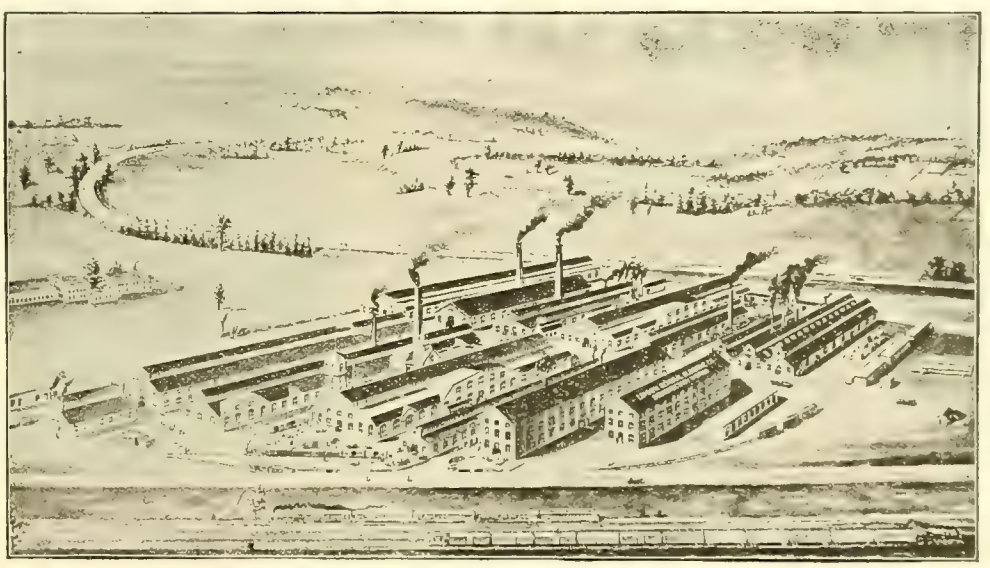
CHICAGO,
NEW YORK,
LONDON,
ANTWERP,
BERLIN,
PARIS.

MANUFACTURERS AND DEALERS IN

Arc and Incandescent Electric Light Apparatus, Patterson Underground and Overhead Cables, I. C. Weather-proof Wire, Washburn & Moen's Hard Drawn Copper Trolley and Galvanized Iron Wires, House Goods, Testing Apparatus, District Telegraph Apparatus, Line Supplies, Tools and all other Electrical Appliances.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

LIGHTING SUPPLIES. HOUSE GOODS. RAILWAY SUPPLIES. FIXTURES.

Great Western Electric Supply Co.,

201, 203, 205, 207 SOUTH CANAL STREET, CHICAGO, ILL., U. S. A.

THE ELEMENTS OF DYNAMIC ELECTRICITY AND MAGNETISM.

A Book For Learners. **JUST OUT!** Price, $2. Postage Free.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

FAN MOTOR,

MANUFACTURED BY

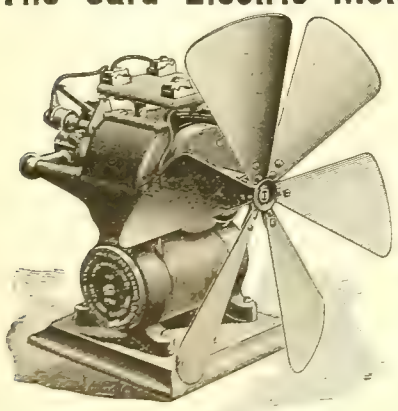
The Card Electric Motor and Dynamo Co.,

Cincinnati, Ohio,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits, from 1-C to 50 H. P.

Correspondence Solicited.



AGENTS:

BOSTON—The Eastern Electrical Supply & Construction Co., 65 Oliver St.
CHICAGO—The Thos. L. Johnson Co., 312 Dearborn St.
MILWAUKEE—Henry Ramien, 641 Third St.
WASHINGTON, D. C.—J. Geo. Gardner, 1005 H St.
ST. LOUIS—Stagl Electrical Engineering Co., 1106 Pine St.
MONTGOMERY, ALA.—W. F. Murphy.
DETROIT, MICH.—The Michigan Electric Co., 212 and 214 Griswold St.
MINNEAPOLIS, MINN.—J. M. Lennon, No. 22 Loan and Trust Building.

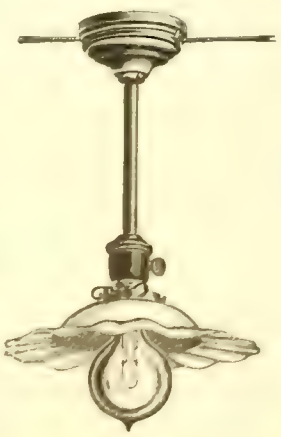
BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS

FOR

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



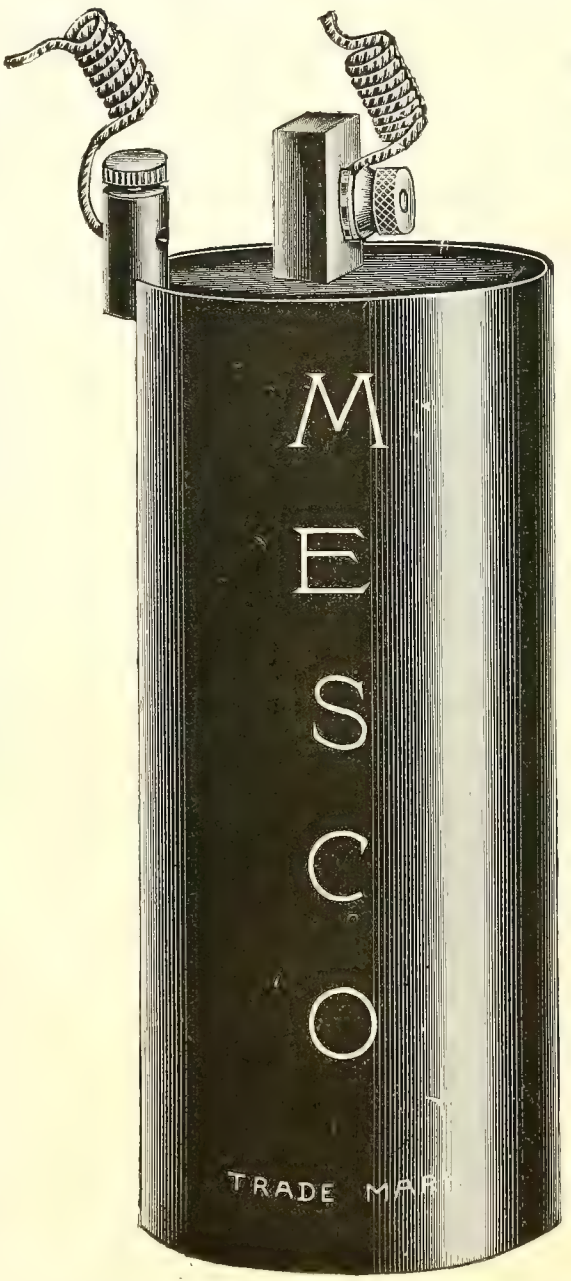
The only arrangement for series lamps and the only socket having insulating material for the outside parts. Send for illustrated Catalogue.

620 ATLANTIC AVENUE,

BOSTON, - MASS.

You Will Oblige

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.



THE

MESCO

DRY

Battery.

(CUT FULL SIZE.)

PATENT

Applied For.

For Call Bells, Annunciators, Burglar Alarms, Telephones, the Laboratory, and all OPEN CIRCUIT USE.

PRICE, 80 CENTS.

Guaranteed equal to any Dry Battery made, in E. M. F., Durability and Recuperative Power. No infringement on any existing patent.

Exhausted Batteries Replaced at a Nominal Price.

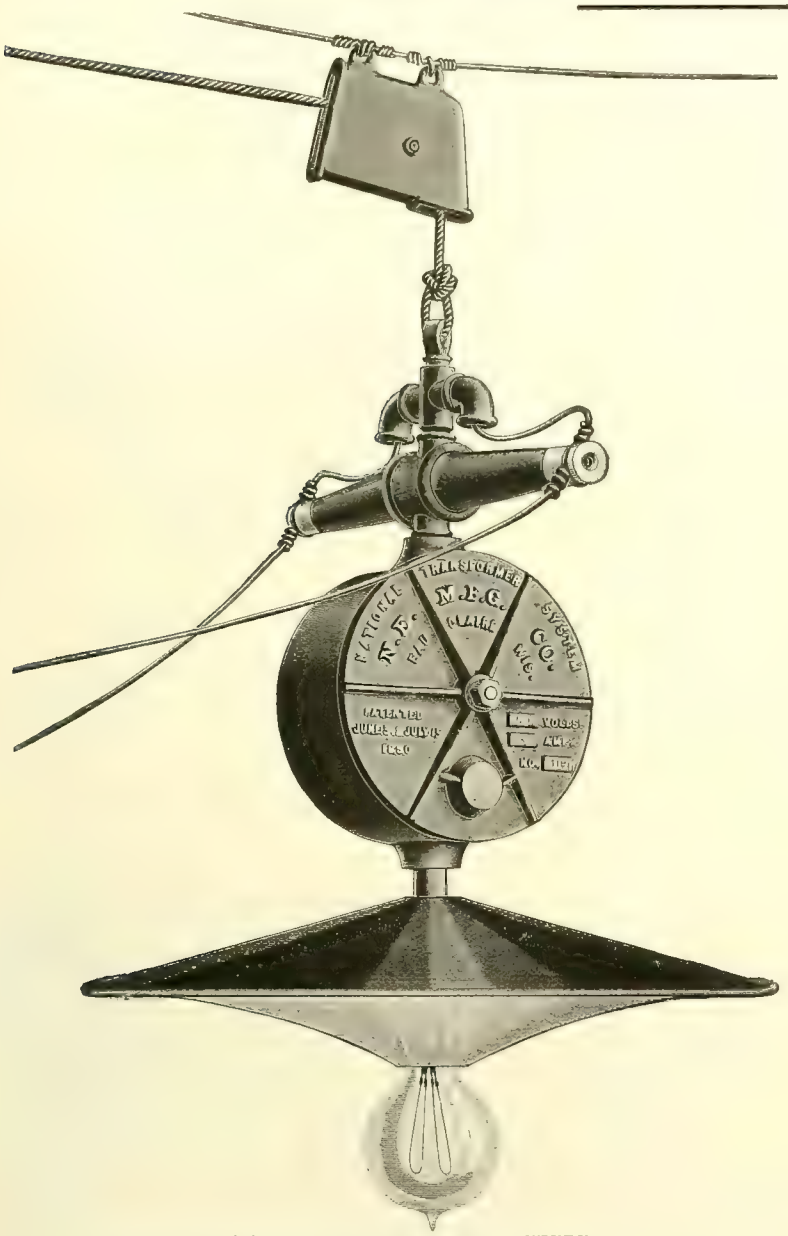
LIBERAL DISCOUNTS TO THE TRADE.

MANHATTAN ELECTRICAL SUPPLY CO.,

36 CORTLANDT ST., NEW YORK.

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



INCANDESCENT STREET LIGHT FIXTURE,
SERIES TRANSFORMER, REFLECTOR CANOPY AND 32 C. P. LAMP.

WHY

USE ARC LAMPS

WHEN THE

NATIONAL

SERIES TRANSFORMER

ENABLES YOU TO DO

STREET LIGHTING

ECONOMICALLY
EFFICIENTLY
SATISFACTORILY ???

Send for Circulars and Prices.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

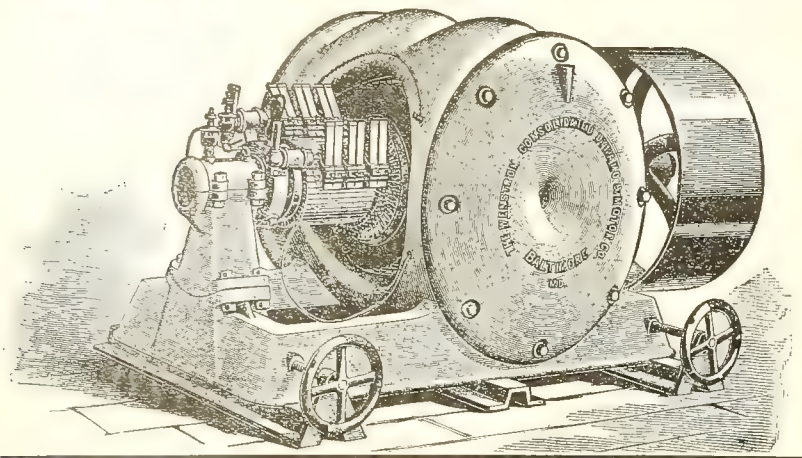
AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	**ST. PAUL, MINN.,**	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	**DETROIT, MICH.,**	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	**DENVER, COLO.,**	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	**WINNIPEG, MAN.,**	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	**SAN FRANCISCO, CAL.,**	National Electric Development Co
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.	**KANSAS CITY, MO.,**	Thomas Wolfe, 515 Main St.
SEATTLE, WASH.,	Chas. H. Baker & Co.	**DULUTH, MINN.,**	The Electrical Eng. & Supply Co.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

WM. HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 **WABASH AVE., CHICAGO, ILL.**

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS.

WIRES.

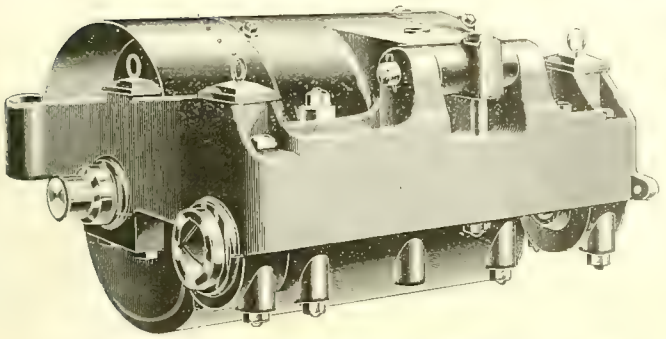
You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK.

G. H. MEEKER, Western Manager.

THE WESTINGHOUSE
"Single Reduction" or "Slow Speed"
STREET RAILWAY MOTOR.



"Slow speed" means small number of revolutions of Armature per minute, NOT SLOW CAR SPEED.

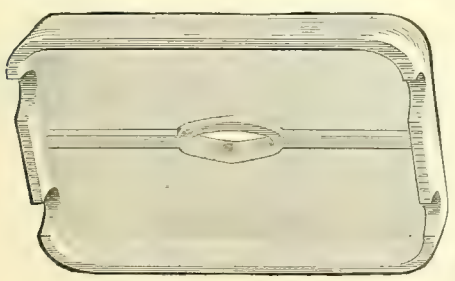
"Single reduction" means elimination of High Speed Gearing and Bearings.

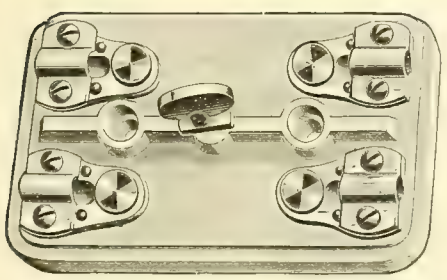
The Westinghouse Single Reduction Motor is **Efficient, Economical** and **Durable,** and is giving ENTIRE SATISFACTION after long usage.

☞ Write for descriptive catalogue. ☜

RAILWAY DEPARTMENT,
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,
PITTSBURGH, PA.

Branch Offices: 120 Broadway, NEW YORK. Pullman Building, CHICAGO.

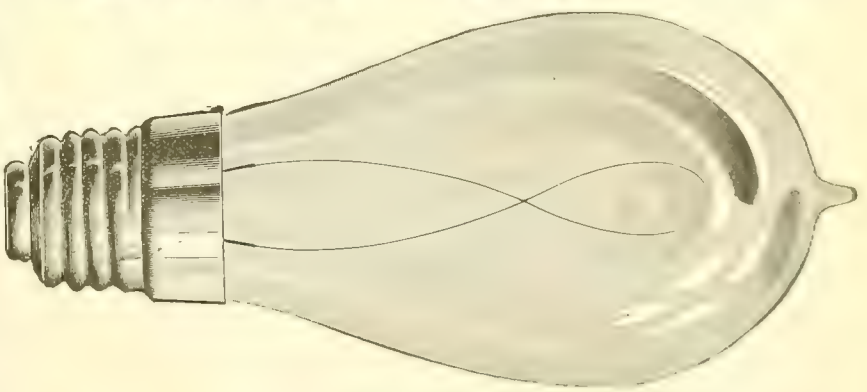




CUT-OUTS,
Single Light, Main and Branch,
OF SUPERIOR PORCELAIN,
With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.
510-534 W. 23d Street, NEW YORK.
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

MICA.

Best for Electric Insulating Purposes. Last in a Mica interest on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

BINDERS

FOR THE

WESTERN ELECTRICIAN,

ONE DOLLAR.

FOR SALE.

STREET CARS.

ONE HUNDRED 12-FOOT CARS,

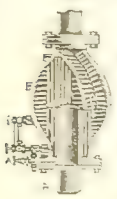
Built by the John Stephenson Co. and Jones, one end type, with fare box, in good order, gauge, 4 ft. 8½ in.

Six Hundred Tons 38-lb. Tram Steel Rails and One Hundred 30 ft. Steel Poles.

ROCHESTER RAILWAY CO.,

ROCHESTER, N. Y.

KNOW WHAT YOU'RE GETTING!



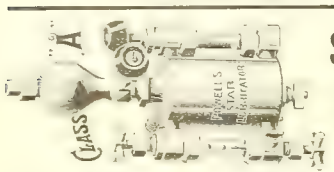
HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

A test of six of the best known Separators has recently been made at Cornell University. **Hine's Eliminator stands at the head.** The full report with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street, NEW YORK.



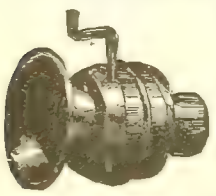
This cut represents our Class A

STAR SIGHT "UP-FEED" LUBRICATOR.

There are no joints about it. Arms and body cast in **One Piece**, so you won't be annoyed by leaking and it will work to your entire satisfaction. Will let you try it before you buy it.

For sale by Jobbers, or apply to

THE WM. POWELL CO., - CINCINNATI, O.

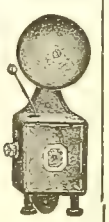


SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.



W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

H. T. PAISTE,

Paiste Electrical Specialties.

241 THE ROOKERY, CHICAGO, ILL.

1201 MARKET ST., PHILADELPHIA, PA.

PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

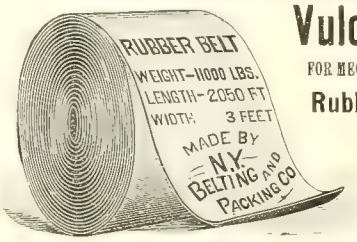
Also New York, Boston, Philadelphia, } 46 SOUTH CANAL ST., CHICAGO. ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, A. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

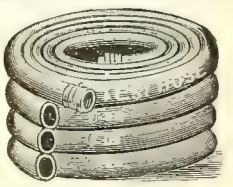
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 160 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 1624 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

REMEMBER

That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

"NOISELESS."

A BEAUTIFUL NEW CAR EQUIPPED WITH

SHORT GEARLESS RAILWAY MOTORS

Has been put through a series of remarkable tests on the BROOKLYN, and the BROADWAY and NEWBURY LINES in Cleveland, Ohio.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

P AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, AUGUST 22, 1891. No. 8

Electric Plant at Roebling's Wire Works, Trenton, N. J.

That the Roeblings appreciated from the start the great utility of the electric light is evidenced in the fact that as early as 1879 there was installed in their manufactory a Maxim lamp with one of the old type Maxim machines to supply current. As time went on this one light plant was followed by the introduction of a 45 light Brush dynamo and then came a small incandescent machine of 200 lamps' capacity. Unfortunately this somewhat primitive machine sparked badly at the brushes and a usurper was brought in in the shape of a Hochhausen 400 lighter. This last named machine, however, is not now operated with the other lighting apparatus. It has been removed and is now employed in what might be called isolated service in one of the shops where the number of lights are such as to require the machine's full duty.

In the place of this Hochhausen 400 lighter there was set up an 800 light United States 110 volt machine, and a short time after this was installed two Waterhouse 30 light arc machines for lighting the yards were put in, and these were followed last year by a Westinghouse alternating current 40 light arc, 2,000 candle power machine for lighting the wire mill. In the winter time all of these machines with the exception of the old Maxim and the 200 lighter are running every night, and in the summer it is the usual practice to run all except one of the Waterhouse machines.

Such is the lighting apparatus now employed at the factory in Trenton, and the reader will obtain a good idea of the general appearance of the dynamo room from Fig. 1.

A close inspection of the illustration just referred to will reveal the fact that the John A. Roebling's Sons company has gone still deeper into the refinement of methods than might appear at first glance.

Those familiar with such machinery will detect in the center of the cut a Thomson generator for welding service. The Roeblings claim the distinction of having installed the first wire welder turned out by the Thomson Welding company. With this plant ⅜ inch iron could be welded. The machine used was of the direct type, that is, with the dynamo embodied in the welder proper, and ran successfully for more than a year, making in its lifetime about 370,000 welds. The Roeblings were so well satisfied with its performance that the generator shown in the illustration of the electric light station and seven small welders were contracted for. It may be mentioned that the first welder is not worn out, but merely superseded on account of the greater convenience of the new type machine.

From Fig. 2 there can be obtained an excellent idea as to the manner in which the welders are set up in the Roebling works. The cut shows two of the seven machines now in service. Between the welders is the small wheel employed to reduced the burrs formed in welding the wire.

The WESTERN ELECTRICIAN is indebted to F. A. C. Perrine, electrical engineer for the Roebling company, for information relating to the welding and lighting plant. The photographs are the work of Mr. Cabazola, also with the Roeblings

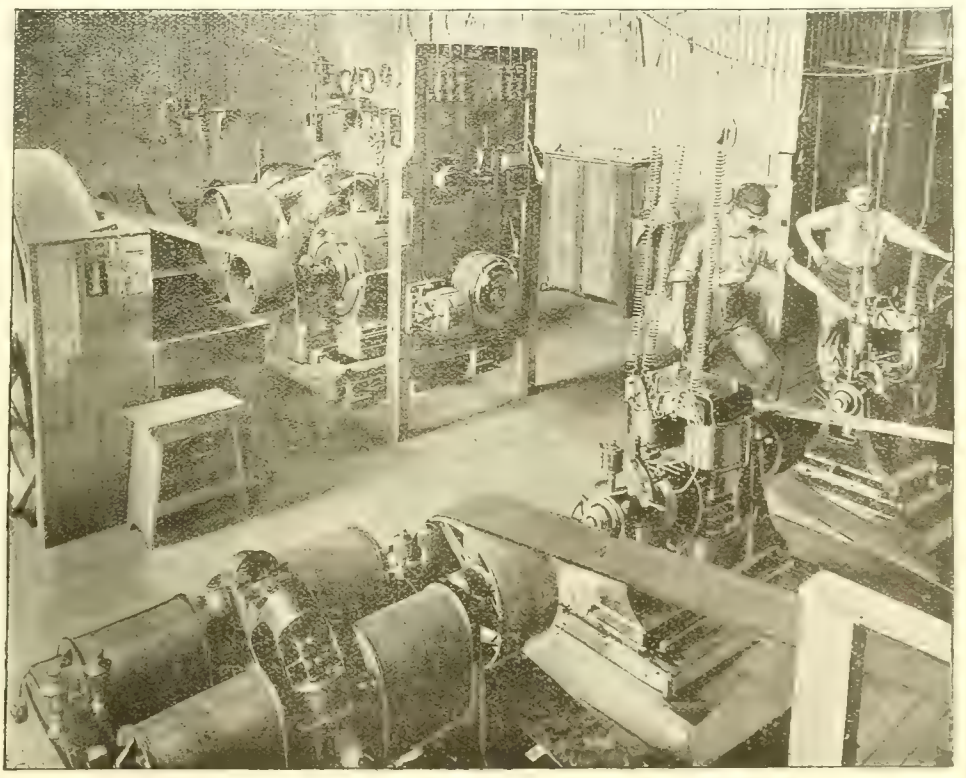


FIG. 1 ELECTRIC PLANT AT ROEBLING'S WIRE WORKS, TRENTON, N. J.

Electricity at the World's Fair.

Apparently no progress has been made in adjusting the misunderstanding between the departments of electricity and construction. The latter has been in stormy water of late, owing to the resignation of Chief Engineer Gottlieb and the subsequent cessation of operations on all the buildings now in process of construction at Jackson Park. For several days last week not a stroke of work was done on any of the buildings, including that intended for the department of electricity. On Monday last building operations were again resumed.

A sensation was caused by the announcement that work had been stopped, and the department of construction was subjected to much unfavorable criticism. It was stated in explanation that it had been discovered that Mr. Gottlieb's calculations of the strains to be put upon the foundations of the buildings were incorrect and that heavier timbers would have to be substituted for those originally laid down in order to sustain the heavy machinery in most of the large buildings. The public was led to infer that the discovery of this serious error led to the chief engineer's resignation. While the new figures were being made all work was suspended. This state of affairs engrossed the attention of the directors and the committee on grounds and buildings to such an extent that nothing was done in relation to the controversy between the committee on electricity and the electrical department on the one hand and the department of construction on the other. It is asserted that the engineers' errors and the changes to be made will cost the exposition company between $200,000 and $300,000.

Another criticism of the department of construction was in relation to the plans for the buildings. A great many of the plans are drawn to a scale of one-thirty-second of an inch to a foot. This, the contractors complain, is too fine. [illegible] could get along with the specifications while laying foundations, but were unwilling to let large mill orders for the finer work when the variation of one-thirty-second of an inch [illegible] foot in the timber. Some of the specifications are drawn to a larger scale, but it is claimed there is a general lack of satisfactory details.

The principle for which Chief Barrett has so long contended—that the chiefs of departments should have charge of the machinery installed on the fair grounds for actual use, in connection with the exhibits—has pervaded other departments, and is the subject of general discussion. The situation in the machinery department is precisely analogous to that in the department of electricity. Many of the directors think that Chief Burnham ought to be empowered to buy the big engines that will be used to furnish power in the [illegible]. Director-General Davis believes that the chief of machinery, [illegible] ought to be allowed to get the motive power free, as a part of the exhibit. That is what President Palmer and other commissioners think, and they have advised Colonel Davis to select his chief at once for that department. "I have my man ready to name [illegible] will make the nomination very soon," the director-general is reported as saying. "I am only waiting to make sure of his confirmation."

The [illegible] states the case clearly as follows:

If the exposition directors were to buy the machinery outright it would cost them considerably more than $1,000,000. To avoid this expense it has been suggested that the manufacturers would be glad to furnish all the necessary machinery free for the privilege of exhibiting the engines and other machinery running.

Right here is where the hitch comes. The director-general and department chiefs have exclusive control of all exhibits. If the directors secure the machinery as exhibits, they cannot install the plant without permission from the director-general. If this permission were refused, the directors would be compelled either to abandon control of the power plant or else pay the million or more it would take to purchase it.

Director-General Davis insists that the construction department should designate the amount and kind of power that will be needed and let the department chiefs secure it as exhibits. While the director-general has been trying to get this question of jurisdiction settled, Chief Burnham, presumably by consent of the directors, has gone ahead and practically completed negotiations for all the machinery to be used for power. But he cannot put in his machinery until the commissioners and directors agree on terms, and so the power arrangements are delayed until the question is settled.

"It may cost the directors $1,000,000 to learn what our rights are," said one of the commissioners. "They have apparently handed the construction and government of the fair over to Mr. [illegible]. I [illegible] Mr. Burnham personally, but I don't like his autocratic methods a little bit. He seems determined to control not only the building work but the executive departments of the fair as well. [illegible] him he will have more respect for the act of congress which gives us our authority, and [illegible] will have a less exalted idea of his ability to dictate to the national commission. [illegible]

they will put the brakes on Chief Burnham and give the director general the power that belongs to him by right."

On Monday afternoon the national board of control considered the question of authority as between department chiefs and D. H. Burnham, chief of construction. It adopted the following resolution:

Whereas, It has been represented to this board by the directory of the World's Columbian Exposition that a very large saving may be effected in that branch of the work of

FIG. 2. ELECTRIC PLANT AT ROEBLING'S WIRE WORKS, TRENTON, N. J.

construction which relates to the supply and distribution of the adequate power, light and heat essentially necessary for the suitable equipment of the buildings to be devoted to exposition purposes, provided the owners of boilers, engines and machinery or other appliances which may be secured for that exclusive purpose by the said directory of the World's Columbian Exposition shall not be, on account of the primary devotion thereof to such utilitarian purposes, precluded from entering such boilers, engines, machinery and other appliances as competitive exhibits within the several classes to which they shall respectively properly belong, and this board has been requested to take appropriate action in this behalf; and,

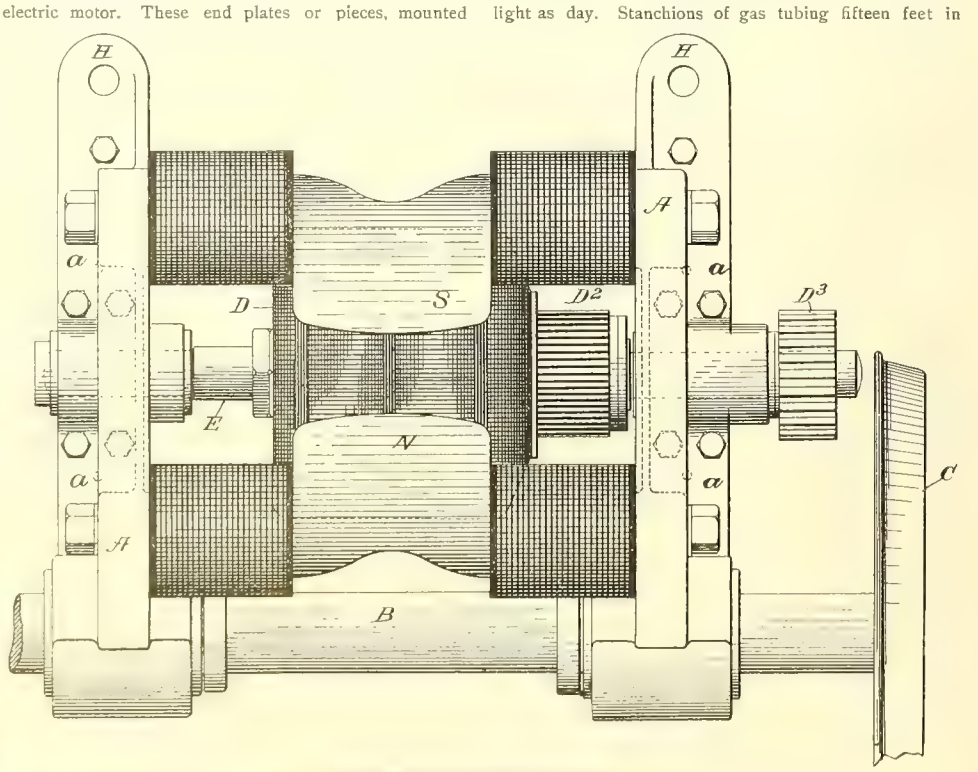
Whereas, This board recognizes that the duty and responsibility of the work of constructing and furnishing suitable buildings, adequately equipped for exposition purposes, rests exclusively upon said World's Columbian Exposition, subject—when completed and tendered—to the right of acceptance by the national commission, and this board is therefore unwilling to assume responsibility in any degree in such work of construction, or to authorize any department or agency subject to its authority to do so; therefore, be it

Resolved, That it is the judgment and opinion of this board and it hereby—in so far as it may lawfully do so—declares that the fact of such boilers, engines, or other machinery or appliances as shall be procured and located by the directory of the World's Columbian Exposition and be by them devoted to the supply and distribution of adequate power, light and heat for the exposition buildings shall not preclude the entry of the same by the owners thereof as competitive exhibits in the classes to which they may severally belong, subject, however, as to the classification and installation thereof, to the rules and regulations prescribed by authority of the national commission.

The *News* prints its account of the meeting under the heading "Burnham is Not Boss," and gives an interview with Commissioner St. Clair as to the effect of the resolution. "It means," said Mr. St. Clair, "that neither the [illegible] will have exclusive con[illegible]. The director wanted us to give Mr. Burnham authority to get machinery free as exhibits [illegible] the power to delegate [illegible] get manufacturer to let [illegible] for power, but cannot [illegible] the chiefs of machinery and electricity agree to accept them. [illegible]

The Mailloux Electric Motor.

In the general construction of electric railway motors it is necessary to lift the armature out of its bearings and remove it from the machine for repairs or examination. This method is often attended with considerable difficulty. In the accompanying cut is shown an arrangement devised by C. O. Mailloux of New York, by which this trouble may be avoided. The motor frame is made in two parts, one of which is supported upon the car axle of the truck frame, while the other, upon which the armature rests, may be lowered with the armature, leaving the main portion of the motor undisturbed. The field magnet frame is also divided into two parts, the lower one being removed with the armature, leaving the upper portion in its usual position. In the cut *B* indicates the axle of the car and *C* the wheel fixed to the axle in the usual manner. *AA* represent the end plates or pieces of the field magnet frame for the electric motor. These end plates or pieces, mounted



THE MAILLOUX ELECTRIC MOTOR.

[illegible] one to the other, are provided with suitable journal-[illegible] for the armature shaft, and are mounted upon the car axle by sleeving the yoke pieces upon it. They are each made in two parts and are connected by the four parallel cross rods or bars which support the four field magnet pole pieces of the machine. The cross rods or [illegible] and are utilized as a part of the field magnet or field magnet circuit, in which case the field [illegible] upon the cross bars or rods [illegible] if [illegible] of magnetic yoke pieces.

D indicates the armature of the motor and *E* the armature shaft. D^2 indicates the commutator cylinder. There is a gear-wheel at D^3 which is employed as the first gearing for rotating the car axle by the armature. Each of the yoke or end pieces *A* is made in two parts, and each is provided with flanges *a* at the line of union, where the two parts may be secured by means of bolts.

The armature shaft of the machine is mounted in the end plates *AA* parallel to the car-axle, as shown, the journal bearings for the shaft being formed on or carried by the plates at or near the center, which is connected with the peripheral thicker portion of the end pieces by flanges *a* and by webs. These webs and the other parts forming the interior portion of the end pieces form a protection against injury to the armature at its ends. Each end plate *A* is enlarged to form a suitable oil box or cavity, and its upper portion is extended, as at *H*, to form a nose-piece, which may rest by a spring or other bearing upon a cross-bar of the truck frame in the manner usual in the art. At its opposite side it rests upon the top of the car-axle, while the lower part, which may be detached from the upper, is provided with a part of the sleeve surrounding the axle. The remaining portion of the sleeve is formed by the detachable cap, like a journal cap, which may be bolted to the parts of the sleeve or journal-bearing which surrounds the car-axle, and are carried by or formed upon the two portions of the bisected end plate *A*. When it is found necessary to remove the armature the car may be run over a pit and the bolts fastening the upper and lower parts of the frame *A* removed, when the lower portion can be lowered with the armature in place upon it, the upper portion resting upon the car-axle and the truck frame. The flanges *a a* are provided with a dowel or guide-pin and guide opening, as indicated, where the lower part may be guided into place when it is to be secured to the upper part. It is possible to attach the lower part of the yoke pieces with the armature shaft in place and fix them in position before applying the cap to complete the sleeve or journal bearing around the car-axle.

Working by Electric Light.

On Aug. 14th work was begun on the pipe laying of the Economic Fuel Gas company on Dearborn street, Chicago. Electric lights about seventy-five feet apart swung over the heads of the workmen and made the street almost as light as day. Stanchions of gas tubing fifteen feet in height were placed at either side of the ditch, the top of the supports coming together like a trestle, and upon these the electric light wire was strung. One end of the wire was then attached to the conductor in a conduit at Dearborn and Harrison streets. The men worked with even greater rapidity than in the daytime for the reason that it was cooler and they did not get tired so easily. The present force of men will be augmented by an additional 500. All of the work of the company north of Van Buren street will be done at night, as the traffic in daytime would be seriously obstructed.

Photochronograph.

The application of electricity to scientific researches and observations is attracting more attention than is generally supposed by those who are not entirely engaged in purely scientific occupations. The accompanying cuts illustrate a device in which the electrical arrangements form a unique feature. It is the invention of the Rev. George A. Fargis, S. J., assistant director of the Georgetown college observatory. The device is known as the protochronograph and is employed in astronomical obser-

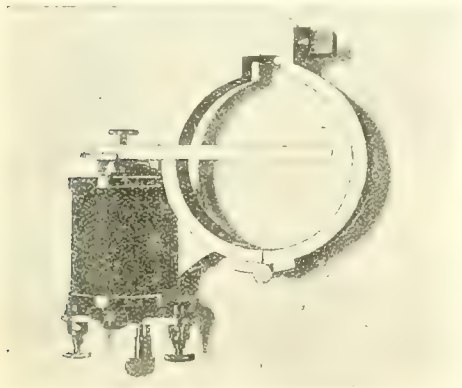


FIG. 1. THE PHOTOCHRONOGRAPH.

vations. For many years experiments have been made with the view of applying photography to this line of work, but there have been many difficulties experienced and but little progress has been reported. The chief defects in the systems heretofore applied have been found in the motion of the sensitive plate, the weight of the moving parts and the resulting uncertain rate of the battery, a photographic parallax, owing to the distance of the sensitive film from the wires and the partial obliteration of the star trail in photographing the wires. Of these serious drawbacks the motion of the plate proved the most troublesome. It was finally decided that the plate should not move and the invention of the occulting-bar followed

During the last year Prof. Fargis has been conducting a line of independent experiments at the observatory with which he is connected and these have resulted in the development of the photochronograph shown in the cuts.

The new apparatus shown in Fig. 1 consists of a strong brass collar, fitting closely to the sliding tube, just behind the collimating plate, by means of a hinge and screw-bolt. To this collar is attached a U-shaped soft iron core, with a coil on one of the arms. The naked part of the core is bent back and up, so as to act on the armature from behind. The end of the core is encircled with a thin ring of cork, to diminish the force of the armature stroke. The usual adjusting and connecting screws are conveniently placed. A strip of steel about two millimeters in width and two-tenths of a millimeter in thickness is soldered to

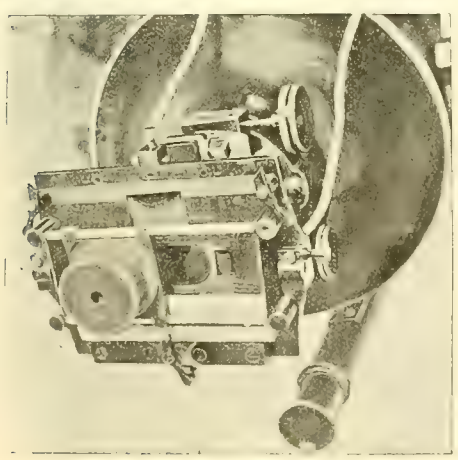


FIG. 3. THE PHOTOCHRONOGRAPH.

the armature at right angles to its line of motion. This is passed through the apertures in the side of the focusing tube intended for direct wire illumination, and stretches across the reticle. The coil, armature, and occulting-bar or shutter are so fixed to the collar that, when at rest, the lower edge of the shutter (clamp east and transit pointed south) is parallel to and a fraction of a millimeter above the horizontal diameter of the reticle. Fig. 2 shows its position on the transit.

The plate holder is merely part of the Ertel micrometer box. The outer plate, carrying the eye-piece, the one next it with the movable wire, and the micrometer screws were removed from the box, together with the set of beveled brass strips which formed the upper grooves, leaving only the plate containing the fixed wires and the one holding the collimating screws. To the outer surface of the latter are attached horizontally, immediately over and about eight millimeters from it, two parallel steel bars holding the eye-piece in a sliding frame so as to command a view of the whole reticle cavity, Fig. 3. The sensitive plate is inserted inside the parallel bars so as to rest flat against the reticle, and is held in place by a wedge of soft wood. When the wires are photographed by the object-glass illumination their images and that of the star are practically in the same focus, so that the thickening and displacement which constitute the photographic parallax are avoided.

For the necessary purpose of identifying the clamp side of the negative, an arbitrary mark, in the present case a minute drop of ink, is placed upon the reticle, on that side. This is printed on the negative when the wires are photographed, and the identification is complete.

Suppose, then, that connection be made with the sidereal clock relay, and that a star begins its transit. When the current is turned on, the shutter falls with the armature, cutting off the light of the star. At the break the shutter rises with the armature, uncovering the star for one tenth of a second, and dropping again as the current flows. Hence the negative shows a simple line of dots, each representing one-tenth of a second exposure. The clock contact may be changed so as to avoid breaking the contact at any time desired. Any second can, therefore, be readily identified. The oval blackened form shown in Fig. 4 is the glass reticle, photographed by the light of the object-glass, and the white band across the center is made by the shutter, which intercepts this light when the wires are being photographed thus preserving the star-trail from obliteration. This is accomplished by disconnecting the clock-relay and turning the current on directly to the apparatus. This holds the shutter down, right across the path just made by the star, completely protecting the photographed transit.

It might be urged that the armature stroke would impart a tremulous motion to the instrument, owing to the manner in which the apparatus is attachd to the focusing tube. But Prof. Fargis announces that the careful micrometric measurement of over 200 photographic transits shows no perceptible trace of any such error, and, if it were so, a very obvious arrangement would permit the application of this method, by a mere juxtaposition of the apparatus to the transit.

In this manner the objectionable features, which led to the rejection of the apparatus as at first constructed, would seem to be eliminated. The sensitive plate does not move from the beginning to the end of the operation, and, being securely wedged in against the reticle, there is little cause to fear photographic parallax. The extreme lightness of the occulting-bar and the simplicity of the armature movement, doing away with all transferrence of motion, reduces friction to a minimum, and makes the clock-beat and shutter movement practically synchronous. The complete protection of the star-trail against the illumination necessary for photographing the wires, as just described, is also a distinctive feature of this method. For these reasons, it may be conceded that the instrument described has a valid claim to the name of "photochronograph," since it actually registers on the sensitive plate the time of the transit of a star.

The battery is composed of four Daniell cells for the photochronograph and one for the sidereal clock-relay. An extra battery of four cells is in readiness in case the first

with three wires running under the floor from the switch-

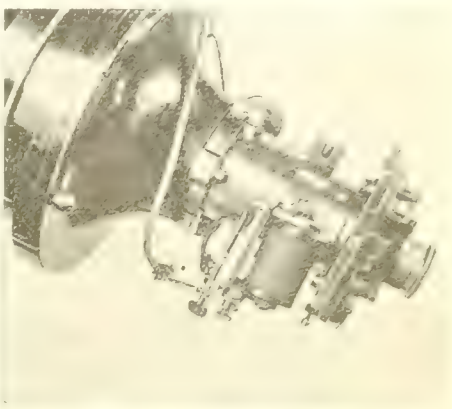


FIG. 2. THE PHOTOCHRONOGRAPH.

forming two loops at the command of the operator. The switch is conveniently situated near the transit pier, and so arranged that on one point the sidereal clock-relay and the photochronograph work as described; by the second the current is turned to the photochronograph alone, or by dropping the lever between the two points both currents are broken. This last is, of course, the usual position between the observations

The operation of the device is thus described by the inventor. The instrument is set on any star about to cross the meridian. The current is switched on to the sidereal clock, and an eye observation is made of the working of the photochronograph. This is of prime importance, excluding as it does all doubt as to its actual performance during the observations. No field illumination is used. By means of the sliding eye piece the eye of the observer takes the place, for the nonce, of the sensitive plate, and the working of the shutter is carefully observed. The star image, though blurred from being out of visual focus, is sufficiently distinct for the purpose. The successive appearances and disappearances of the star are regulated with the slow motion screw; care being taken that the appearance is unmistakable, the disappearance complete, and this for the whole course of the transit. This operation affords the observer a striking illustration of his personal equation. For the armature beat at the appearance and disappearance of the star enables him to appreciate the slowness of the retina in receiving and losing the star

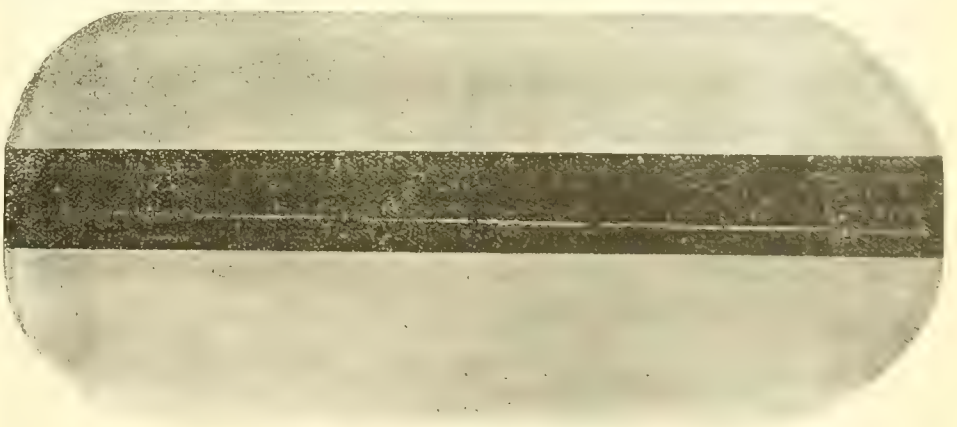


FIG. 4. THE PHOTOCHRONOGRAPH.

image; reminding him that the star is not seen where it actually is, but where it was [illegible] way of parenthesis. The shutter once [illegible] everything is supposed to be ready for a photographic [illegible]

The transit instrument is now set on the star and clamped. By means of the finder the star is [illegible] until by its position on the vertical wire, it is seen to be on the point of entering the field of the reticle. The current is then turned on at the switch, the [illegible] to the west side of the reticle, and with the [illegible] the star is adjusted to the armature edge of the [illegible]

for a one-tenth second exposure, and to the other edge, if a nine-tenth second exposure be desired. This settled, the plate is slipped in flat against the rettcle, the wedge pressed in between the back of the plate and the parallel bars, and the bag securely fastened.

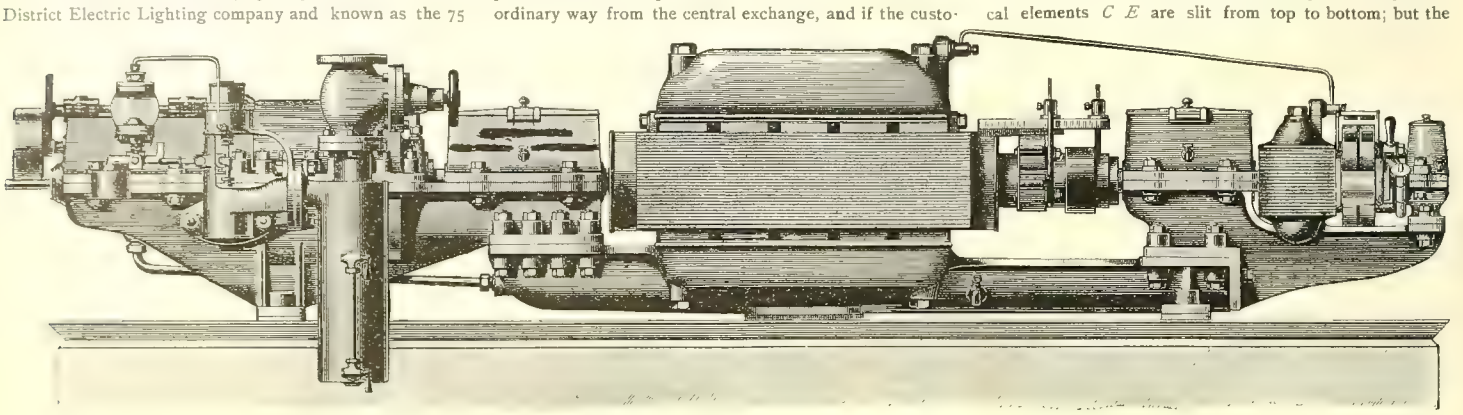
The time of passage across the reticle varies, of course, according to its size and the declination of the star. In the present instance an equatorial star takes four minutes to cross.

The transit over, the clock circuit is broken and the current turned on to the photochronograph alone. This brings the shutter down and protects the star trail while the wires are photographed. The transit instrument is unclamped, tilted to a convenient position, and a light is held to the object-glass. This done, the current is broken, the plate removed and placed in the box prepared for it.

It may be well to remark that the slight irregularity of star trail in the beginning of the transit, as shown by three or four of the dots in Fig. 4, is owing to the fact that the occulting bar was already in motion before the sensitive plate had been adjusted to the plate holder.

Parsons' Steam Turbine Dynamo.

In the accompanying illustration is shown an English steam turbine alternator employed by the Newcastle and District Electric Lighting company and known as the 75

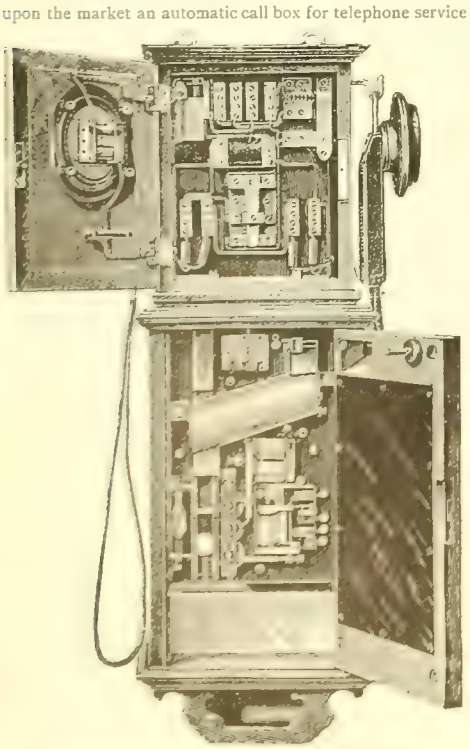


PARSONS' STEAM TURBINE DYNAMO.

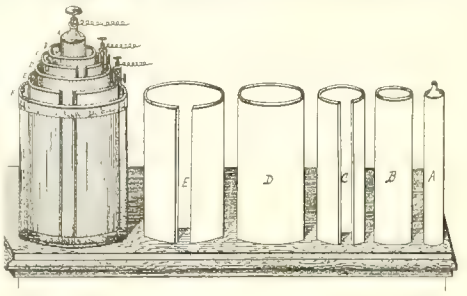
unit alternator. These machines are made to operate at 5 000 revolutions per minute. Four machines are now employed and the demand for electric light has been so great that the station is being enlarged after eighteen months' operation. The capacity of the plant will be 10,500 ten candle power lamps. The cut is reproduced from *Electric Plant.*

Automatic Pay Call Box for Telephones.

A Berlin manufacturer announces his readiness to place upon the market an automatic call box for telephone service



through the usual arrangement for testing with regard to diameter, thickness and weight and it will then pass to a pair of grooves, which are movable upon a hinge. Here its progress is arrested by the upper of three wheel segments, which, protruding into the side of the grooves, and actuated by the armature, of an



THE POUDROUX BATTERY.

electro-magnet, form a check arrangement. Just before reaching this point, the coin has pressed a small projecting lever, thus making contact and allowing the bell to be rung when the black knob in front of the telephone instrument is pressed. The call is answered in the ordinary way from the central exchange, and if the customer is informed that for any reason the required communication cannot be obtained, he has only to press the white stud, when the movable grooves, are thrown forward, releasing the coin from the check arrangement, and allowing it to fall to the refunding box. Should, however, the desired connection be made at the exchange, the current passes through the magnet, attracting the armature with a force sufficient to overcome that exerted by the spring. The coin thereupon falls to the fixed pair of grooves, and is arrested by the segment.

Here it remains until the signal at close of conversation is given, when it is again released by the magnet, and allowed to fall into the cash box, pressing *en route* a second lever, which, being connected diagonally with replaces it, and at the same time breaks the contact. This lever is of such a length that a coin passing to the refunding box presses it, replacing it and breaking contact as if at close of a conversation.

Should, however, the closing signal be omitted, it is obvious that the coin will remain at the grooves. In order to prevent loss from this cause a lever, connected at one end to the armature and terminated at the other by a small roller projecting into the slot, is provided. By this means the armature is moved, as if electrically, upon insertion of the next coin, and the one remaining in the instrument has fallen into the cash box before the other has passed through the testing arrangement. The cut is reproduced from the London *Electrical* [illegible].

Underground Conductors in Paris.

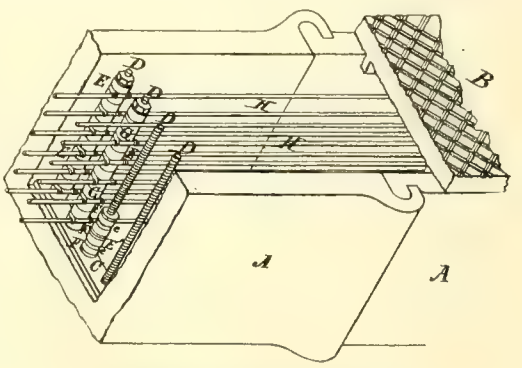
A brief description of the underground system for electric lighting in Paris was presented in the WESTERN ELECTRICIAN of Aug. 8th. The method of arranging the wires in the conduit, which was illustrated and described, appeared to be the principal feature of the system. An American inventor, W. E. Banta, of Springfield, O., [illegible] the system as his invention, and in support of this a [illegible] patents granted him June 27, 1882, and May 19, 1885. A drawing forming part of the specifications in the former patent is reproduced herewith, showing the same general appearance of the subway and method of [illegible] the wires on posts, as that employed in Paris. In the letters patent granted Mr. Banta, the system employed in Paris is described in detail. The application for the patent was filed Nov. 2, 1881.

Poudroux Battery.

Flavien Poudroux of Paris claims to have "solved the long-existing problem of a substitute for dynamos in electric lighting by providing a cheap, inodorous, inoffensive electric battery capable of supplying light enough for domestic uses." In the accompanying illustration a view of the battery and duplicate parts is shown. Mr. Poudroux claims that by the construction of this battery he is enabled to employ a great surface of zinc in a cell of moderate capacity containing little liquid. The ingredients of the solutions, he adds, are very cheap. One charging of the battery will suffice to fit it for working at least one hundred and eighty hours, excepting the liquid within the cell *D*, which should be renewed every thirty hours.

The battery is thus described: *A* is a carbon cylinder, which forms the center of the battery, to which a wire is attached; *B*, a porous cell or partition surrounding the cylinder *C*, a hollow cylinder of zinc similarly surrounding the cell or partition and having a wire attached to it; *D*, a porous vase or partition in like manner surrounding said hollow cylinder *C*; *E*, a hollow carbon cylinder having a wire attachment and also surrounding the cell or partition *C*; and *F*, the external glass vase or jar which surrounds the carbon cylinder *E*, and being provided with a bottom contains the operative parts of the battery. The cylindrical elements *C E* are slit from top to bottom; but the cylindrical cells or partitions *B D* are left with solid walls.

The space between carbon element *A* and partition *B* contains a depolarizing aqueous solution consisting of azotate of potash, binoxide of manganese, bichromate of soda and sulphuric acid in the proportions, by weight, in the order named, of two-twentieths, one-twentieth, three-twentieths, and two-twentieths of the water employed. In the space immediately surrounding the zinc element *C* and within the cell or partition *D* is a liquid excitant consisting



UNDERGROUND CONDUCTORS IN PARIS.

of an aqueous solution three parts, by weight, of chlorhydrate of ammonia and two of azotate of potash to twenty parts of water employed. In the space surrounding the carbon cylinder *E* is another depolarizing solution of bichromate of soda acidulated by one-tenth of its weight of sulphuric acid.

In addition to the advantages noted, the inventor of this battery claims that it "creates in each element two distinct and constant currents, which are utilized in giving an energy hitherto unknown."

An electric plant intended to supply 4,000 incandescent lamps is being installed at Alicante, Spain. Power will be given by Otto gas engines supplied with Dowson gas. This is the first instance in Spain of a large power being produced by gas engines, the gas being made in the neighborhood of the engines. It seems probable that the use of gas engines will increase, especially at Madrid, as smoke abatement has now become an important question in that city.

Electric System of the Buffalo Street Railway Company.

One cannot but be impressed, after a visit to the station of the Buffalo electric street railway, with the idea that if all electric roads were built and equipped as this has been there would be no opposition to, but rather a universal sentiment in favor of, electrical power in street car work.

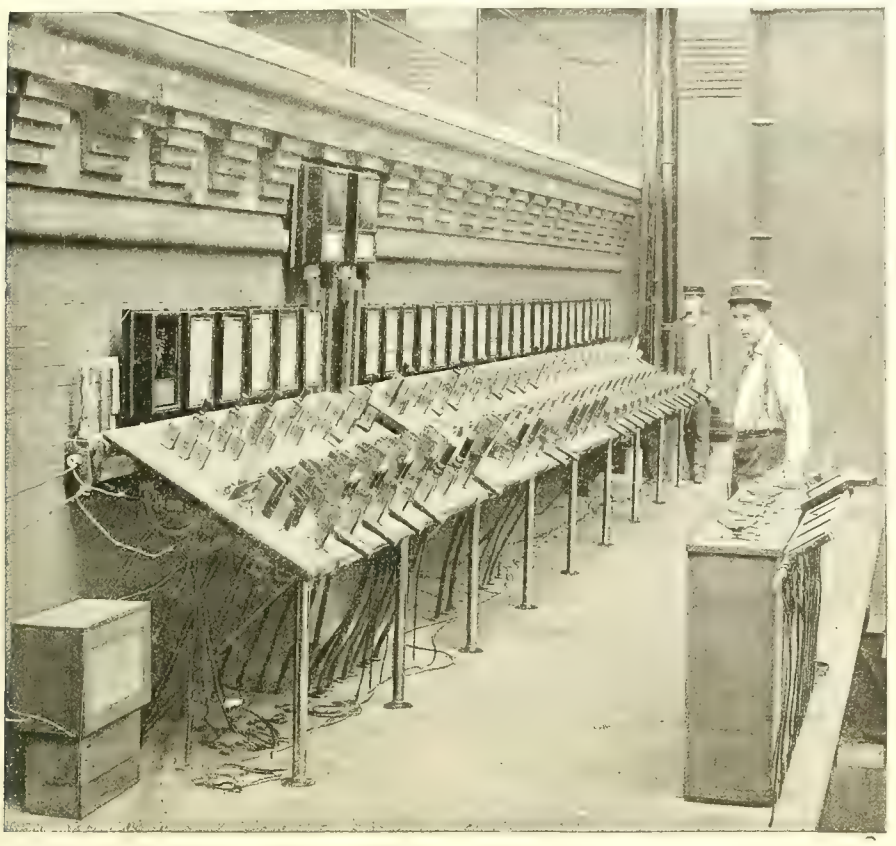


FIG. 2. ELECTRIC SYSTEM OF THE BUFFALO STREET RAILWAY COMPANY.

On July 1st the cars on the first line of the converted system of the company were started. This portion of the system included the Niagara street and Forest avenue lines. It was the first sixteen miles out of one hundred miles which are being equipped electrically, but about forty miles of the system are expected to be in operation during this season.

The Buffalo railway system is owned by a syndicate which controls the largest amount of street railway property in the country, including lines in Newark, Paterson, Rochester, Pittsburg, Louisville and other places.

The power station, interior views of which are shown herewith, is one of the largest in the country, and will, when completed, have a capacity of about 5,500 horse power.

The present installation, Fig. 1, consists of three engines of 250 horse power each, made by the Ball Engine Co., Erie, Pa., and two vertical compound engines of 500 horse power each, built by the Lake Erie Engineering Works, Buffalo. The last mentioned engines are improved forms designed to occupy the field between the Corliss and high speed engines. They are especially constructed for direct belting or direct shaft connection. The large engines are each to drive two 200 horse power Edison generators, and the smaller ones one each. The boilers are the Babcock & Wilson sectional water tube type set in two batteries of two each. Everything is arranged in duplicate, to provide as far as possible against any break-down. The power room is 86x140 feet, with an iron truss roof spanning the whole. There is provided a ten-ton traveling crane for handling the engines and dynamos. This is operated either by hand or electric motor.

The switch-board, as will be seen from Fig. 2, is one of the most complete that has ever been introduced for railway work. It has several novel features. On the front of the gallery will be seen the regulator boxes for controlling the dynamos. In the rear is located the dynamo switch-board proper carrying the switches, ampere meters and main bus ampere meters. Further along on the back are the feeder switches and feeder ampere meters, each feeder having a separate switch and meter. A particular feature of this switch-board is the use of two "bus lines," so that two different pressures may be had if it is desired to distribute to the lines of a territory with outlying districts. As this station feeds a radius of seven or eight miles the value of this arrangement will be understood. All feeders from the station are underground cables laid in conduits. The local distribution to the trolley wire is, of course, overhead, the underground system.

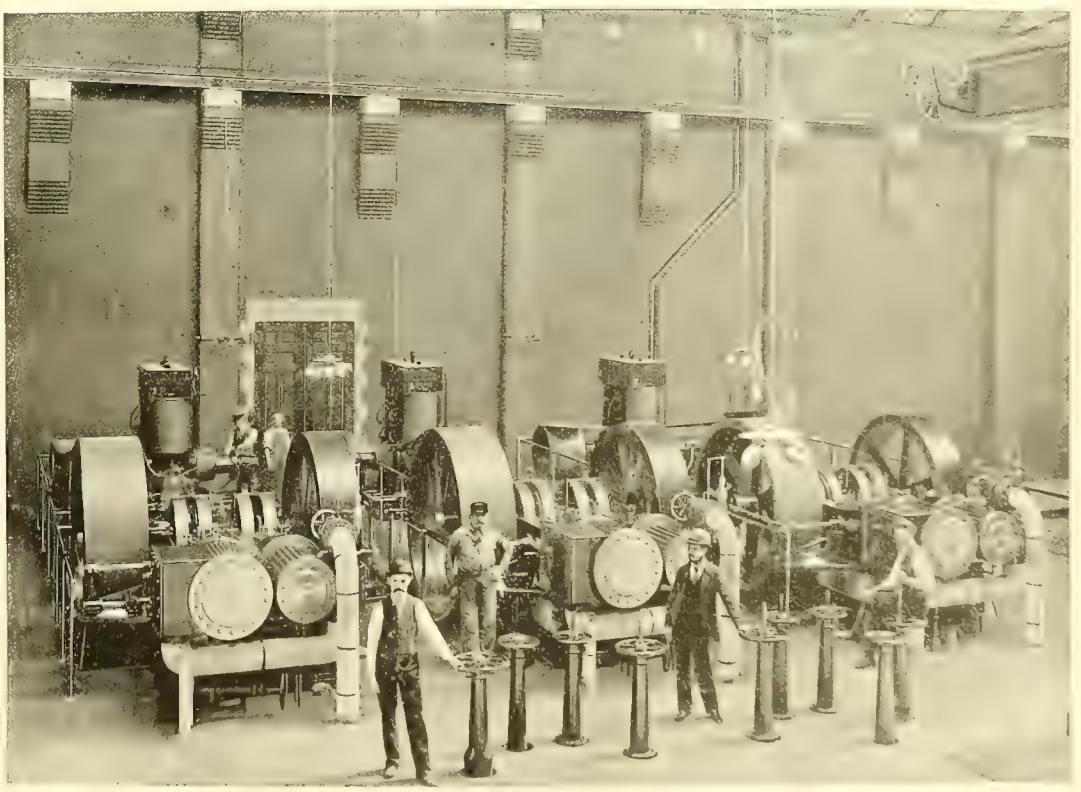


FIG. 1. ELECTRIC SYSTEM OF THE BUFFALO STREET RAILWAY COMPANY.

line.

The cars, as already stated, were first started on July 1st, after a trial the evening before, and have operated successfully since. [illegible] fifty cars on this [illegible] operation. The system will be extended until it comprises about [illegible] miles of [illegible] intention is to equip the entire system with electric motors as rapidly as possible.

The Field Engineering [illegible] engineer and electrician for the Buffalo system, as well as that in Newark and Paterson. The work at Buffalo is in charge of Engineer J. B. Craven, who has been very energetic in pushing the construction in all its numerous details. The planning of the system was done at the New York office of the Field company, under the direction of the engineering staff, C. J. Field, E. F. White, E. J. Cook and F. Beurre.

The officers of the Buffalo Railway company are Henry A. Watson, president; H. M. Littell, vice-president and general manager; Edward Edwards, general superintendent. The cuts showing the dynamo and engine equipment and the switch-board are taken from the *Street Railway Journal*.

A Key-Hole Circuit.

In a United Press dispatch dated at Hartford, Conn., is given the following account of the alleged misdeeds of a street railway electrician: "George A. Waddell, of New York, was recently employed as electrician by the H. & W. street railway. He did not get along well with Superintendent Shepard. Last week Waddell built a room about twelve feet square in the car house and put up a sign to the effect that this was his laboratory, and the superintendent was ordered to keep out of the room, as well as everyone else. Mr. Shepard had a key to the room. On Saturday afternoon Mr. Barrett, of the Barrett Storage company, heard Waddell say to a man that if the superintendent tried to get into his room again he'd get something he wouldn't like. Mr. Barrett made an investigation and found that Waddell had rigged up a [illegible] circuit through the keyhole of the door, so that as soon as a key was inserted the person [illegible] would receive a shock of 500 volts. Waddell asserted that he meant no serious injury. He was discharged and has left the city."

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

[illegible] A. KREIDLER, - - Editor and Publisher.
[illegible] O'HARA, } Associate Editors.
[illegible] L. PERRY,
W. E. KE[illegible]Y, }
[illegible] BAKER, - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK

W. [illegible] OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3 [illegible] for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—The WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. **Electrical merchants and manufacturers** ***desiring Western trade*** will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Electric Plant at [illegible] Wire Works, Trenton, N. J. Illustrated ... 100
Electricity at the World's Fair ... 1[illegible]
The [illegible] Electric Motor. Illustrated ... 100
[illegible] Electric Light ... 10[illegible]
The P[illegible]. Illustrated ... 101, 102
[illegible] Steam Turbine Dynamo. Illustrated ... 1[illegible]
A[illegible] Pay Call B[illegible] for Telephones. Illustrated ... 1[illegible]
Underground Conductors in Paris. Illustrated ... 102
The P[illegible] Battery. Illustrated ... 102
[illegible] System of the [illegible] Street Railway Company. Illustrated ... 103
[illegible] ... 104
Interesting Motor Installation. Illustrated ... 10[illegible]
The Montreal Convention ... 105
[illegible] Electric Elevator. Illustrated ... 10[illegible]
[illegible] Crystal Palace ... 1[illegible]
[illegible] Lamp Hanger. Illustrated ... 1[illegible]
Convention of the Association of Edison Illuminating Companies, New York City ... 1[illegible], 107
[illegible]. Illustrated ... 10[illegible]
[illegible] Convention ... 1[illegible]
[illegible] Ocean Steamer. Illustrated ... 107
[illegible] Convention ... 1[illegible], 1[illegible], 1[illegible]
[illegible] Electrical Exhibition ... 10[illegible]

DEPARTMENTS.

[illegible] ... 1[illegible], 110
New [illegible] ... 111
[illegible] ... 111
[illegible] ... 111
[illegible] ... 111
[illegible] ... 111
[illegible] ... 111
[illegible] ... 111
[illegible] ... [illegible]
[illegible] ... 112

[illegible] last week was [illegible] interesting topics were [illegible] for presentation. The Edison [illegible] closed doors, [illegible] reports of the proceedings to the electrical papers from the official stenographer's minutes. This year, however, the report was withheld for the [illegible]

WHEN a temporary committee, organized for the pur[illegible] its correspondence, we may expect that all its work of [illegible]

is entirely correct. The Canadians are outdoing themselves to show every attention to the visitors, and the members of the association should show their appreciation of these graceful attentions by making the convention the largest and most successful in the history of the organization.

AN exchange calls attention to the fact that the question of securing rapid transit for New York is being handled in a unique manner by the daily papers of New York city. The *Sun*, for instance, which is supposed "to shine for all," dwells on every trivial accident connected with the underground system of London and passes lightly those which occur on the "L" roads in Gotham. The *Sun* is certainly outspoken in its opposition to the underground system, but its present policy is nevertheless at variance with its position on other subjects, where its fearlessness has won the admiration and respect of its bitterest foes.

REPORTS from the Frankfort electrical exhibition indicate that American interests are rather scantily represented. This is undoubtedly due to a great extent to the fact that the electrical fraternity in this country is husbanding its resources for the World's Fair in 1893 when it intends to put its best foot forward in handsome fashion. This does not prevent a hearty interest in the German exhibition, however, nor a cordial desire to see it completely successful. The outcome of the experiment in long distance transmission, especially, is awaited with the confident expectation that it will materially contribute to the development of this important branch of electrical science.

A NOVEL method of displaying exhibits has been adopted by the committee of the American Street Railway association for the Pittsburg convention. It has been decided to arrange the exhibits on a double-deck excursion boat moved to the wharf near the headquarters of the convention. The last convention of this association was devoted largely to the consideration of electrical matters and was in a large measure an electrical convention. This year it is anticipated the electrical interests will assume even more prominence, and the displays will be more elaborate. There will be ample opportunity to examine the operation of the several systems of electric railways and compare them with the cable system.

ONLY a short time ago the WESTERN ELECTRICIAN published an account of the manner in which a hose-cart was whisked to a fire in a Chicago suburb by being atttached to an electric car. Out in Omaha electricity has been put to even a queerer use as a motive power. A house was being moved along a street in which the tracks of the electric line were laid, and in order to get it out of the way as soon as possible the superintendent of the road made fast an electric car to the building at night and hauled it comfortably to the top of a hill which had proved a formidable obstacle. The spectacle presented by a house pursuing its ponderous course on rollers, in tow of an electric car, must have been very droll, but the practical aspect of the incident will commend itself at once to all who have been subjected to the annoying street blockades caused by these tortoise-like obstructions.

RECENTLY the announcement was made that the electric lighting companies of Minneapolis would soon place their wires under ground. The telegraph companies were also expected to bury their cables, but it was feared that they would refuse to do so until the other companies complied with the city ordinance relating to this matter. In fact, a prominent official of the Western Union company was reported as expressing the opinion that the telegraph companies would consider the matter when the electric light and railway companies had taken steps to comply with the law. Now, however, the statement is made that the Western Union company will voluntarily bury its wires and that it will go about the work at once and push it to a speedy completion. The announcement has been received with much favor in Minneapolis. That city will soon have the distinction of having more underground work proportionately than any other city in the country. It has already gained distinction from the fact that it has one of the most complete as well as extensive electric railway companies in [illegible] gain fresh laurels in the electrical world.

[illegible] Columbian Exposition reached an interesting point during the last week. Chief Engineer [illegible] owing to a difference of [illegible] Work was temporarily discontinued on Mr. Gottlieb's retirement and it is understood that several important changes will have to be made in the plans. It is certainly to be regretted that there has been so much friction between the several departments of the exposition, and the present instance has served to bring the matters prominently before the public. The directors and commissioners have been obliged to take action in the matter. The dispute between the chief of the construction department and the chiefs of the departments of electricity and machinery was the topic discussed at a meeting last Monday. The result was practically a victory for the latter, as their claims for recognition in the matter of introducing apparatus were recognized. It is to be hoped that the heads of departments will be able to reach a satisfactory arrangement with Chief Burnham, but it is also to be hoped that they will not sacrifice the interest of their departments to the whims of the construction department. They should be the best judges of the machinery to be installed, and their approval of all apparatus and machinery employed should be demanded.

THE disposition of fire engineers to gain information as to the best manner of handling wires conveying electric currents, shown at the national convention of fire engineers held in Springfield, Mass., last week, is entirely commendable. Electric companies are often subjected to needless expense and annoyance by the over zealous haste of firemen, who, it must be confessed, have usually a decided antipathy to electric wires. The electrical companies are willing to sacrifice their property promptly at any time when the public safety demands it; but in many cases, at fires, the wholesale cutting of wires is unnecessary, or at least can be deferred until a competent lineman can be sent for. Were fire engineers generally better acquainted with the fundamental principles of the commericial applications of electricity, excesses of this kind would occur rarely. In the case of fires arising from badly insulated wires, too, knowledge of this character would greatly aid the firemen in intelligently subduing the flames. Mr. Brophy is entitled to credit for his endeavor to diffuse useful information about electricity among firemen. He is severe, but to no greater extent than he should be, on defective insulation. His suggestion that persons reponsible for bad work should be held criminally responsible is interesting. If it could be impartially enforced, a law of this kind would undoubtedly have a salutary effect; but it is not difficult to foresee that many hindrances to its application would arise. For one thing, it would be no easy task to obtain competent inspectors at the salaries that cities would be willing to pay, and when large salaries were provided the offices would generally be filled by political parasites.

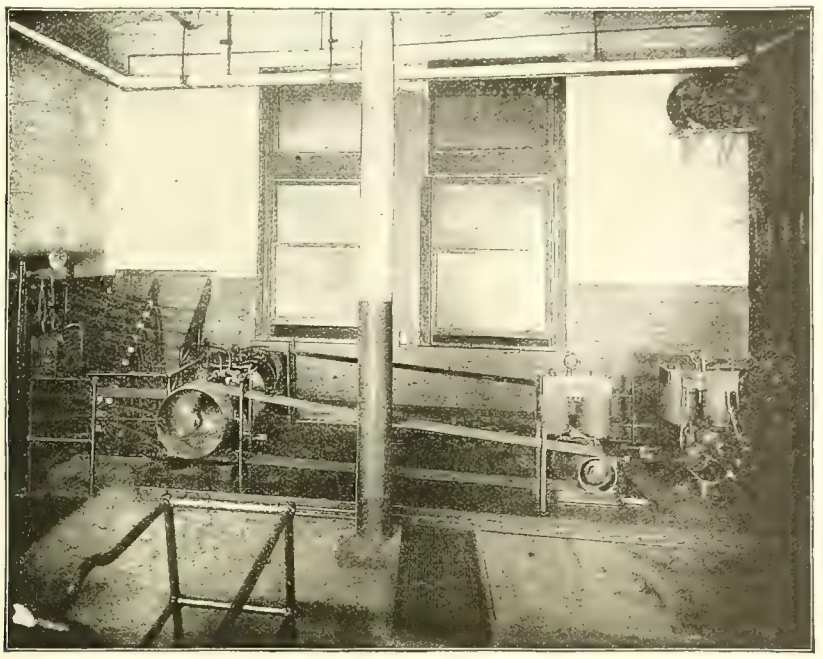
THE stirring days of the rebellion are vividly brought to mind as one reads the highly interesting address of W. R. Plum, president of the Society of United States Military Telegraphers, delivered at Washington, August 19th. The tributes to this important branch of the service have been numerous and hearty, and its usefulness is best summed up in the terse statement that during the war it constructed 15,389 miles of military telegraph lines, and sent 6,500 000 telegrams. Very many of the latter were of the utmost importance, and were transmitted under the most trying circumstances. Many stories of the courage and fidelity of the war-time telegraphers have been told to the admiration of thousands, but a far greater number of acts of real heroism and patriotism on the part of comparatively unknown operators have never been brought to public notice. The survivors of this honorable corps have just cause to take pride in their record, and they may rejoice in the assurance that their countrymen, recognizing the value of their services, will wish that the future of their organization may be as pleasant as the past has been useful and distinguished.

The telegraphers desire recognition as a component part of the army, and their claim seems to be a just one, and has been so held by nearly all of the leading Union generals. It is no half-hearted concession that the veterans seek, and should have. They desire certificates of honorable discharges from the army, such as will enable them to enter Grand Army posts. As Mr. Plum observes: "If it was justice to make officers of those in command of us, and honorably discharge them with increased rank, three months' extra pay and transportation home, while we who bore all of the casualities of the service, except in Captain Bruch's case, were dropped from the rolls at our posts of duty unhonored and unthanked, the query arises. Why, in times of peace, has our own government since established the military telegraph service as a coordinate branch of the army, and why has every civilized government on the globe done the same thing?"

We hope the telegraphers will succeed in obtaining long-deferred justice.

Interesting Motor Installation.

In the accompanying cut is shown a novel motor installation at one of the stations of the Edison Electric Illuminating company, Brooklyn. The plant consists of a 50 horse power C. & C. electric motor with two No 6 Edison dynamos. These are utilized to raise the voltage of the feeders in place of running the large station unit on the necessarily light load. The total efficiency of the entire plant taken on a run of twenty-four hours at full load, it is claimed, is something over 80 per cent. The plant is kept in operation day and night, as the dynamos are carrying a full load of 500 lights during the night and in the daytime are furnishing current to C. & C. electric motors ranging in size from 25 horse power downward.



INTERESTING MOTOR INSTALLATION.

The Montreal Convention.

The programme of the National Electric Light association convention has been nearly completed. The daily sessions of the convention will be from 10 A. M. until 2 P. M.

On the 8th of September the reports of the following named committees will be read and discussed: Committee on relations of manufacturing and central station companies, committee on data, committee on World's Columbian Exposition, committee on legislation, committee on underground conduits and conductors, committee on safe wiring.

On the 9th of September papers will be read and discussed as follows: Discussion of T. Carpenter Smith's paper, read at the Providence convention, on the "Distribution and Care of Alternating Currents;" W. C. Warner, "Various Forms of Carbons for Use in Arc Lamps;" Capt. Eugene Griffin, "Three Years' Deve'opments of Electric Railways;" H. Ward Leonard, "A Central Station Combining the Advantages of Both Continuous and Alternating Current Systems."

On the 10th of September there will be the reading and discussion of the following named papers: J. I Ayer, "Some Details of the Care and Management of an Arc Lighting Station as Practiced in the 'Municipal' of St. Louis;" C. J. Field, subject to be announced; George A. Redman, "Central Station Lighting by Water Power;" J. J. Burleigh, "Uniformity of Method in Keeping Central Station Accounts." An executive session will be held to elect three new members of the executive committee and to name the place of the next meeting.

Following is the programme arranged for the entertainment of the visitors by the citizens' executive committee of Montreal:

Monday, September 7th—3 P. M., opening proceedings of the convention in the Windsor hotel, address of welcome by the mayor and other distinguished members of the reception committee; 8 P. M., formal opening of the exhibition by his excellency, the governor-general.

Tuesday, September 8th—2:30 P. M., drive through the city and around the mountain; 8 to 11:30 P. M., conversazione at Redpath museum, Molson hall, McGill college.

Wednesday September 9th—2:30 P. M., fire department disp'ay on Champs de Mars; 5 to 7 P. M., garden parties; 8 P. M., banquet at the Windsor hotel.

Thursday, September 10th—2:30 P. M., through the kindness of the harbor commissioners, trip by boat down the St. Lawrence and the Lachine Rapids, stopping at the way at Caughnawaga, 5 to 7 P. M., garden parties.

Friday, September 11th—3 P. M., lacrosse match. In the evening promenade concert at Sohmer Park, through the courtesy of Messrs. Lavigne and Lajoie.

Saturday, September 12th—7 A. M., excursion to Ottawa at reduced rates.

C. H. Barney of New York has been appointed general manager of the exhibition to be held in Montreal September 7th to 16th, inclusive, in connection with the National Electric Light convention Mr. Barney is now in Montreal arranging for the display. Nearly all of the space has been apportioned, but a few desirable locations are still left.

The Windsor hotel has been selected as the headquarters of the delegates, and the meetings of the association will be held in the spacious assembly room of the hotel. Rates for room and board at the Windsor will be from $3 50 to $5 per day; at St. Lawrence hall, from $2.50 to $4 per day. A rate of a fare and one-third, on the certificate plan, has been obtained on all railroads. Special rates of freight have been granted by the Canadian railway companies, by which exhibitors will be required to pay for one way only, provided the goods remain the property of the original owner.

A yachting trip up the Richelieu river, from Iberville to the Isle Aux Noix, has been arranged for the ladies.

The Frisbie Electric Elevator.

[illegible] on the machine which enables the car to be run at full speed and yet be stopped automatically at the end of the run. A slack cable stop, in the event of the car meeting any obstruction in its descent, engages a clutch on the end of the drum shaft, stopping the machine instantly and locking it so that the car can make no further descent.

In the event of the current being cut off for any reason while the car is descending with a [illegible] governor on the machine, operated by reason of the centrifugal force, throws out a friction clutch and puts on a powerful brake which stops the machine instantly. The motor embodied in the Frisbie electric mechanism is one of the C. & C. Electric Motor company's make, and is fitted with self-oiling bearings and carbon brushes. These machines can be run at a high rate of speed and yet the car can be started and stopped very smoothly.

The D. Frisbie Company of New Haven, Conn., [illegible] New York city is the manufacturer.

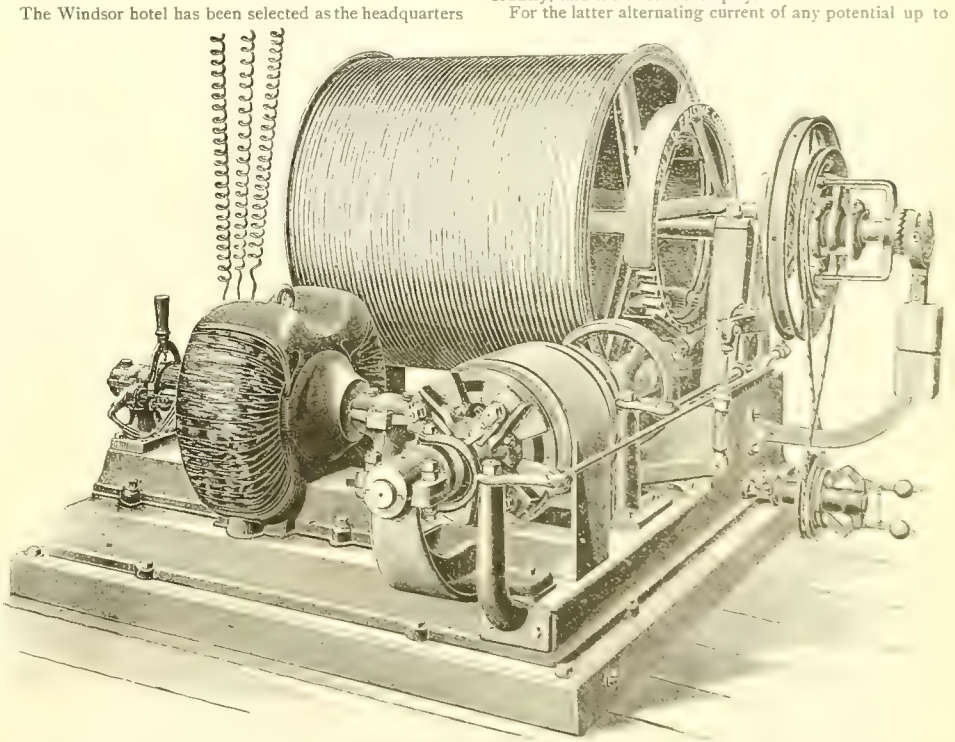
Electricity at the Sioux City Corn Palace.

The electrical display and electric lighting were among the main attractions in the Corn Palace at Sioux City last year, and both will be on a more extensive scale this year, it is promised.

The building will be 380 feet long and 200 feet high, with daylight entirely shut out. About 3,000 incandescents and 50 arcs will be used for lighting and decorating.

The two leading attractions this year will be a South American exhibit, in charge of representatives of each country, and the electrical display.

For the latter alternating current of any potential up to 1,000 volts, direct constant potential up to [illegible] volts and eight amperes can be obtained.



THE FRISBIE ELECTRIC ELEVATOR.

Last year the model electric [illegible] was played, except the ten horse power [illegible] This year desirable exhibits from [illegible] be displayed, and unless sold [illegible] Sioux City Electrical Supply company, which has charge of all the electrical work. The [illegible] festival continues for seventeen days.

The Edison General Electric company has [illegible] an isolated plant having a capacity [illegible] First Minneapolis Hospital for the Insane, [illegible] St. Peter, Minn.

Arc Lamp Hanger.

The cuts represent the action of the Paddock safety arc [illegible] upon the market by the Central Electric company of Chicago. This hanger is simple in construction. It prevents the falling of lamps and all attendant dangers and expenses by reason of insecure fastening, or the breaking of ropes. Combined with the hanger is a sleet proof pulley.

Convention of the Association of Edison Illuminating Companies, New York City.

[illegible] the metropolis at a point where one fears to glance at the scale and the humidity immeasurable, except perhaps by comparison with vapor off the lakes in that region only referred to by those profanely inclined. the Edison people began their midsummer convention in New York at the Murray Hill hotel last Tuesday.

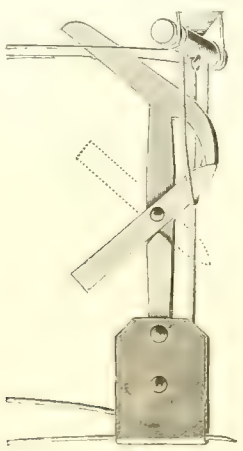
Like the Edison convention, held heretofore, this meeting was conducted behind closed doors. This convention is the seventh thus far held by the association. Tuesday, August 11th, was the day appointed by the executive committee for the opening of the convention, and 10 A. M. found a goodly number of the members assembled for the work of the first session. Among those present the first day were the following named prominent Edison men:

Edison General Electric company, J. Hobart Herrick, vice-president; E. H. Johnson, director, and L. Stieringer.

Lamp manufacturing department, Wilson S. Howell, inspector; Francis E. Jackson, inspector.

Light, power and intelligence departments, H. Ward Leonard, general manager

Legal department, W. J. Jenks, E. W. Hammer, W. H. Lauman.



ARC LAMP HANGER.

Eastern district department, Chas. D. Shain, district manager.

Southern district department, A. H. Reece, district manager.

Official stenographer, W. J. Sullivan.

Edison laboratory, A. E. Kennelly.

Engineering department: G. D W. Williamson, A. E. Winchester, J. H. Vail, assistant engineer-in-chief; W. S. Andrews, technical assistant.

Samuel Insull, second vice-president; J. P. Ord, comptroller; S Dana Greene, assistant to second vice-president; Morris Slattery, agent southern district; F. R. Upton, general manager lamp manufacturing department; Sidney [illegible] manager New England district; W. S. [illegible] engineering department, W. T. M. Mottram, assistant to district manager south district; S. A. [illegible]

Edison Electric Illuminating company, Philadelphia, [illegible] and general man-

[illegible] Paterson, N. J.,

[illegible]

[illegible]

[illegible]

[illegible]

Edison Electric Illuminating company of Brooklyn, N. Y., C. E. Chinnock, director; W. D. Barstow, general superintendent.

Edison Electric Illuminating company of Boston, Mass., Walter C. Baylies, vice-president; C. L. Edgar, general manager; W. A. Hill, cashier; Chas. E. Pattison.

Harrisburg Electric Light company, Harrisburg, Pa., John I. Beggs, director; W. R. Fitzpatrick, superintendent and electrician.

Edison Electric Illuminating company of Detroit, Mich., C. P. Gilbert, secretary and manager; Hoyt Post, attorney; Barton L Peck, motor inspector.

Grand Rapids Edison Light & Fuel Gas company, Grand Rapids, Mich., A. F Walker, superintendent; T. C. Harnish, constructor.

Appleton Edison Light company, Appleton, Wis, A. L. Smith, president

Consolidated Electric Light company, Birmingham, Ala., Leigh Carroll, secretary and general manager.

Des Moines Edison Light company, Des Moines, Ia., J. A. Colby, director, secretary and manager.

Columbus Edison Electric Light company, Columbus, O., A. W. Field, secretary and manager.

Edison Electric Light & Power company, St. Paul, Minn., Geo. H. Finn, secretary and treasurer.

Edison Electric Illuminating company, Lawrence, Mass., W. H. Wolvekamp, electrician.

Edison Electric Illuminating company, Topeka, Kan., W. W. King, superintendent.

Edison Electric Illuminating company, Westchester, Pa., Maurice Hoopes, superintendent

Edison Electric Light & Power company, Kansas City, Mo., W. Preston Hix, director.

Tiffin Edison Electric Illuminating company, Tiffin, O., A. Kaup, manager.

Edison Electric Light & Power company, Little Rock, Ark., G H Van Etten, president.

Elgin City Railway company, Elgin, Ill., C. Wustenfeld, manager.

Scranton Illuminating Heat & Power company, Scranton, Pa, J. E. Parrish, superintendent.

Wilmington City Electric company, Wilmington, Del., C. Regi ald Van Trump, general superintendent and manager.

Toronto Incandescent Electric Light company, Toronto Canada, Frederick Nicholls, manager and secretary.

Renovo Electric Light, Heat & Power company, Renovo Pa, J. H. Sheddy, general manager.

Forest City Electric Light & Power company, Rockford, Ill, M. A Beal, secretary, treasurer and manager.

Mt. Holly Electric Light & Power company, Mt. Holly, N J., J. L. Jamison, superintendent and treasurer.

Edison Electric Illuminating company, Rochester, N. Y., H. L. Brewster, secretary.

Edison Electric Illuminating company, Amsterdam, N. Y., J. H. McClement, vice-president; H. K. McCoy, general manager; T. D. Mosscrop, secretary and treasurer.

Winston-Salem Railway & Electric company, Salem, N. C., J. H. McClement, president; H. S. Cooper, general manager.

Edison Electric Illuminating company, Hazelton, Pa., J. Edwin Giles, manager.

Edison Electric Illuminating company, New Orleans, La., Wm. Oswald, director.

A perusal of the above list of members shows that there were present representatives from a large number of Edison illuminating companies from all over the country, in addition to those sent by the Edison General Electric company and also by Mr. Edison.

The business of the morning was begun with the examination of the delegates' credentials. The convention proper was then formally opened with an address by the president of the association, John I. Beggs of Chicago. Mr. Beggs was followed by A. E. Kennelly of the Edison laboratory, who read the reports of committees on "Grounding the Neutral Wire on Three Wire Systems," and on "Lightning Protection."

A report on "Dangers to Edison Circuits from Crosses with High Potential Conductors," prepared by C. P. Gilbert of Detroit, Mich., was next read by H. Ward Leonard.

A free discussion of these topics followed, in which the convention extended the privileges of a portion of its session to A S. Hibbard, general superintendent of the American Telephone & Telegraph company, and John J. Carty, electrician of the Metropolitan Telephone & Telegraph company.

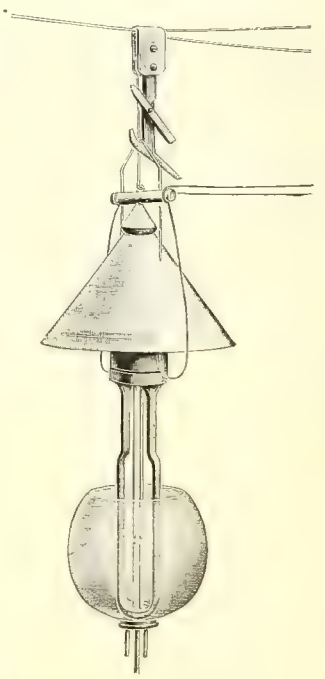
On the reassembling of the members for the afternoon session at 2:30 P. M., the delegates received an invitation from the New York Edison Illuminating company to visit its various stations now in operation, and also the new Elm street station which is in process of construction.

The next feature of the programme was another instance of the New Yorkers' hospitality, for sunset found the delegates seated at the open air tables at the Brighton Beach hotel forgetful of volts and amperes and still under the care of the New York Edison Illuminating company.

[illegible] meeting of the association was called to order promptly at 10 A. M. by President John I. Beggs. The morning was occupied in the discussion of A. E. Kennelly's report on the "Grounding of the Neutral Wire in Three Wire Systems," which was read the day before. [illegible] on of Mr. Kennelly's topic was followed by a [illegible] Prof. Wm. D. Marks, superintending engineer and general manager of the Edison Electric Light company [illegible]. The title of Prof. Marks' paper was, "How to Get Paying Loads for Stations." Next came a paper by R. S. White, on "The Edison Meter in the Brooklyn Station." The morning session was concluded with an address by Samuel Insull, second vice-president of the Edison General Electric company, on the present business policy of the parent company, the outlook in the patent suits the condition of the business, etc. After the close of the business session, the preliminaries of Mr. Insull's trip for Thursday to Schenectady were completed, and invitations for the excursion were distributed.

At the afternoon session of the second day the following named gentlemen read papers: Leigh Carroll, Birmingham, Ala., on "Some Practical Ideas on Distribution;" A. E. Kennelly, of the Edison laboratory at Orange, N. J., on the "Mechanical Meter." Mr. Kennelly exhibited a model and used it for the illustration of points brought out in the lecture. Wilson S Howell addressed the convention relative to 'Peculiar Features of Edison Feeder Systems" Mr. Howell was followed by W. J Jenks on the "Success of the Mutual Insurance Idea in Electric Lighting and Power Stations."

The next thing in order was the election of officers for the year of 1891–92. The following named gentlemen were elected: John I. Beggs, president; C. L. Edgar, vice-president; W. J. Jenks, secretary; W. S. Howell, treasurer. It will be noticed that these members are the same as those which held office the preceding year.



ARC LAMP HANGER.

The executive committee for 1891–92 is as follows: A. L. Smith, C. P. Gilbert, Thos. P. Merritt, H. J. Smith, Leigh Carroll, John I. Beggs (ex officio).

After the election came the report of the executive committee, and the business was continued by the presentation of the treasurer's report.

An invitation was then extended to the delegates by the Edison Electric Illuminating company of Brooklyn to visit its station in Brooklyn at the close of the afternoon session.

L. Stieringer's was the last paper. His subject was "Incandescent Lamps for Decorative Purposes."

The meeting place for '92 was decided in favor of Toronto, Canada, at the invitation of Frederic Nicholls of the Edison Electric Illuminating company of Toronto. This was virtually the close of the convention, for Thursday and Friday were spent in making tours of inspection.

On Thursday the delegates left business behind and 6 A. M. found them on board the train bound for Schenectady and Mr. Insull's "awfully good time." Breakfast was served, according to programme, between New York and Albany. Schenectady was reached at 10:10 A. M., and the delegates scattered throughout the immense factories to see what there was to be seen. Lunch was served on board the cars at noon, and 7:15 P. M. found the convention once more in New York, dinner having been served like lunch in the handsome dining car provided by Mr. Insull.

The New York Illuminating company took the members in hand for the evening, and Madison Square Garden was inspected in more ways than one.

Friday was winding-up day, so to speak; a number of

the out-of-town Edison men availed themselves of this opportunity to visit the lamp works, the Edison laboratory and also the New York Edison works.

Taken all in all and judging more particularly from the list of prominent men in attendance, the last convention of Edison interests was an affair most creditable to those in whose hands had been placed the arduous task of bringing to a successful termination a midsummer gathering.

Reflected Light in Dentistry.

An American dentist in Paris named Michaels has invented a simple device for throwing the rays of an electric lamp into the mouth in order to facilitate dental examinations and operations The idea of the apparatus, which is illustrated in the accompanying cut, is to concentrate

REFLECTED LIGHT IN DENTISTRY.

the light on the spot which it is desired to examine without the annoyance of the heat and bulk of the lamp. This is accomplished by the employment of a reflector and a slightly curved glass tube, to the end of which the rays of light are directed.

As will be seen by a glance at the cut, the details of the device are very simple. The lamp is encased in a wooden holder *m*, fashioned to be conveniently held in the band of the operator. This handle is closed by a screw plug *b*, to which is attached a ring *a* for the purpose of hanging up the instrument when not in use. The thumb switch *i* serves to control the current, which is fed to contact points by a flexible conductor, not shown in the cut. The light is concentrated into the end of the tube *l*, projecting from the holder, by the polished metal reflector *r*. Only the end *l* of this tube is of clear glass, the rest being ground or colored. It is said that this light has been successfully applied in dentistry, while its availability in other surgical operations is obvious. The cut is reproduced from *Electricite*.

Electricity at the Firemen's Convention.

In connection with the national convention of fire engineers held in Springfield, Mass., last week, an extensive electrical exhibition was made by the Thomson-Houston company. The object of the display was to instruct the firemen in the rudiments of electrical transmission in order that they might more intelligently prevent or subdue fires from wires carrying currents of electricity. The programme, which was prepared by William Brophy of Boston, was as follows:

Fifty arc lamps were placed in the circuit in the building, no outside connection being made.

These lamps were controlled by the ordinary cut-out switch which is usually placed at the entrance of every building.

The method of using the same was explained.

The current was sent through the magnets of an ordinary telephone call-bell, which was protected by the proper fuse.

The current from a fifty-light arc dynamo was sent through the same to show the effect.

The current necessary for one or more arc lamps was derived through a short circuit of wire, showing the effect of such current on the human body.

The operation of the arc lamp was explained.

The effects of poor connections in the arc light circuit were shown, and the heating effects that will result therefrom.

The best methods of preventing accidents to persons and property were illustrated.

The difference between series and multiple arc circuits was explained.

Experiments were made to show that current from fifty to 200 volts is not dangerous to persons.

Heating effects of current were explained.

Safety devices and their operations were shown.

The effects of poor work as applied to electric light installations and the dangers of poor insulation were described.

Operations of transformers were illustrated.

Difference between primary and secondary circuits was explained.

Wires from a fifty light arc dynamo, a 750-light incandescent machine and a railway generator were carried into the hall.

Prof J. P. Barrett, chief of the department of electricty, World's Fair, and city electrician of Chicago, was in attendance at the convention.

On Wednesday evening Mr. Brophy made some electrical experiments and delivered a brief address on the subject of handling electric wires. He was assisted by H. S. Anderson, superintendent of the United States station in Springfield. Mr. Brophy said that the danger of such wires causing fires was principally from defective insulation. Several illustrations of poor work of this kind were given. In closing Mr. Brophy said that by proper appliances the dangers of electricity could be reduced to a minimum. He thought that those who furnish bad work should be held criminally responsible.

Among the exhibitors at the display of apparatus were the Gamewell Fire Alarm company, New York; Gamewell Auxiliary Fire Alarm company, Boston, and Shaffer's Automatic Sprinkler & Fire Alarm company, Milwaukee, Wis.

Gregory's Electrically Driven Model of an Ocean Steamer.

There are, perhaps, few electrical engineers already in possession of spurs well won who cannot remember their first attempts as amateurs to build electrical apparatus. How many can look back to the time when they lay awake nights plotting and planning some little device with which to astonish "the other boys," the majority of whom had neither the inclination nor, oftentimes, the brains to investigate even the simplest electrical effect? It might be ventured, too, that there are not a few who might resurrect, from that safe hiding place among the rubbish of the garret or store room, "my first dynamo, built with my own hands!"

The outcome of the first real practical effort is the treasure; so among those who read of the little ship Miramar, there will in all probability be some who will feel a genuine pleasure in extending, as does the WESTERN ELECTRICIAN, words of encouragement to Julian Gregory, the builder

Several months ago young Gregory, who, by the way, is but seventeen years of age, told his father that he believed he could construct an electric motor of sufficient power to propel a small pleasure launch. His idea was to supply the current from primary batteries. The elder Mr. Gregory was somewhat skeptical, but not wishing to discourage his son he suggested that the better plan would be first to construct a model. If the experiment were a success, the

GREGORY'S ELECTRICALLY DRIVEN MODEL OF AN OCEAN STEAMER.

young electrician was to receive more substantial encouragement to aid him in equipping a larger craft.

Young Gregory went to work with a will, and the accompanying cuts will give the reader some idea of what he accomplished. It is to be understood that the model as an entirety was constructed by young Gregory.

His letter descriptive of the work and also the line drawing of the vessel are given as they were received. Master Gregory writes:

"My electrical ship Miramar is 36¾ inches from stem to stern, and 8½ inch beam.

"It is a perfect model of an ocean steamer fitted on the inside with saloons and motor room, and lighted by electricity. Each light has a separate battery with the exception of one in the motor room, which is lighted by the large main battery.

"The motor is run by six cells of bichromate battery, which are all inclosed in an acid-proof compartment, with the exception of one in the motor room. The propeller makes 240 revolutions per minute in water."

Several days ago the model was tried on Oak's mill pond at Glen Ridge, N. J., which is the builder's home. It was a success; and it is almost needless to say that Julian Gregory is now in a position, as far as his father is concerned, to experiment with a larger motor and boat.

An Enterprising Superintendent.

To say that electrical men are never without resources would only be giving credit where credit is due. But there is an electric light superintendent in Pittsfield, Mass., who deserves a great big city station. One day last week Manager Gardner of the Pittsfield electric light company, was notified that the water was to be shut off at six o'clock to repair a break in the main. As most people are aware an electric light plant cannot be run without water, and how to get it in sufficient quantities was the question. Four large street sprinklers were filled with water and taken to a position near the boiler. Several teams with a lot of extra men were started out and returned with 183 water-tight [illegible] thing in it."

Telegraphers in Convention.

[illegible] question of securing recognition of the members of the military corps by Congress. The address of the president, W. R. Plum, herewith presented, was devoted almost exclusively to this topic, and will prove generally interesting.

Having held our reunions in Niagara Falls, Chicago, St. Louis, New York, [illegible] Kansas City, we now meet at the great civic and military headquarters of the nation, in many respects the most beautiful city on the continent.

From this standpoint it behooves us to take a cursory view of the rise and dismissal of our corps, whose splendid example in war occasioned all the governments of civilization to engraft a like service as a part of their army systems.

When, on April 12 1861, the cannon in Charleston harbor cemented the confederacy and unwittingly sealed the death warrant of disunion and the only potent object for it, the telegraph resounded the echo northward beyond the great lakes and westward beyond the plains

In three days after the call for 75,000 Union troops fully 100,000 were preparing to respond.

Boston Commons contained troops from various parts of the state the night of the first day, and Pennsylvania forces reached this city at 7:30 P. M. April 17th, Baltimore was in the hands of a secession mob. Harper's Ferry was captured the 19th. The same day the Richmond wires were cut, thus severing all southern connection except via Kentucky, whose lines were intact until September. April 21st, Philadelphia was cut off, and the nation's capital became the object of intense solicitude

The enemy having destroyed portions of the railroad and telegraph between Washington and Baltimore, Thomas A. Scott called to his aid Andrew Carnegie first, and shortly after David Strouse, D. H. Bates, Samuel M. Brown and Richard O'Brien, all from the Pennsylvania railway, for the purpose of operating the railroad from Baltimore to Washington.

These telegraph experts were the first in the Federal service, and unwittingly, by mere development, formed the necleus, in this vicinity, of the army telegraph corps which, during the war, constructed 15,389 miles of military telegraphs and sent 6,500,000 telegrams.

The first military line ever constructed on the American continent was built in April, 1861, connecting the War Department with the navy yard, and though new lines were constantly being built hereabouts, yet, for the first seven months of the war, the American Telegraph company, under the presidency of E. S. Sanford, advanced nearly every dollar expended in their construction and operation in eastern Virginia, Maryland and the District. The other necleuses were organizing about Wheeling and St. Louis also, without warrant of law.

Nor is this surprising, for, except perhaps an untried corps in Germany, no army system in the world embraced a telegraphic department. Even our signal service employed but one man, who did not reach Washington from the Indian country, until June.

Thus was the great civil war inaugurated, and McDowell moved to defeat at Bull Run, leaving his nearest telegraph offices at Fairfax Courthouse and Burks Station. At the same time General Patterson was near Winchester with no telegraph nearer than Harper's Ferry

Had Generals Scott, McDowell and Patterson been in constant telegraphic touch, as they might easily have been

GREGORY'S ELECTRICALLY DRIVEN MODEL OF AN OCEAN STEAMER.

the battle of Bull Run would not have occurred in the absence of Patterson's forces.

This first great disaster of the war [illegible] strated the necessity of constant telegraphic access to advancing armies, and was in sharp [illegible] example previously set in western Virginia, where McClellan was in constant telegraphic [illegible] moved to victory at Rich Mountain.

In Missouri General Lyons' army was defeated by superior forces at Wilson's Creek, [illegible] twenty-five miles from the nearest [illegible] courier after courier was dispatched [illegible] succor, although troops were at hand to relieve far less exposed points in the department.

When General Fremont took command of this depart-

[illegible] was to organize a telegraph [illegible] companies were partially organized, armed and drilled for this special service, under the plan of Major George H. Smith, the commander, contemplating [illegible] in any emergency, so that time and expense may be saved, each operator to be furnished with a pocket instrument, to open communication from the field of battle or the marching army to headquarters, or elsewhere instantly;" but under the civic plan of Anson Stager, who in the meantime had been appointed superintendent of all United States military telegraphs, with the rank of captain, by order of the secretary of war, the battalion was disbanded after having constructed several hundred miles of line.

Henceforth the telegraph became an indispensable adjunct to each of our armies and every post, and in its fuller development, also, of every army corps, and frequently of lesser bodies.

The operators accompanied the troops in every campaign and numbered, all told during the war, about twelve hundred. They were sworn into the service, taking an oath substantially as follows:

"I do solemnly swear that I will bear true allegiance to the United States of America, and that I will support and sustain the constitution and laws made in pursuance thereof, as the supreme law of the land anything in any state constitution or laws to the contrary notwithstanding. That I will not take up arms against the United States, or give aid and comfort to the enemies thereof, or to any authority or pretended authority that is or may hereafter be engaged in armed hostility thereto; and that I disclaim all fellowship with the so called Confederate states and Confederate armies. I do further swear that I will not reveal to any person or persons the contents of any dispatch, report or other communication, either directly or indirectly, that may come to my knowledge through my connection with the telegraph, in any manner whatever. That I will not reveal or divulge to any person or persons any cipher that may be given me for United States military purposes; and that I will faithfully keep and observe this my solemn oath of secrecy and allegiance to the government of the United States of America."

The telegraphers in the various departments were under the military orders of the commissioned officers, who were given rank in the army solely in view of such a command. Not one of them ever had any other duties assigned to them. These officers were Captains Bruch, Smith, Bulkley, David, Whitney, VanDuzer, Fuller, Gross, Gilmore, Clowry and Lynch, Major Eckert and Colonel Stager.

Bruch died of disease at Memphis; Smith, David and Bulkley resigned and were mustered out; the others, at the close of the war, were "honorably mustered out of the service in the armies of the United States" with a brevet lieutenant colonelcy except Stager and Eckert, who were brevetted brigadier generals, while the operators who had borne the brunt of the service were simply told to quit and go home. No discharge was granted them; not even a commendatory order was ever issued by our own chief; and now, at this late day, when over half of our comrades are in their graves, although for eight years we have sought congressional recognition, yet six favorable reports upon our bill from Senate and House Committee on Military Affairs declaring that we were an integral part of the army, and should be recognized as such, is as far as we have progressed in Congress.

The House Committee of the last Congress, however, in its exceptional (?) wisdom, presented a substituted bill which declared that the act should not be construed as [illegible] as a part of the army.

The reasons the committee reported why the bill should pass clearly justify the former findings of the other military committees

Among other things this committee reported were:

"The men of such service were of unusual intelligence and showed themselves possessed of a courageous spirit and indomitable pluck. No men who served with the army showed themselves possessed of these traits to a greater degree. They put up their instruments many times on the skirmish line and frequently almost by the lines of battle. They went with the advance and were often the last to leave an abandoned position even when it meant capture and imprisonment. Some were killed at their posts of duty, many were wounded and crippled for life. . . . They were made prisoners of war and exchanged for important officers. They were to a certain extent subject to military orders, but have never been able to claim a [illegible] among the nation's defenders. Some held an assimilated rank, but [illegible] were just as in [illegible] as though they had [illegible]."

This committee supplemented its report with communica[illegible]

Their duties constantly placed them in exposed positions, and they are favorable objects of rebel surprise. It is much to be desired that some mode of recognizing and rewarding the bold, faithful and most important services of these gentlemen should be provided."

The Committee's Exhibit of the Reports of the Committees of the 48th, 49th and 50th Congresses show the following statements, approved by it: "The reports of the secretary of war and the commanding generals bear uniform testimony to their efficiency, intelligence and patriotism. Their duties were purely military and were performed with the same exposure to the dangers of the field and disease as fell to the lot of the ordinary officer and soldier. . . . By the efforts of personal friends, their history has been collected, and it is known that of the entire number 199 were either killed, died of disease or were captured while in the line of duty. It is estimated that more than 100 others suffered from the casualties of the service."

It was "organized . . . upon a quasi military basis; . . . its operators were sworn into service"

"The services performed . . . were of such importance and efficiency that every European nation and our own government have since reorganized their army systems so as to include an electric telegraph corps to perform the same telegraph duties that were required of the United States Military Telegraph Corps in question. In addition to their strictly military telegraph service, the operators were . . . the custodians of all cipher keys, and required to put into cipher and translate all important dispatches, and thus they became, and continued throughout the war, most confidential and trusted aides engaged in the courier service, transmitting about 6,000,000 dispatches" Their 1,000 miles of field wires "were ofttimes worked on the field of battle and under a heavy fire." Then follows the commendations of some of the most prominent officers of the army.

This bill was put upon its passage without (by reason of unforeseen events) the knowledge of our committee on congressional action, notwithstanding our society at Kansas City had repudiated it, and so advised the House Committee.

Thereupon I proceeded to this city, and being ably seconded by Comrade Stafford, we had no difficulty in securing an adverse report on this bill, and a favorable one on our own from the Senate Committee, but, by an oversight, consequent upon the pressure of an expiring Congress, the House bill was presented with the report instead of the one actually approved by the Senate Committee.

Owing to this mistake, and the few remaining days of Congress, it was evident that nothing could be accomplished except the prevention of the passage of the House bill, which Senator Hawley, for whose many kind offices we should ever feel deeply grateful, assured us of. Such is the present situation.

We have established the facts that we were sworn into the service; that we were exposed to the dangers incident to the army in war, that our service was the counterpart of that of the Signal Corps, which was honorably discharged and which lost far less in the casualties of war than we; that we alone of all the army were intrusted with the cipher keys; that we wore officers' uniforms by general orders, that 175 enlisted telegraphers were permanently detailed or discharged from their regiments to enter our service; that the war department discouraged the enlistment of telegraphers in other branches of the service and by general order prohibited their conscription; that we unavailingly petitioned our chief during the service to organize us distinctly upon a military basis that our officers alone of our corps were entered upon the army rolls; that we were solely subject to military orders; that we operated our wires upon the field of battle in every territorial departement; that every important cavalry movement was accompanied by one or more army telegraphers; that in the great movements, especially from the fall of 1863, every section of the armies in near proximity to the enemy was kept, even on the march, in constant intercommunication; that unparalleled facilities for communicating with distant forces were provided by us; that thousands of lives and millions of treasure were saved by the timely aid of the corps; that the war was shortened, perhaps years, by concentrative and co operative use of the telegraph, which first declared victory or defeat, the need of troops, of munitions of war, of quartermaster, commissary and medical supplies; which patroled the sea coast and the whole army front, keeping every post and division in constant touch and, in emergencies beat the "long roll," to arms. We have shown that the history of the war was thus preserved on paper largely in the handwriting of the actors themselves; that its history is the most authentic up to that time in the annals of war; that our people in the North were encouraged, stimulated and assured by hourly reports, thus minifying to the least degree the sad worriment that war brings to the lonely hearthstones where parents, wives, children and others prayed and rejoiced or wept.

Ours was the mystic chord which alone enabled Grant to command a million of men and brought assurance and repose to many a commander during all hours of the day and night, for its operatives kept vigils night and day in the fort, in the tent, in the lonely bivouac, on the ground, in the malaria of the Chickahominies, or the Yazoos, in unprotected guerrilla countries, and upon the battle fields; [illegible] in posts of danger, but as secretive of confidential [illegible] are the bolts and bars of the federal treasury.

We have seen our comrades shot down in battle, torn to pieces by buried torpedoes, imprisoned in Libby, Andersonville, [illegible] and other bastiles, where many died and others [illegible] helpless wrecks. We have seen them in [illegible] and other fever, seen them at [illegible] and emaciated by chronic diarrhea or other camp diseases until the hospital or the grave wrought [illegible] them in later years in the county [illegible] paupers because there was no pension for them, save what we donated, and we now know that one half are in their graves unthanked and unhonored.

We propose to go there also undamned by invidious praise, rather than accept a certificate of creditable service as camp followers.

The narrowness of the last House Committee's bill is the more remarkable when we consider that the Grand Army of the Republic representing 410,686 survivors of the army and who ought to know, had already solemnly resolved that we were a part of the army and as such should be recognized.

This was supplemented by the resolution of the society of the Army of the Tennessee, and that of the Ohio legislature

There is no question of congressional power; it is purely one of legal recognition of an actual status. Nor is there any moneyed idea, for it is simply one of sentiment; of being placed in peace alongside of those who in war were and in peace are glad to welcome us.

We solicit no pension, nor bounty, nor further compensation. Ours is not a raid upon the federal treasury, but an insistence upon a *de jure* recognition of a *de facto* status.

In the light of our services, exposures, deaths, wounds, capture and imprisonments, sufferings and deprivations, all voluntarily risked, solely from patriotic impulse, this governmental silence for twenty-six years touching the value and dangers of the corps, while justly heaping unparalleled thanksgiving and thankofferings upon our comrades on the adjutant's rolls, is a striking illustration of the ingratitude of republics as represented in congresses, where thanks originate so largely through fear of an individual loss or hope of gain of constituent votes. Scattered all over this land of 60,000,000, we have have no power but the influence of a just cause, reinforced by the testimony of nearly half a million surviving veterans, their great generals and the reports of six millitary committees, themselves, perhaps, wholly composed of ex-officers of the war.

Death is reaping a rare harvest of our gallant witnesses. During the last year it removed General Sherman, who wrote that "the greater number were distributed along the lines, had to work day and night, and were as much a part of the army as though armed with muskets in the ranks; for before the discovery of the magnetic telegraph, the sending of messages back and forth, to and fro, was always done by armed cavalry messengers and escorts, consuming a large portion of the active army. In fact there should have been in the civil war a regular corps of telegraph operators with regular muster rolls, so that the wounded and disabled could be entitled to the same pension as other staff soldiers and officers."

It behooves us to take action upon his demise, as one of our stanchest friends and greatest commanders. Among other witnesses called hence we may note General Grant, who declared that "the telegraph and the signal service, its coordinate, were as necessary to our success as the railroad is to commerce. Nothing could be more complete than this body of brave and intelligent men. The operators were assigned to particular headquartes and never changed except by special orders The moment the troops were put in position to go into camp, all the men connected with this branch of the service would proceed to put up their wires . . . Thus, in a few minutes longer than it took a mule to walk the length of its coil, telegraphic communication would be effected between all headquarters of the army. No orders ever had to be given to establish the telegraph." Also General Sheridan, whose testimony was that "in my own experience I found them (military telegraphers) invariably active, brave and honorable." Also General Logan who championed our cause in the Senate, and who said: "No part of the army during the war discharged its duties more diligently and faithfully than the telegraph corps."

Also, General McClellan, who testified: "I do not not think that any one appreciates more highly than I do the value of those services and the loyal and invaluable devotion so constantly displayed by the men. I had ample occasion to recognize the devotion to duty which so often kept them at their posts in the midst of danger; the patience, intelligence and thorough honesty they displayed, and the great debt—still unpaid (1883) and too little recognized—due them by the country. I sincerely trust that they may receive the recognition they so richly merit, and cannot doubt that upon a presentation of the case, Congress will take favorable action."

Also General Burnside, whose evidence: "I have no hesitation in saying that the telegraph corps was of infinite service during the late war, and I am free to say that I never knew a body of men who possessed more integrity, industry and efficiency than the operators with whom I was thrown."

Also, General Warren who wrote of an operator bringing his line and operating his instrument within musket-range of the enemy under a heavy cannonade, and again, of another under a severe musketry fire, and added: "I don't want to see the telegraph operator in the war neglected, as far as I can have anything to say."

Also, General Franklin, who recalled that it was always a pleasant surprise to him within an hour or two after a long day's march that the wires were brought to his quarters, thus saving the lives and time of couriers and horses, and giving a comfortable feeling of security which would otherwise have been wanting; adding that "The duties . . . were so well performed and the men themselves so modest and unobtrusive that their merits have not received sufficient notice from the generals with whom they served. I know of no class of men in the army who were more faithful and energetic. . . . I always found them alert, intelligent and courageous."

Also, Secretary Stanton, who officially reported that: "The military telegraph has been of inestimable value to the service, and no corps has surpassed, few have equaled, the telegraph operators in diligence and devotion to their duties."

General J. M. Schofield, at present in command of the army of the United States, wrote the chairman of the Senate Military Committee that "there is no question, in my judgment, that the persons engaged in the military

telegraph service during the late war deserve recognition for the bravery, fidelity and skill with which they discharged their duties, and that they should at least receive a certificate of recognition and honorable discharge from the service. . . . There would, I think, be no objection to naming the assimilated rank in the certificate of discharge if it could be fairly ascertained. But, in view of the difficulty which must be encountered in any attempt to do this at this late day, it would probably be better for the members of the military telegraph department to be content with a certificate of honorable discharge, in which should be mentioned the grade of the service in which each was employed. The war department could readily prepare a form of certificate which would contain all that can reasonably be desired, without attempting to determine relative rank."

If to this convincing evidence we add that of Generals Rosecrans, Banks, Sanborn, Haupt, Compte de Paris, G. A R. Commanders Warren and Veazey, and the declaration of 410,686 other living veterans, that the corps "constituted, in fact, a part of the Union army and partook largely of its hardships and dangers while rendering invaluable aid," and that Congress "should promptly recognize the status and services of the corps," which it has wholly ignored though many "were killed, wounded, or died at their posts of duty," do we not make a case that should shame every congressman who fails to do what he can to secure for us an honorable discharge from the army, and should we be content with anything less?

After waiting long in silence and knocking at the doors of Congress eight years for some sign of appreciation, shall we be put off with a recognition that classes us with the army sutler; that debars entry into the Grand Army of the Republic; that we cannot hand down to our children as proof that we were more than hirelings with the army; that forbids the government from erecting the usual headstone at our grave and refuses our bones an interment among the nation's defenders?

No, a thousand times no. Better to "die like a dull worm, to rot; thrust foully into earth to be forgot," than accept from the representatives of a great people a long deferred and niggardly certificate that entitles us to nothing, and on its face expressly declares that out of nothing nothing shall come. If it was justice to make officers of those in command of us, and honorably discharge them with increased rank, three months' extra pay and transportation home, while we who bore all of the casualities of the service, except in Captain Bruch's case, were dropped from the rolls at our posts of duty unhonored and unthanked, the query arises, Why in time of peace has our own government since established the military telegraph service as a coordinate branch of the army, and why has every civilized government of the globe done the same thing?

Here in the capital of a united and loyal nation let us again resolve, as we did last year at Kansas City, that a discharge from the army is a *sine qua non* to any acceptable certificate.

Frankfort Electrical Exhibition.

By F. B. H. Paine.

The exposition was opened officially on May 16th, and is now nearly completed. The grounds have an area of about 20 acres, in which there are an artificial hill, a pond, etc. The buildings are mostly occupied by the exhibitors of electrical apparatus, but there are also a theater, where a good farce or music may be heard; a cyclorama of the harbor of New York as seen from the deck of one of the great steamers, the entrance being through the cabin, and so capitally done that one can perceive the ship's smell, also numerous beer gardens and two band stands.

Entrance to the grounds is through the old railroad station, in which are the offices, reading room, press bureau, etc., of the exposition. The first building contains a collection of medical electrical apparatus, some fine testing instruments and toys In one end Siemens & Halske of Berlin, and other Siemens manufactories have a collection of their electrical instruments for all purposes, with dynamos, motors and accumulators to put them in operation. In an adjoining building Siemens & Halske have a small model theater with complete arrangements for showing the scenic effects possible to attain with electric lighting.

From here we go around the artificial hill, surmounted by a pretty wine garden, through which flows a stream of water that tumbles over the cliff, making a waterfall of considerable size. Under the cliff is a cavern from which a great dragon is crawling and vomiting hot water and steam; at night the dragon and cavern are beautifully illuminated with changing colored lights.

Under the hill is a "drift," in which Siemens & Halske show their electric mine locomotive and other mining apparatus. The locomotive pulls a passenger car into the "mine," on which everybody rides, to the delight of those who have never been underground. The apparatus is similar in design to that in use in the United States. They use a ground return wire and copper overhead conductor supported in the usual way. The trolley used, however, differs entirely from those in America, but has the same characteristic that makes their street car trolley worthy of notice. They have a line running from the grounds to the opera house, with two cars working on the trolley system and one or two with accumulators. Instead of a wheel or spoon, as used in the United States, they have a steel rod nearly as long as the car is wide, supported in a somewhat similar manner to our trolley wheel. It has many advantages, the principal ones being that it cheapens the line construction greatly, as no switches need be used to guide the trolley, and with it it is unnecessary that the trolley wire should conform to the curve of the track exactly, as contact can be made at any point on the cross-rod. The pole is attached to the car as ours are, except that it is much shorter; the hinge and springs, instead of being on the car roof, are raised considerably above it; the pole, being shorter, stands straighter, and when the direction of the car is changed it flops over, raising the trolley wire just a little

From the "mine" we cross an open space in which is a band stand and enter the main building, at the entrance of which is the electric light exhibit of Schuchert & Co. of Nuremberg showing their direct and alternating current machines, lamps, etc Then we hear the familiar "buzz" of a Thomson-Houston arc machine, and beside it stands one of their street car generators. It seems strange to see these old friends in the hands of people who do not understand the language in which they were built

In the center of the building is the largest dynamo in the exposition an alternator built by the Helios Electric Light company of Cologne, under the patents of Zipernowsky-Deri-Blathy, who are the experts of Ganz & Co. of Buda Pesth. This machine has a capacity of 600 horse power with an electro motive force of 2,000 volts. It is provided with an internal revolving field with 40 laminated pole pieces bolted to a cast iron frame keyed to the shaft, which is directly connected to a compound engine of 600 horse power, one cylinder on each side. The engine makes 125 revolutions, giving the dynamo 2,500 periods per minute (about one-third the periods usually employed in America). The latter is excited by a separate direct current machine, The dynamo is about 10 feet in diameter. The Helios people have adopted an ingenious switching apparatus with levers and interlocking arrangement, by which they are enabled to regulate the current, throw the alternators into multiple-arc, and accomplish all the work usually done by separate switches placed upon a switchboard. It is questionable, however, whether they really simplify the central station or are less liable to accident than with the old way, although they do somewhat lessen the work of changing over, etc.

At the far end of this building is Siemens & Halske's principal installation, consisting of many direct current dynamos of small size; direct current machines coupled to alternators, one acting as a motor and the other as a generator, as the case demands; also two direct current machines on the same shaft, one acting as a motor and the other as a generator, their use being to transform a direct current of high potential and small current into one of low potential and large current, or *vice versa*. This is, of course, done at considerable loss. At one side stands their largest type of direct current dynamos directly connected to an upright triple expansion engine. The dynamo has an internal stationary field of four or six poles, according to the size of the machine, which are bolted to brackets on the foundation. Through a hole in the center of the field the shaft revolves, keyed to which is the cast iron web supporting the external revolving armature, the core being of laminated iron, bolted to the web, forming a Gramme ring. The winding consists of almost innumerable copper hoops, bent so that they exactly fit, insulated from each other and the outside surface turned off smooth, each hoop being one turn and forming one bar of the commutator. Thus the whole exterior of the armature is the commutator, on which press as many stationary brushes as there are poles, supported by a very ingenious brush holder, so arranged that all brushes are moved together over the surface of the commutator by one motion, giving more or less lead, and by another altering the pressure of all brushes or removing them entirely from the commutator.

By the side of this great direct current machine stands a new alternator directly connected to its compound vertical engine. This machine is of about the same size as the other, with an internal revolving field and an external stationary armature wound for a comparatively low electro motive force, for an alternating current. As the machine has as yet never been run, nothing is known as to the efficiency or the advantages to be gained by its form of construction.

In addition to those mentioned, there are a great many dynamos, engines, gas and petroleum motors with no peculiarly novel features, all doing their work and helping to make a wonderfully fine display.

A few common and prominent characteristics mark the difference between the European and American dynamos. In Europe designers favor commutators with a great diameter; a few are using small steel ones, with an air gap for insulation, copper brushes being always used; even for motors the carbon brush is rarely seen. Almost all European dynamos are built with a great clearance between armature and field, they believing that the loss in efficiency is more than compensated for by the better regulation of the dynamo. Americans believe that we make as close a regulating dynamo as they, and at the same time run with as small a clearance as is possible to make. The greatest difference, however, is that in Europe the tendency is toward great cumbersome machines running at a very small number of revolutions, while in America we make a compact machine running at a great number of revolutions, and get as much service from a pound of metal as possible. Which is better? It seems as though the different conditions existing in the two countries demanded different apparatus.

Arc lighting in Europe is superior to ours, due chiefly to the use of much better carbons. There all arc lamps are operated in parallel, as we run incandescent lamps, and from the same machine. This custom demands the use of more copper in mains, but greatly simplifies the central station.

On emerging from this immense building we are greeted by the stars and stripes floating over a little round pavilion bearing a prominent sign, "American Bar;" it does not look entirely American, but they do know what a "whisky sour" is! Close by is the gate leading to the exhibition of electric light projectors for marine use, situated on the river bank, with a lighthouse on which is one of the most powerful projectors ever made. Schuchert & Co. and Siemens & Halske monopolize this section, Siemens & Halske also exhibiting models of their torpedo firing apparatus, etc.

Schuchert & Co. have built a short electric street car line from the main grounds to the Marine Department that system and the underground conduit system, with its

time and they are both covered by the car, the current being

contact strip set into the pavement. The only novel feature is the use of the iron filings, the action of the magnet

it looks as though the use of the filings might so simplify the arrangement that it would be a practical success.

There are two small buildings devoted to a wonderfully beautiful display of electroliers from the works of some of the best European manufacturers. At the end of the grounds the Otis Elevator company has built a tower about 100 feet high, up which one of its electric elevators carries passengers for

tion. On the side of the ground opposite the main building are three long ones, the first containing long distance and loud speaking telephones, Edison phonographs, etc.; also a very extensive exhibition of telegraph instruments of all kinds by most of the European makers. In one part of the next building are shown some systems of railroad interlocking signals and other apparatus for railroad use in which electricity plays a more or less important part. Nothing important, however, is new. In this building two manufacturers show portable electric light plants intended to be drawn by horses; boiler, engine, dynamos, poles, wire and lamps, all well arranged for instant use. On one a Westinghouse standard engine is used, and on the other a Brotherhood, both directly connected to their dynamos.

The Royal Prussian railroad exhibits a car carrying an electric light plant, of larger dimensions than the two just mentioned, for use in case of accidents. In one end across the car is a boiler with firebox on the side. Close to the boiler is a Westinghouse engine belted to a dynamo. The apparatus is admirably arranged with everything necessary ready and in convenient position for instant use. The poles and wires are carried on the roof

The third building is devoted to an interesting exhibition of apparatus for various electrolytic processes, shown in operation, and also some of the products. The Algemeine Electricitats Gesellschaft has a large and interesting collection of the articles made in its Swiss works from pure aluminium and its many alloys, which may be considered in one sense products of electricity.

The proposal to transmit 300 horse power from Lauffen to Frankfort, 110 miles, has made the Frankfort Exposition most notable in America, although the work is not yet under way and can not be completed before September 1st, if so soon The intention is to use a multiphase or rotating current of 30,000 volts. The results of the experiment are awaited by the electrical world with bated breath, and, if successful, will enlarge our present views of what is practicable in electric transmission of power,

It will be impossible to realize the size and interest of this exposition from such short and very general notes as these, but some conception of it may be formed from the fact that the boiler power, with that of the gas and petroleum motors, is 3,800-horse power, much of which is again delivered in additional power by electric motors, making in all about 4,800-horse power in use every night.

The pleasantest time to visit the exposition is about five in the afternoon, and after four hours' hard work we come out of the electrolysis building tired and hungry. At the sight of the Munich beer garden brilliantly lighted, the pretty Bavarian girls in their native peasant costumes, covered with bangles and bright decorations, running in and out among the little tables filled with contented Germans, with now and then one of another nationality, we are immediately conscious of an irresistible thirst; but with a litre of beer before us we soon become as happy as the rest, and finish the evening in listening to a good military band and the latest gossip in German, while watching the crowd.

1. From the *Railroad Gazette*.

CORRESPONDENCE.

New York Notes.

New York, Aug 15.—If the convention of the association of Edison Illuminating companies had not been held behind closed doors, this week's issue of the Western Electrician would be teeming with columns of matter interesting to those identified with constant potential distribution. But it is the policy of the Edison company to maintain a strict privacy on all except the most general matters. Doubtless this course is a wise one, for secrecy, nowadays, seems to be worth any number of patents, in that to maintain your rights there is no need, where secrecy is employed of resorting to the law. There was a full attendance in spite of the intense heat and hard

sphere. As one delegate remarked contemptuously, in reply to a question as to the possibility of an afternoon session "Edison men don't mind a little heat." Whether the mysterious sessions had their own peculiar charm or the thought of Mr. Insull's "awfully good time" kept them patient is difficult to decide. Such sessions as these were too hard for the long suffering newspaper men who waited in the hallway of the hotel for the news that never came.

Another of the periodical exhibitions of the Sims-Edison

torpedo was given this week. It is asserted that in this test all former speeds of government torpedoes were exceeded. It is claimed that under the manipulation of W. Scott Sims, the co-inventor with Edison, the little craft made as high as twenty miles an hour. This rate of speed is two miles more than the contract with the government requires. The trial was made at Willet's Point, and was witnessed by a large number of army and naval men, together with several representatives of foreign governments. Mr. Sims is to go to Europe to superintend the manufacture of his weapon at a factory which has just been established near Havre, France. An invitation has come from Turkey to exhibit the working of the torpedo in that country. Sir William Armstrong of England, also, has placed a vessel at Mr. Sims' disposal, from which to operate the apparatus and exhibit it to the British admiralty.

Again we have an instance of the complacency with which some of the daily newspaper editors undertake to write knowingly on topics just a little beyond them. "Steam gets a new lease of life," says the scientific scribe, who fills space for the New York *Evening Sun*. "Of the thousands of dynamos now in use in civilized countries at least 95 per cent. are driven by steam, the remainder being driven by water power. So that the time when we shall become a steamless world seems almost as far off as it did to the great railway kings of half a century ago."

It is to be presumed that the elderly gentleman—elderly, because a young man would know better—who writes these words of consolation had a dim idea that a dynamo, like the perpetual motion machine, runs itself. Will some people never awaken to a realization that electricity, whatever else it may prove to be, is merely an agent.

Here is another, but not so bad, from the *New York Tribune*. Speaking of Boston's action in regard to burying the lighting wires an editorial paragragher undertakes to "crow" at the expense of the Hub's street railway system. "We are better off in one respect than Boston is in the matter of wires. Boston is afflicted with the intolerable trolley system in an aggravated form."

This man must be a night editor—at any rate he writes in the dark in more ways than one. A careful glance down Broadway would, perhaps, check his enthusiam over the "thoroughness" of Mayor Grant's hasty work.

The storage battery people are already getting to work. Now that the stumbling block of possible litigation has been at least partially removed, we may look for rapid progress. The Newark & South Orange Horse Railroad company, through its president, John Radel, is reported to have entered into negotiations which may lead to the equipment of the line with the storage battery system. A New York company is to be allowed the privilege of demonstrating whether accumulators will do the work required.

It is customary for journalists to inform the reading masses that it is hot when the mercury reaches 90°. Your correspondent, then, merely claims his rights by referring to an "electrically" storm. Storms in summer are, of course, not usually electrical, but, perhaps, Elizabeth, N. J., was favored. Passing over the everyday incidents, such as the striking by lighting of a church spire, the killing of a horse, and the stunning of a boy, it may interest inventors of safety cut-outs for telephone circuits to know that the Elizabeth system as well as that of Perth Amboy and Rahway suffered greatly—120 telephones, in fact, are reported to have been burned out in Elizabeth. The usual fireworks on the switch-boards were the order of the day. Coney Island, it seems, also had its electrical display in the shape of a thunderbolt, which struck the old iron pier.

Now that we are treated almost daily to a description of [illegible] interesting application of electricity, one hesitates to devote much space to an account of the [illegible] but as not every ball room is a Vanderbilt's, and few others could afford so brilliant a [illegible] of interest to [illegible] paragraph taken [illegible] account of Mrs. F. W. [illegible] at Newport.

[illegible] room [illegible] and [illegible] pended from the center. In the top of the umbrella was [illegible] the brackets festooned with flowers and greens. The large stained glass bay window, extending, like the ball room, to the roof, was treated in a similar manner, the ceiling having a smaller Japanese umbrella with a 100 candle power light. On the floor was a large fern tree, rising from a bed of smaller ferns, and making under the subdued electric lights a pretty picture."

That the electric light contributes greatly to man's enjoyment is evidenced by the above, but there is a Harlem man who thinks differently. To put it mildly, and not in the words of the plaintiff, Howard A. Morse has just brought a suit against the Mount Morris Electric Lighting company. An injunction will be asked to compel the lighting company to remove two arc lights which hang just beneath Mr. Morse's flat in Harlem. According to Mr. Morse there is such a thing as too much light. Two arc lamps in particular he considers are veritable instruments of torture. Shocking the servants who clean the windows, attracting into his rooms myriads of moths and other insects, the lamps must be removed. It is doubtful, then, whether Mr. Morse would be pleased to read of the Vanderbilt ball.

Detective Superintendent Byrnes did good work last night as an electrical engineer. He caught a thief by rigging up, in connection with a safe, an electric alarm. A man had been suspected, and wires were run to an electric bell in a hat store below the apartment which contained the safe. The thief at 5 A. M. made his last electrical contact, for some time to come at least, and is now probably wondering how it was done.

The Rapid Transit commission did not meet after all on Friday, Aug. 14th. A representative of the WESTERN ELECTRICIAN called at the office of the Rapid Transit commission, 22 William street, on the afternoon appointed for the meeting of the commissioners, and saw Wm. De B. Parsons, one of the two successful competitors thus far in submitting plans and specifications. Mr. Parsons would give out nothing for publication, and stated that probably no details would be made public until after the final adoption of the plans by the common council. There being present not enough members to constitute a quorum, no meeting was held.

There was a rumor last week to the effect that the construction of a rapid transit line in Broadway as proposed by the commission would vitiate the contract by which the Broadway Railroad company was given alleged exclusive privileges in that thoroughfare, in consideration of its agreement to pay the city $150,000 annually for the privilege of laying and operating a cable system. John M. Bowers, legal adviser of the commission, however, stated that there was nothing in the story. Under the conditions of its charter, he explained, the Broadway Railroad company was required to pay the city annually $40,000 in rent and 5 per cent. upon its gross income The bond referred to only guaranteed the city that the sum to be paid under the provisions of the charter requirements should not fall below the sum named. It did not matter what should be done about granting a charter for an underground railroad, the Broadway Railroad company would still be required to pay these items to the city so long as it operated its railroad.

The electric light buoys numbered "2," "4" and "6" in Gedney's channel, near Sandy Hook, are bothering the lighthouse department. Apparently the service has not been of the best, and notice was given on Aug. 14th from the Tomkinsville station that these lights would be extinguished during the time repairs were being made on the cables.

The White Squadron has sailed away. The vessels, with the exception of the Atlanta, which remains for repairs, left on Aug. 12th for a cruise along the New England coast. The Chicago carries a number of members of the Senate naval committee. F. L. P.

Omaha, Neb.

OMAHA, Neb., Aug 15.—The Omaha Street Railway company has recently commenced reconstructing its Thirteenth street line prior to changing it from animal to electric power. It is laying new Johnson side bearing girder rails and copper bonding the joints. This line will extend to the southern limits of the city. The company is building a large addition to its Nineteenth street power house, and is installing one 600 horse power Reynolds-Corliss engine, together with six 80,000 watt Edison generators. It has recently installed two 80,000 watt Edison generators of the latest design in the Harney street cable house, and [illegible] are operated by the same engine which drives the Dodge and North Twentieth street cable line. This company claims the only plant in the country where the same engine operates both cable and electric street railways.

This is the plant where the electric cars, solely by their [illegible] have driven on the cable cars from their own track. A few years go the Harney street cable line was built Now it has wholly been abandoned, so far as the cable is concerned, and nothing except the slot between the rails indicates the former use this track was put to. The electric cars glide smoothly over the rails, which needed no copper bonding, the heavy rails, yokes, etc , furnishing a most perfect return circuit.

The East Omaha electric line was recently opened. This line is about two and a half miles in length. It connects East Omaha, a manufacturing suburb, with the city. It was built by the Interstate Railway & Bridge company as a starting line for the new bridge, which is to cross the Missouri river, connecting Omaha and Council Bluffs. The motors are single reduccion Westinghouse, two 20 horse power motors to each car. The equipment at present consists of two motor and two trail cars, but this is to be increased soon. The motors are geared for twenty miles per hour, and run finely. Power is furnished by the Omaha Street Railway company to operate this line. It is expected that the "Benson line" will open shortly to an addition in the northwest part of the city. Westinghouse motors are to be used.

A. F. Blundell, who has for a long time been identified with telephone and electrical interests in this part of the country, has gone to Brooklyn, N. Y., where he has accepted a position with the telephone company.

N. Mudge, who has been conducting an electrical business for the past two years, has closed up his affairs and gone to Michigan.

Victor Poissant, an electrician of this city, has recently accepted a position with the Blue Bird Mining company, Butte City, Mont.

Electrical business is suffering from the general depression noticed all over the country. Several of the dealers and contractors say there is but little going on.

Recently in Council Bluffs it was decided to move a building along a street where the motor track was laid. There were several curves and a grade of four to five per cent , and considerable difficulty was experienced in attempting to move the building with horses. So one night, after the cars on that line stopped running, the superintendent ordered two motor cars hitched to the building, and it was rapidly drawn up the hill and out of the way of the cars.

It is stated that the motor line recently started in Lincoln, Neb., is running quite smoothly. A motor car on this system in crossing a steam railroad was brought to a standstill, its trolley flying off the wire. A freight train backing down the track struck the motor. As this train was moving slowly, but little damage was done, and nobody was injured. A.

Pittsburg, Pa.

PITTSBURG, Aug. 15.—McKeesport, Pa., will not be long without the advantages of electrical rapid transit. The dynamos and other electrical apparatus for the equipment of the McKeesport & Reynoldton Electric Railway company have arrived. The work of laying the track has so far progressed that it can be completed within a few weeks, and it is expected that everything will be ready for operation by October 1st. The Thomson-Houston company is furnishing the electrical outfit.

The Michales Electric Mining Machine company of Pittsburg, Pa , the business of which is the manufacture of machinery for use in coal mining. has made a change in its chief officer. A few days ago M. A. Michales, who has been president of the company since its organization, tendered his resignation and his place was filled by the election of William W. Grier, a well-known manufacturer of the vicinity of Pittsburg. The Michales company is now engaged in the construction of a mining plant at the coal works of O'Neil & Patterson on the Monongahela river.

The Second Avenue Passenger Railway company of Pittsburg has filed its annual report with the secretary of internal affairs at Harrisburg. During the year the road carried 1,808,993 passengers. Twelve persons were injured, but none seriously, and the accidents were all due to carelessness on the part of the injured and to no fault of the company. The receipts for the year ending June 30, 1891, were $88,492.45, the expenses being $61,094.94.

The Birmingham Traction company of Pittsburg is making an experiment upon its cars with the Genett air brake. It tried the cable brake in the first place but found it unsuited to the requirements. It is expected that the Genett appliance will work to the entire satisfaction of the management. David Reid, a representative of the Western Steam & Street Railway Equipment company of Chicago, has charge of the work.

G. Wilbur Hubley, Jr., electrical engineer, who has been for a long time in the employment of the Westinghouse Electric Manufacturing company, has just entered

the service of the Citizens' Traction company of Pittsburg and will have charge of the new electrical feeder, five miles n length, of the Citizens' company's cable line.

B. I. W.

PERSONAL.

Nelson W. Perry of Cincinnati, O., was in Chicago last week.

Louis A. Ferguson of the Chicago Edison company is enjoying his vacation at Boston.

Among the visitors at the Chicago Electric club last week was Alex. H. Lewis of Cincinnati, formerly of Chicago.

C. A. Daigh of the Electrical Engineering & Supply company has just returned from a western trip covering Minnesota, Iowa and Missouri.

W. H. McKinlock, president of the Central Electric company, is away on his well-earned vacation, and writes that he is finding both health and pleasure in the surf on the Jersey coast.

F. H. Whiting of Denver was in Chicago on Saturday last renewing old acquaintances. Mr. Whiting was for some time connected with the Thomson Welding company and later has been with an electric railway which is now being built between Denver and Golden.

A Irvine, superintendent of construction of the National Electric Manufacturing company, Eau Claire, Wis., was in Chicago on Monday returning home from an eastern trip. Mr. Irvine reports the business outlook for the coming fall season as very bright.

NEW INCORPORATIONS.

Buffalo & Williamsville Electric Railway company, Williamsville, Erie Co., N. Y.; capital stock, $50,000; to operate a street surface railroad.

Middletown Electric Street Railroad company, Middletown, Ohio. capital stock, $100,000; electric street railroad; H. Knight, Middletown, Ohio.

Electric Light, Street Railway & Power company, Creal Springs, Ill.; capital stock, $6,000; to operate an electric light plant; J. M. Eubanks, Creal Springs, Ill.

Kansas Fuel Gas company, Chicago, Ill.; capital stock, $1 000,000; to furnish electricity for light, heat and power; Loftus Edwin Daucey, 101 Auditorium, Chicago, Ill.

Edison General Electric company (of New York), Boise City, Idaho; capital stock, $12,000,000; supplying electric power and light; John W. Cunningham, Boise City, Idaho.

Flint Creek Electric Power company, Butte, Mont; capital stock, $25 000; generating electricity and using same for all purposes for which electric current may be used.

Citizens' Fuel, Light & Power company, Celina, O.; capital stock, $50,000; producing, purchasing and selling oil, gas and electric light and power, etc.; A. D. Marsh, Celina, O.

Chicago & Evanston Electric Railway company, Chicago, Ill.; capital stock, $500,000; to construct and operate a passenger street railway system; Alex. Clark, 97 Clark street, Chicago, Ill.

Georgia Electric Light company, Atlanta, Ga.; capital stock, $600,000; to manufacture, buy, sell, lease and use machinery, articles, etc, appertaining to the use or application of electricity.

Washington County Electric Light & Power company, Troy, N. Y.; capital stock, $10,000; to furnish electricity for light and power in Cambridge, Shushan and Salem in Washington Co., N. Y.

Kinsey Wright Electric Elevator company, Denver, Colo; capital stock, $25,000; manufacturing and constructing electric hydraulic, steam and hand elevators and set up and put in place the same.

Fall River Electric Gas Machine company, Rockford, Ill.; capital stock, $50,000; to manufacture and sell gas and electric lighting machinery and gas and electricity; Geo. D. Roper, Rockford, Ill.

Grand Haven Electric Light and Power company, Grand Haven, Mich.; capital stock, $50,000; to supply electric light and power to Grand Haven and Spring Lake; O. C. Mackenzie, Grand Haven, Mich.

Edison Electric Light & Power company, Fresno, Cal; capital stock, $100,000; to produce, manufacture and supply electricity for light and power, to be sold and disposed of; Frank H. Thorb, Fresno, Cal.

Pneumatic & Electric Tool company, Jersey City, N. J; capital stock, $300,000; to manufacture and sell and let pneumatic and electric tools and all improvements thereon and substitutes therefor. John Griffin, Jersey City, N. J.

Hughesville Electric Light & Power company, Hughesville, Pa.; capital stock $10,000; to supply electric light and power to the public in Hughesville, Lycoming Co., Pa.; F. H. Cheyney, 216 S. Third street, Philadelphia, Pa.

Contractors' Supply company, Chicago, Ill.; capital stock, $1,000,000; general merchandise and supply business and operating steam, heat, power, light and water supply plants; Theo. Burkhard 167 Dearborn street, Chicago, Ill.

H. Ward Leonard & Co. (incorporated in New Jersey), New York City, N. Y.; capital stock, $200,000; to carry on and supervise electrical steam, water and other engineering and construction work; Charles M. Hough, 150 Broadway, New York.

Portland & Southern Railway company, Portland, Ore.; capital stock $10,000,000; to build, buy, sell, lease, establish, maintain and operate all means of transportation, both by land and water, including horse, steam or electric lines; Ayer & Cone, attorneys, Portland, Ore.

D. & D. Electric Manufacturing company, Minneapolis, Minn; capital stock, $50,000; to manufacture and sell electric motors, dynamos, and all kinds of electrical and other machinery, apparatus and supplies, metal castings; D & D. Motor company, 327 St. Paul street, St. Paul, Minn.

Columbian Electric Light, Power, Heat and Manufacturing company, Jersey City. N. J.; capital stock, $1,000,000; to purchase, own, manufacture, operate and sell patented and other devices, compositions, machinery and systems for producing, applying and utilizing electric light, heat and power; Clinton Rice, 60 Broadway, New York City.

ELECTRIC LIGHT.

The Pass Christian, Miss, Electric Light company intends to establish an electric light plant at that place.

It is reported that a company has been incorporated for the purpose of establishing an electric light plant at Mascoutah, Ill.

The electric light plant at Bushnell, Ill., was blown to atoms by a boiler explosion recently. John Van Winkle and Charles Paul were killed.

Joseph Schrieher of Baltimore has made a proposition to establish an electric light plant in Ellicott City, Md, and it has been accepted by the city council.

At Wheeling, W. Va., the city authorities have let the contract to the Fort Wayne Electric company for the municipal electric lighting plant for $85,420.

The city council of Brownwood, Tex., has granted a franchise to the Brownwood Improvement company for the erection of an electric light plant. The contract requires the plant to be in operation within 90 days.

In Berlin, Germany, at the end of the year 1890, 4,944 arc lamps and 80,788 incandescent lamps were in use, as against 3,778 arc and 62,876 incandescent lamps in 1889, being an increase for the year 1890 of 1,166 and 17,912 respectively.

The Westinghouse Illuminating company's plant at Schenectady, N. Y., has been purchased by Samuel Insull, John Kruesi, William B. Turner, W. B Gilmore and other stockholders of the Schenectady street railroad. The same gentlemen were recently awarded the contract for lighting the streets of Schenectady by electricity.

It is expected that the electric plant of the Louisville, Ky. Gas Light company will be in readiness for operation next month. The Wood arc system is to be used. The company's contract with the city calls for the immediate supply of 165 arc lights; others to be provided as the city authorities desire. The lamps are to burn from sundown to dawn. In due time the lighting will be extended to the suburbs, when the present gasoline system will be done away with.

There has been a change in the management of the English company which supplies electricity in Madrid, Spain. Many serious complaints are being made by consumers, and some users are reverting to the use of gas. The mistake made by the company is said to consist in keeping up the price at an extravagant charge, which tends to limit the amount of business. The company could make a reasonable profit by electric lighting, even if it charged less than for gas and petroleum lighting. The price of petroleum in Madrid is five times as great as in London.

There is a man living on West Madison street, Chicago who evidently believes in reducing expenses as far as possible. or who wishes to get the greatest possible return for the taxes which he pays into the city treasury. The gentleman keeps a store, which, however, is closed during the evening. Taking advantage of the brilliant electric light from a neighboring lamp, he sits just inside the door with his back to the street and stores his mind with classic literature. Although the lamp is fully thirty feet away, its light is so powerful that the type can be clearly seen even by those who in passing glance at the page.

Referring to a statement which has been publicly made that the adoption of electric lighting in place of gas at the office of the Savings Bank Department of the General Postoffice, London, has been followed by a marked reduction in the amount of sick leave, the *Lancet* says that it has good authority for believing that the statement in question is substantially correct. Although the time which has as yet elapsed—two years—since the introduction of the new illuminant has been insufficient for the collection of trustworthy statistics, the paper named thinks that there is every reason to believe that electric lighting will prove to be much more wholesome than ordinary gas flames. An electric lamp does not compete for the oxygen of the apartment in which it is placed, and this circumstance gives it a marked advantage over any open flame.

ELECTRIC MOTOR.

The draw on the new Harvard bridge which spans the Charles river at Boston and Cambridge is to be operated by electrical power. A six horse motor will be utilized.

ELECTRIC RAILWAYS.

[illegible] electrical railroad at Alexandria, Va.

The survey for the Florence, Ala., electric street railroad [illegible]

[illegible] power plant.

[illegible] stallation is described as including eight arc and 2,653 incandescent lights.

[illegible] car lines of Alton, Ill., have determined to combine under one system, and to operate by electricity. The improvement will cost about $40,000, and will be completed in September.

Thomas Lowry of Minneapolis has written a letter to the Edison company on the published statement that the Edison motors were being replaced by others in which he says: "There is no truth whatever in the statement. We are using the motors and they are giving satisfaction."

The city of Bremen will probably soon enjoy the distinction of being the first German city in which horses will have been wholly supplanted by electric power for street car service. A part of the Bremen street car system has been worked electrically for some time, having been equipped by the Thomson-Houston company and now arrangements are being made with this company to fit up the whole Bremen system.

A contract for an electric railway to be installed in Brazil, says the *American Manufacturer* of Pittsburg, has been taken by Benjamin Blum, who will send a sample installation consisting of one car with 25-horse power motors; one 50,000 watt generator and all station apparatus and entire equipment for one and one half miles of track. This is for a narraw guage road, and if successful the entire road is to be equipped by Mr. Blum.

On August 13th the sale of the Belle City street railway of Racine, Wis., was consummated. The purchaser was C. H. Holmes, who represented a St Louis syndicate, and it is said that the consideration was between $75,000 and $90 000. The new company will, it is asserted, expend $200,000 in extending the line and putting in an electric system next year. The property consists of seven miles of track, twelve cars, real estate and the franchise.

Julian Ralph, the well-known New York correspondent, in a letter in the [illegible] says "In the streets of Minneapolis I found several lines of electric surface railway, all of which were better than either our elevated railways or our horse cars; more frequent, numerous, fast, commodious and pleasant than any vehicles in New York. The cars are propelled by the overhead trolley system and are run in couples. They are open at the sides, and are wide and handsome."

ELECTRIC MINING.

The new power house at the Winter Quarters coal mines near Salt Lake City, Utah, is nearly ready for the roof, and the electric locomotive is on its way from the manufacturers. It will be run by a trolley system, and haul the dump cars of coal through the mines and to the chutes, where they will be loaded on the cars. The stationary engine and boilers are on the ground, ready to be set up, and the dynamos have arrived, so that the entire establishment should be ready for operation by the 1st of September.

TELEPHONE.

There are now 4,400 subscribers attached to the telephone central station in Friedrichstrasse, Vienna.

It is stated that the Austrian government intends to take charge of all telephone lines conceded to foreign companies as fast as the present concessions expire.

The Clifton Forge & Covington Telephone company of Covington, Va., has been organized with J. M. Buck president; J. W. C. Bryant, vice-president, and G. T. Shepperd, secretary, for the purpose of constructing telephone lines.

TELEGRAPH.

A new cable to the West Indies is among the [illegible] ties. F. N. Gisborne, official electrician to the government of Canada, has recommended the construction of such a line after visiting the West Indies and collecting statistics as to the volume of business that may be expected from each island. His report has been submitted to a London syndicate. The line recommended will be an extension of the cable between Halifax and Bermuda [illegible] will terminate at Demarara, touching on its route Forture Island and the Island of Jamaica and passing through the Caicos passage.

MISCELLANEOUS.

It is said that the small quantity of water that can be eliminated from ordinary [illegible] can be removed by electrolysis, being decomposed into oxygen and hydrogen before the acid itself suffers change. In order to avoid the decomposition that might occur, M. Leon has recently patented a process in which [illegible] electrodes of large area, kept cool by the circulation of water through them, are used. The acid itself is also cooled.

TRADE NEWS.

[illegible] stated in these columns a [illegible] with very gratifying [illegible] and [illegible] a considerable number have been sold by the Central Electric company.

[illegible] general manager of the light and power department and also of the intelligence department of the Edison General Electric company, resigned on August 3d, in order to start an independent electrical engineering business. Mr. Leonard will take with him several well tried assistants, among them A. St. C. Vance, E. H. Harrison, C. H. Bloomer and August Munning. The company give particular attention to the subject of the transmission of power by electricity and the application of electric motors to the operation of special machinery. Mr. [illegible] experience since 188[illegible], when he became a member of Mr. Edison's first electrical engineering staff, has given him experience in every branch of electric light and power work. He has had experience in exploiting as well as constructing and operating all kinds of electric light and power plants. An interesting feature of the business will be the intelligence department.

The Stanley Electric company's shops on Clapp avenue, Pittsfield, Mass., are very interesting to visitors. This is Pittsfield's youngest industry. There are now employed at the factory about eighty hands, including several women who have light work to do. On the first floor the Stanley converters are made. The company has just made on a special order what are claimed to be two of the largest converters ever manufactured. They are wound each for a primary current of 3,000 volts. They are to be used on Long Island, where the current is carried ten miles. At this point other converters reduce the current to 1,000 volts, and it is then ready for further distribution. Though compelled to meet with very spirited competition, the company has held its own from the first, and is constantly behind its orders. From 30 to 60 converters are turned out each week, and the firm of Jones, Sons & Co. of Pittsfield, who do the castings at a foundry across the street, finds quite a sizable addition to its business. On the second floor of the building the company makes the fan motors. About 50 of these little machines are made every day. The prosperity of the company is a matter of rejoicing to every citizen.

BUSINESS.

The Metropolitan Street Railway company, of Macon, Ga., has recently ordered from the Ball Engine company, of Erie Pa., a complete plant consisting of a 150 horse power tandem compound engine, boiler and heater pump. Dravo & Black, the Pittsburg representatives of the Ball Engine company of Erie, Pa., have sold the Braddock Street Railway company, of Braddock, Pa., a 100 horse power Ball engine, also boiler, heater, pump, etc. They have also sold the Pittsburg Plate Glass company two 150 horse power Ball engines.

E. F. Van Ness & Co. of Valparaiso, Ind., have arranged to install an electric lighting plant, and have purchased their machinery, including two steel boilers and an Armington & Sims engine. This order was placed with the Chicago office of the Pond Engineering company. The Salt Lake City Power, Light & Heating company has found it necessary to make a large increase in its power plant, and has ordered two additional Armington & Sims engines from the Pond Engineering company. St. Louis. The Sioux City Gas Light company of Sioux City, Ia., is making some extensive changes in its power plant, and will put in two large Armington & Sims engines. This company has been using a 400 horse power engine of this make for some time past. The Pond Engineering company of St. Louis has the order for this additional work.

ELECTRICAL PATENTS.

Issued Aug. 11, 1891.

457,334. Pole Trolley and Stand for Electric Street Railways. Thomas E. Adams, Cleveland, Ohio.
A sliding grooved shoe is employed, the shoe or shoes being held in contact with the conductors by [illegible] pressure.

457,[illegible] [illegible] Henry H. [illegible], Detroit, Mich.

457,[illegible] [illegible] Henry H. [illegible], Detroit, Mich.

457,343. Magnetic Belting. Thomas A. Edison, Llewellyn, N. J.
[illegible]

457,[illegible] [illegible]

[illegible] York, N. Y.
[illegible]

[illegible] Cyprien O. Mailloux, New York, N. Y.

This invention consists, essentially, in sleeving the driving motor upon a shaft or bearing parallel to the driven axle, but preferably upon the driven axle or shaft itself, and interposing an eccentric sleeve between the motor bearings and the shaft or axle, said sleeve being combined with means whereby it may be adjusted circumferentially about the shaft or bearing and set in any particular position, thereby moving the motor frame and armature shaft bodily, so as to move a member of the gear train carried by said shaft to or from its opposite member, which is connected directly or indirectly with the axle upon which the motor is sleeved.

457,362. Electric Steam Generator and Heater. Willis Mitchell, Malden, Mass.

457,374. Safety Device for Electric Wires. John H. Sedlmeyer, Johnstown, Pa.

457,377. Trolley for Electric Railways. S. H. Short, Cleveland, Ohio.

457,378. Trolley. S. H. Short, Cleveland, Ohio.

457,382. Electric Railway. Michael H. Smith, Halifax, Eng.
In this invention the negative and positive conductors are arranged in different horizontal planes, preferably with one conductor directly over the other, and while it is not necessary to use more than a single positive and a single negative conductor in some instances it has been found preferable to make use of two positive and two negative conductors, the positive and negative conductors being arranged in separate horizontal planes.

457,407. Self-Regulating Electric Converter. Thomas Spencer, Pittsburg, Pa.
This invention consists in placing upon the core a few convolutions of secondary wire wound in the reverse direction from the main portion thereof and in locating these convolutions so that the escaping lines of force do not thread them. From this construction it results that when but little current is flowing in the secondary, and consequently but little opposition is offered to the flow of the lines of force through the core, practically all these lines of force thread both the main and the reversed secondary convolutions.

457,43[illegible]. Electric Battery. Flavien Poudroux, Paris, France.

457,453. Electric Meter. Eugene Maylan and Wencelas Camille Reckneiwski, Paris, France.

457,454. Annunciator. Walter R. McCann and Simon S. Creider, Sterling, Ill.

457,457. Electric Oil Well Heater. Charles W. Robinson and Samuel D. Robinson, Allegheny, Pa.
This invention is utilized by inserting into the well an electrically heated coil or high resistance conductor, and, when it is at the oil bearing strata, passing through it a current of electricity, by which it is heated, so that it may communicate its heat to the well. The nature of the heating coil and of the electric current supplied thereto should at least be such that sufficient heat is generated to fuse paraffine.

457,477. Automatic Telephone System. Hammond V. Hayes, Cambridge, Mass., and Henry D. Sears, Lynn, Mass.
The object of this invention is to furnish a system of intercommunication for such places as are unable to sustain a regular central station organization, whereby in its operation each sub-station in the system shall be enabled to place its own line in connection with any other line converging to the same point; to send call signals to the desired sub-station over the compound line thus formed without in any degree impairing the connections thus established between the two lines constituting the component members thereof, and upon the completion of the communication to restore the original normal or resting condition of both of the lines. An additional object of this invention is to accomplish these operations without any other sub-station apparatus than that in ordinary use and without material change in the construction of the apparatus, and, furthermore, with central station apparatus of the most simple character compatible with absolute certainty and accuracy of operation.

457,483. Automatic Electric Circuit Switch. William L. Silvey, Lima, Ohio.
The object of this switch more especially is to open the external or electrical circuit of a street railway system whenever by any cause the conducting wires shall become crossed or short circuited. The object is to prevent an overplus of current in the crossed circuit, thereby endangering the armatures of the generators attached to the line by reason of the overplus of current generated on the instant of closing the circuit.

457,[illegible]. Electric Motor. W. S. Hill, Boston, Mass.
Claim one describes an electric motor, the field magnets of which are composed of plates of sheet metal clamped between the end plates, recesses in said [illegible] and rods having reduced ends passing through the sheet metal plates and end plates and secured by [illegible] thereto, the whole is securely clamped together.

457,[illegible]. Electrode for Secondary Batteries. Leonard [illegible]

457,561. Apparatus for Heating by Electricity. Rankin [illegible]
[illegible] relates to that class of apparatus in [illegible] is to be converted into [illegible] magnetism, which is generated by deriving from any suitable electric generator electric currents, preferably of an alternating [illegible] to be heated [illegible] that magnetism may be applied directly thereto and the heat produced within its substance. Smoothing irons, soldering irons, and other tools and utensils of similar character are heated by placing them against or between the poles of an electro magnet, preferably provided with a laminated iron core and energized by a current, preferably alternating in its character. The magnetism is induced within the iron utensil under the influence of the alternating currents within the mass of iron of which the articles are constituted, so that the whole energy of these currents is transformed into heat within the iron.

457,565. Signal Telegraph for Cable Railways. Theodore A. B. Putman, New York, N. Y.
The object of this invention is to provide a signaling telegraph by means of which an alarm may be given in the power house by the driver of any of the grip cars whenever he finds that he can not release his grip. By this invention the signal can be given by the gripman without leaving his post and without a moment's delay, thereby saving every available second of time at an instant when even a slight delay may result in a serious accident.

457,572. Switch. S. Bergman, New York, N. Y.

457,573. Means for Suspending and Controlling Electric Lamps. S. Bergman, New York, N. Y.

457,657. Wind Apparatus for Generating Electricity and Charging Secondary Batteries. James M. Mitchell, Lawrenceville, Ga.
This invention relates to apparatus whereby wind power may be applied to operate a dynamo electric machine for the purpose of generating a current which may be utilized in charging a secondary or storage battery to supply lighting, motor and other circuits.

457,660. Hanger for Trolley Wires. Nelson Newman, Springfield, Ill.

457,687. Electric Light Hanger. Frank A. Weimer, Stanberry, Mo.
This invention consists in forming the flexible conducting cord around a core of steel or other spring material, and then winding the so formed cord like a spiral spring, the core having sufficient elasticity to permit it to be streched or drawn out far enough to allow the lamp to be carried from place to place in the room or hall or even from one room to another and at the same time having sufficient strength to return and hold the lamp in its original position when the latter is brought back.

457,736. Electric Railway. Rudoph M. Hunter, Philadelphia, Pa.
Claim one describes a conduit for an electric railway, provided on its upper portions with lateral flanges formed integral with the side walls, said flanges being provided with drainage apertures, in combination with working conductors located within and insulated from said conduit.

457,745. Electrically Heated Oven. Willis Mitchell, Malden, Mass.
This invention has for its object to increase the efficiency of electrically heated ovens and to protect and insulate the heating wires more effectually and easily than hitherto. For these purposes the bottom, top and sides of the oven are made with successive layers of asbestos or other insulating material, the heating wires being wound around the interior space in successive coils or layers and practically imbedded therein.

457,754. Dynamo Electric Machine or Motor. Edward M. Warning, Brooklyn, N. Y.
In general terms this invention consists of two field magnets arranged one upon each side of the armature concentric with the armature shaft or axis of rotation, the pole pieces of each system being connected together to form consequent poles, the whole structure forming a cage inclosing and protecting the armature and commutator.

457,761. Connection for Electric Conductors. Joseph Dillon, Larchmont, N. Y.
This invention provides a case or shell for inclosing the joined ends of the conductors with parallel openings through which the ends of the cables or sheathed wires or groups of wires are thrust, and into which they are fastened in a manner both rigid to resist mechanical flexure and impermeable to air or moisture. The case or shell is constructed with a cap or cover, which can be applied and removed independently of the connection of the cable ends in said openings. The ends of the conductors in the case are bared of insulation and, being arranged parallel with each other, are electrically connected by applying to them a bridge piece of copper or other conducting metal, the ends of which clasp the bared wires, and are preferably soldered to them.

457,762. Electric Air Pump. Allen A. Dittmar and Hugo Falkenhausen, New York, N. Y.
Claim one describes an electric air pump, suction and discharge compartments communicating with the pump cylinders by valve openings, in combination with solenoids placed over openings in the top plates of the compartments and having movable cores which pass through the openings in the said top plates and act as valve stems, so as to open and close the respective valve openings by electric currents conducted alternately through the respective solenoids.

457,76[illegible]. Electric Light Carbon. William P. Eltringham, Dubois, Pa.
The object of this invention is to prolong the life of the carbon sticks, especially those used in arc lights, so as to do away in a measure with frequent renewals, and it consists in heating or tempering the carbons by the use of borax, or any equivalent of borax either during the process of manufacture of said carbons or afterward.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

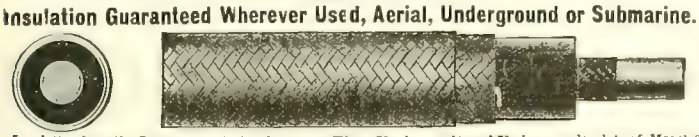
FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.



In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and is **guaranteed to be waterproof, and will not deteriorate, oxidize or crack**, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS,

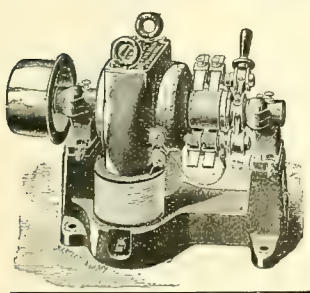
4 LaSalle Avenue, Chicago.

Write us for Prices.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. **Telephone, 1718.**

THE CROCKER-WHEELER



PERFECTED MOTORS.

Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

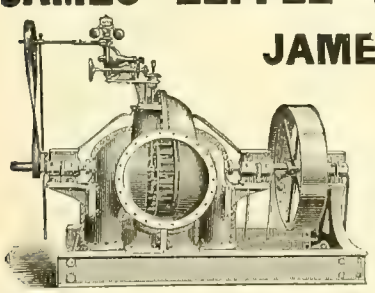
Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.



UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

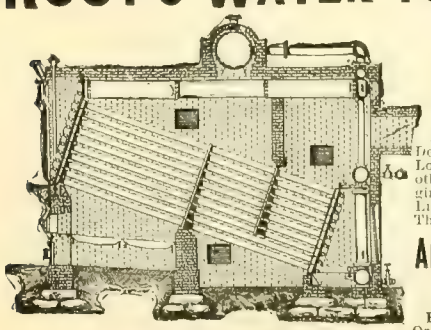
Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE **JAMES LEFFEL & CO.**

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE.



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Electric Light Companies** of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City, and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Beef Line Street Ry. Co., Lynn, Mass., and the Thomson-Houston Electric Co., Lynn, Mass.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

LIGHT MACHINE SHOP

FOR SALE, suitable for electrical work or model maker. Price reasonable. Cheap rent and power. Conveniently located.

LOCK BOX 479, CHICAGO POSTOFFICE.

WANTED.

F. O. R.

STAR GAUGE GLASS CUTTER.

A necessary tool in the engine room, machine shop and on the farm.

No. 1. Cuts tubes [illegible] $1.50

S. TAUSSIG, 45 River St., Chicago. WESTERN AGENT

ELECTRIC SLATE

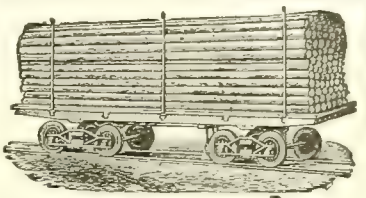
Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. **136 Liberty St.,** NEW YORK.

ELECTRICAL WOOD.



Telegraph Telephone Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 **Park Ave., Brooklyn, N. Y.**

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES

A SPECIALTY.

L. BLATZ, 103-107 West Monroe St., CHICAGO.

"MAGNETIC VANE"

AMMETERS AND VOLTMETERS

ARE THE BEST INSTRUMENTS FOR

Central Stations, Isolated Plants,

Marine Installations, Electric Railways.

Correspondence Solicited.

Send for Illustrated Circular 235.

QUEEN & CO., PHILADELPHIA.

THE ELECTRICAL ENGINEERING AND SUPPLY COMPANY,

413 Jackson St., ST. PAUL, MINN.

Purchasing Dept., 931 Rookery, CHICAGO. Branch Office, DULUTH, MINN.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.
No. 180 MAIN ST.
FITCHBURG, MASS., U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

SYNOVIAL DYNAMO OIL.

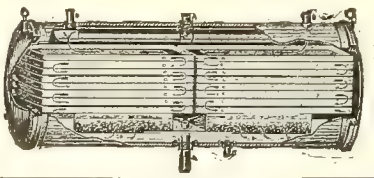
Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

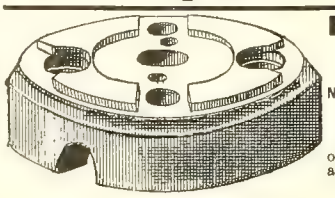
Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

To Colorado via BURLINGTON ROUTE

Only One Night On the Road.

Leave Chicago at 1:00 P. M., or St. Louis at 8:25 A. M., and arrive Denver 6:15 P. M., the next day. Through Sleepers, Chair Cars and Dining Cars. All Railways from the East connect with these trains, and with similar trains *via* Burlington Route to Denver, leaving Chicago at 6:10 P. M., St. Louis at 8:15 P. M., and Peoria at 3:20 P. M. and 8:00 P. M. All trains daily.

Tourists' tickets are now on sale, and can be had of ticket agents of all roads and at Burlington Route depots in Chicago, Peoria and St. Louis.

There is no better place than Colorado for those seeking rest and pleasure.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

ALUMINUM

50 Cents per Pound.

THE COWLES
Electric Smelting & Aluminum Co.,
LOCKPORT, N. Y.,

Offer Aluminum guaranteed to be equal in purity to the best in the market at 50 cents per pound for ton lots in ingots.

Aluminum sheet, wire and castings at lowest market price.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence solicited.

FOR SALE.
New 10 and 25 Light
Arc Dynamos and Lamps.
HIGH TENSION. CHEAP.
JAS. McLAUGHLIN, Mfg. Electrician,
50 N. Clinton St., Chicago.

BEST MAST ARM IN USE.

More Lamps Trimmed. No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRON TOWER CO., FORT WAYNE, IND.

SEND FOR New American Electrical Directory, just published; very complete lists. Invaluable for its information of Lighting and Railway Plants.

COOLIDGE FUEL & SUPPLY CO.,

RAILROAD CROSS TIES AND PILING.

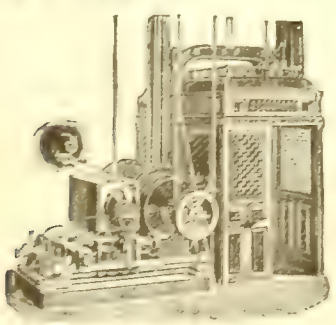
CEDAR AND OCTAGONAL PINE POLES.

CROSS ARMS, PINS AND BRACKETS.

—MANUFACTURED BY—

J. R. CLARK CO., Minneapolis, Minn.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

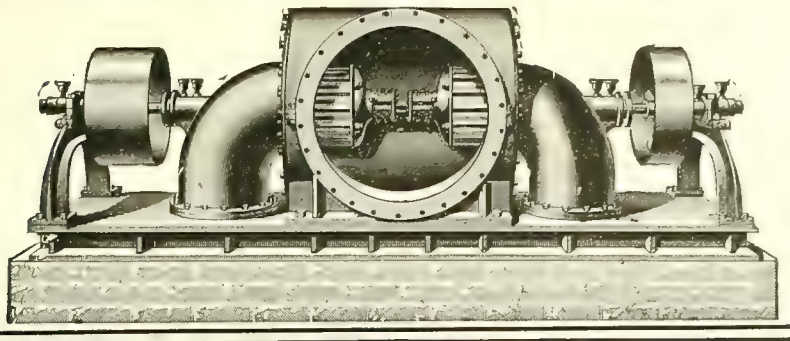
MANUFACTURERS OF

PASSENGER AND FREIGHT

Hydraulic and Electric

ELEVATORS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC [illegible] is called to the **CELEBRATED WATER WHEEL** [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency**, and **large Capacity** [illegible] diameter, being **double** the **Power** [illegible] number of the leading electric [illegible] ical use of water it is without an equal [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a [illegible] Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The [illegible] strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

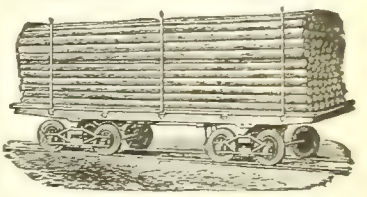
HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,
Consulting and Constructing
ELECTRICAL AND MECHANICAL ENGINEERS.
Complete Equipment of Electric Railways. Steam and Electric Plants.
47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

TO LAY HOLD! AND HANG ON!

HUMP!

In the interest of the

"SUNBEAM"

Is our immediate business on earth. July—the dullest month of the year—proved for us a "BANNER" month.

Like "some other" things the

"SUNBEAM"

Lamp improves with AGE. Continued use proves its HIGH AVERAGE efficiency.

Write for prices.

The Sunbeam Incandescent Lamp Company,

CHICAGO, ILLINOIS.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

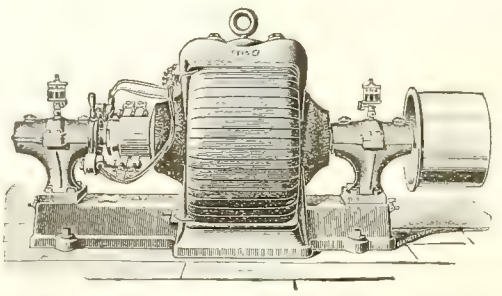
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



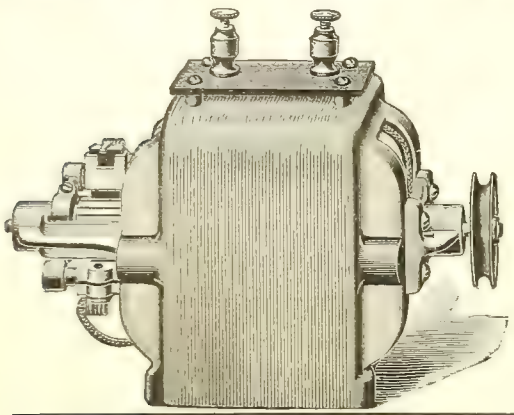
Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

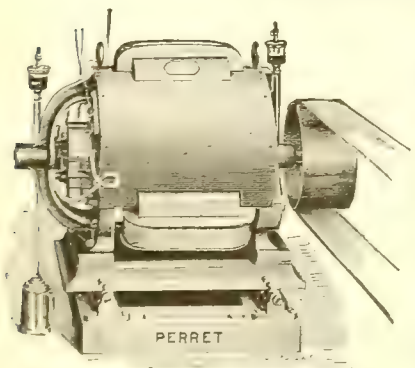
Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.



Perret 25 H. P. Motor, Speed 550, Weight 1,200 lbs.

—MANUFACTURERS OF—

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.

JOHN STEPHENSON CO.,

LIMITED,

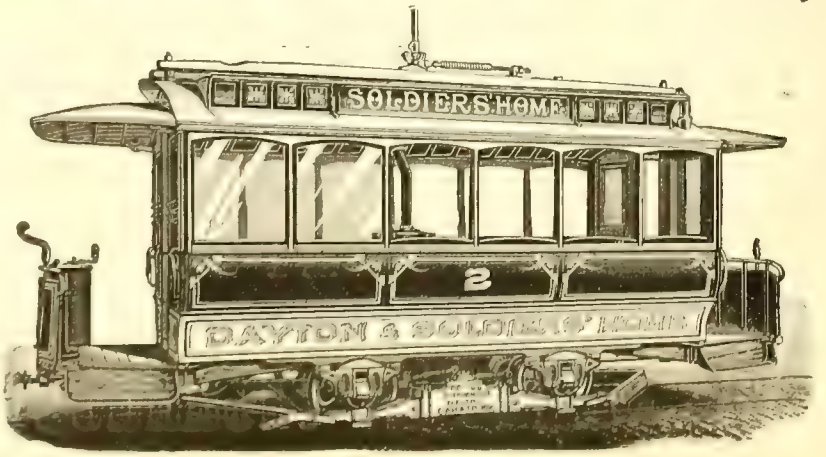
NEW YORK.

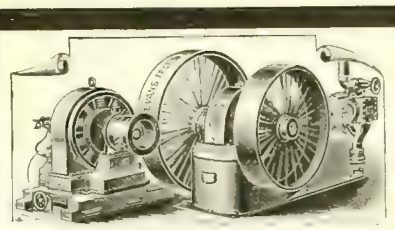
STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.



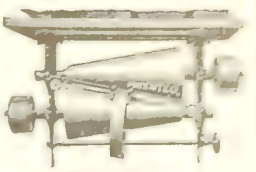


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | **CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.**

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

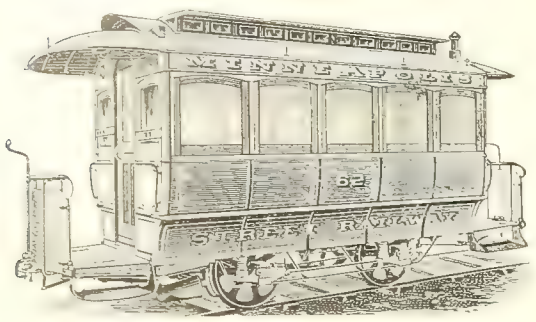
Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

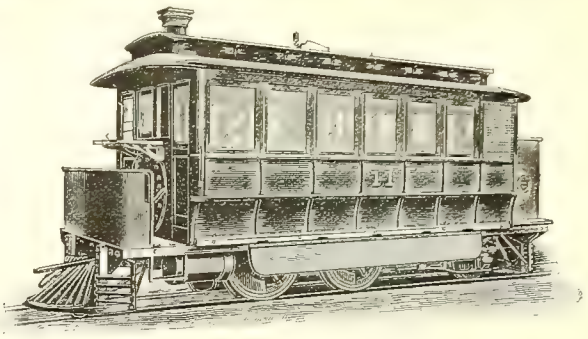
Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.



STREET CARS



FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

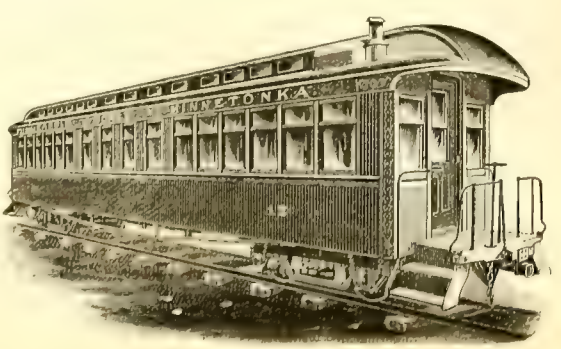
MINNEAPOLIS STREET RAILWAY CO.,

Of Minneapolis, Minn.,

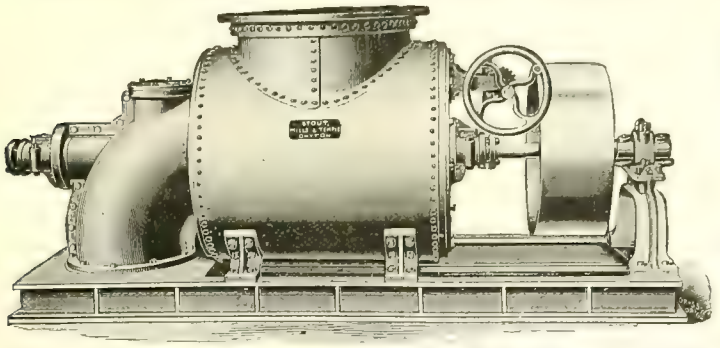
OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.



The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

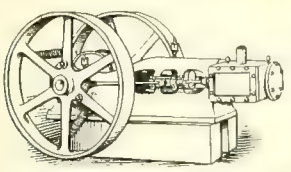
ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shafts.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North Street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY THE BALL ENGINE CO ERIE PA.

Binders FOR THE Western Electrician $1.00.

STEAM PLANTS

INSTALLED BY

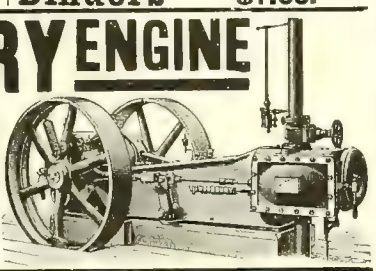
W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application. —
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES | Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



WESTINGHOUSE ENGINES

A FEW RAILROAD USERS:

	Engines.	Horse-powers.
Ashland Coal & Iron Railroad Co	1	60
Baltimore & Ohio Railroad Co	6	190
Boston & Albany Railroad Co	3	130
Camden & Atlantic Railway Co	3	75
Central Railway of New Jersey	4	275
Chicago & Erie Railway Co	2	30
Chicago, Burlington & Quincy Railroad Co	3	175
Chicago, Milwaukee & St. Paul Railroad Co	5	100
Chicago, Rock Island & Pacific Railroad Co	4	170
Colorado Midland Railway Co	1	25
Denver & Rio Grande Western Railroad Co	3	75
East Tennessee, Virginia & Georgia Railroad Co	3	325
George's Creek & Cumberland Railroad Co	2	50
Grand Trunk Railway Co. of Canada	12	500
Gulf, Colorado & Santa Fe Railway Co	3	135
Kansas City, Wyandotte & Northwestern Railway Co	2	55
Newport News & Mississippi Valley Co	2	200
New York Central & Hudson River Railroad Co	4	127
New York, Lake Erie & Western Railroad Co	2	140
New York, West Shore & Buffalo Railroad Co	6	340
Northern Pacific Railroad Co	2	45
Pennsylvania & Northwestern Railroad Co	1	25
Pennsylvania Railroad Co	51	2330
Peoria & Pekin Union Railroad Co	1	55
Philadelphia & Reading Railroad Co	7	615
Pittsburgh, Cincinnati, Chicago & St. Louis Railway Co	2	20
St. Louis & San Francisco Railway Co	3	260
Southern Railway Co	1	10
Wabash, St. Louis & Pacific Railroad Co	4	60
Washington & Georgetown Railway Co	1	15

Many foreign railroads unreported.

THE WESTINGHOUSE MACHINE COMPANY. PITTSBURGH, PENNA. U.S. OF A.

FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO.
HALF TONE PLATE A SPECIALTY

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,

ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

"BE YE THE JUDGE."

HAVE YOU TRIED THE

ECONOMIC INCANDESCENT LAMP?

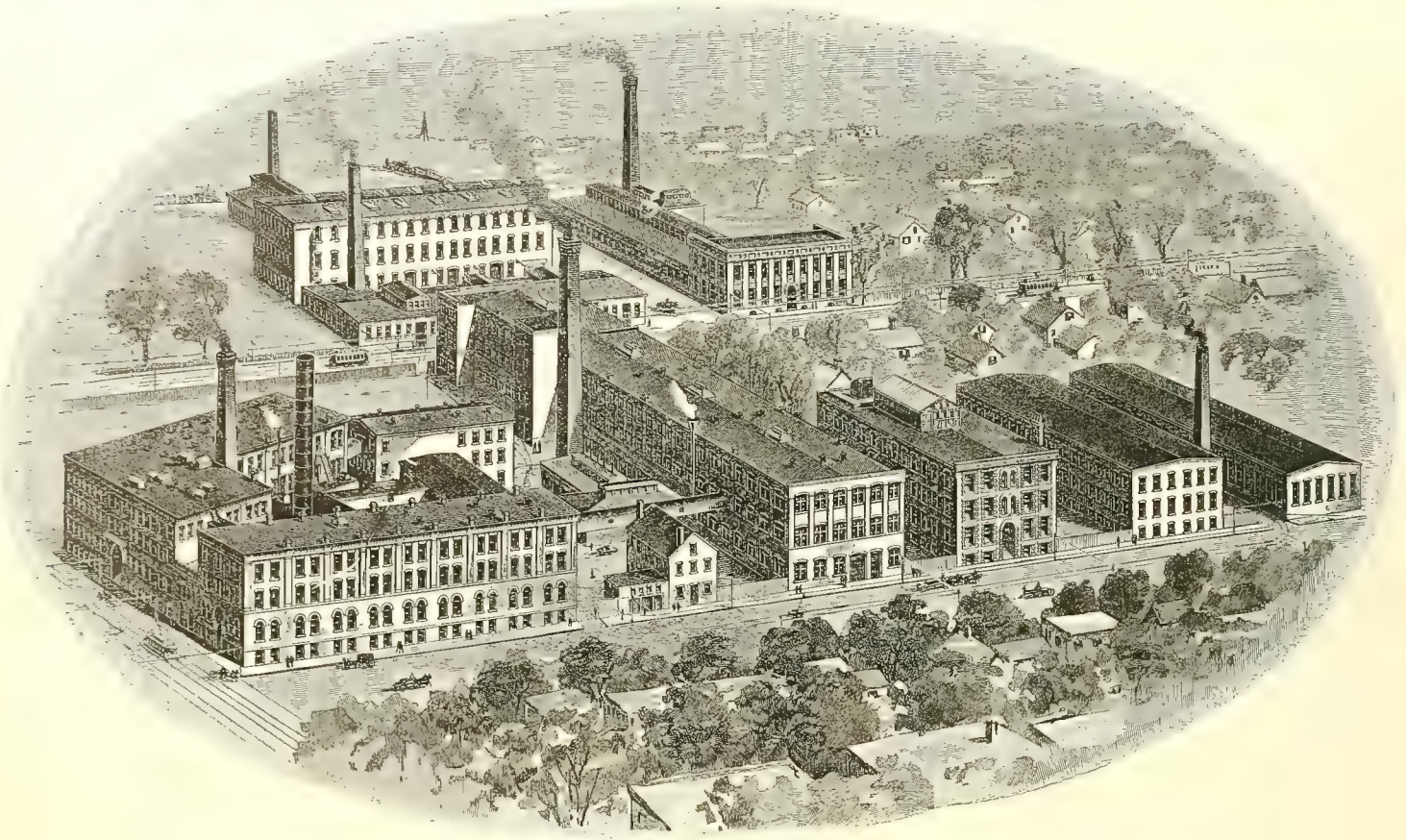
If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again*. Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

GEO. L. KIRKHAM, Manager. 1017 Chamber of Commerce, CHICAGO.

THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.

The KNAPP ELECTRICAL WORKS,

GENERAL AGENTS FOR

"SAFETY"

WIRES, CABLES AND CORDS

For Inside, Underground and Submarine Use.

"SAFETY" Fire-Proof House Wire. "ATLAS" Line Wire.

R. B. WATSON & CO., Agts., DETROIT, MICH.

J. W. MASON, Agt., 527 Delaware Street, KANSAS CITY, MO

POST & CO., Agts., CINCINNATI, O.

THE PERKINS ELECTRIC LAMP CO.

LAMPS

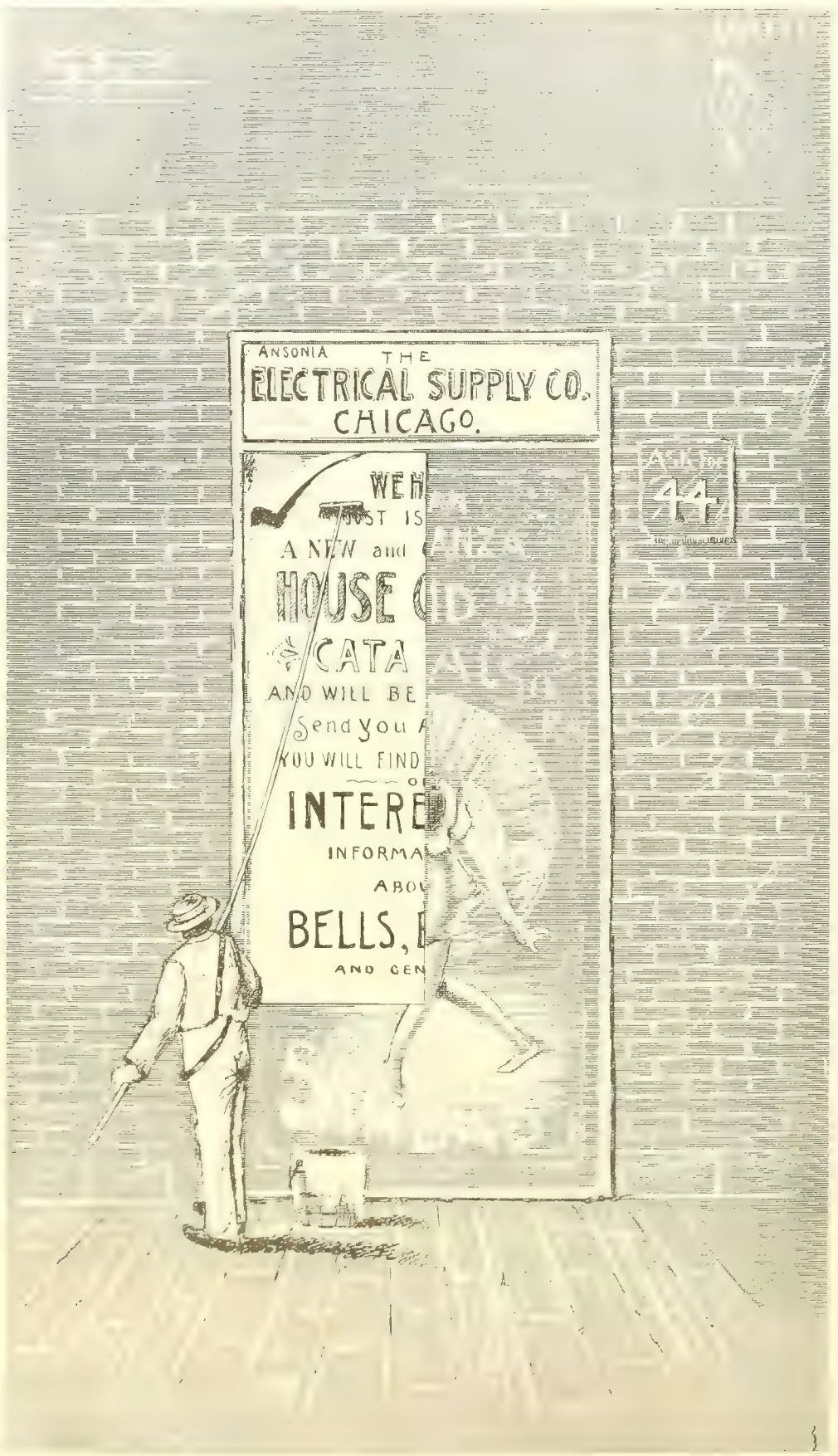
TO FIT ANY SOCKET.
ANY CANDLE POWER.
ANY VOLTAGE.
LONGEST LIFE.
HIGH EFFICIENCY.

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

54 and 56 Franklin Street, CHICAGO.

SEND FOR CATALOGUE.


ANSONIA THE
ELECTRICAL SUPPLY CO.
CHICAGO.
WEH
ST IS
A NEW and
HOUSE
CATA
AND WILL BE
Send You
YOU WILL FIND
INTERE
INFORMA
ABO
BELLS,
AND GEN
44

THOMAS STURGIS, President. WM. C. LANE, Secretary and Treasurer. C. P. MACKIE, General Manager. S. S. HOGART, General Agent

ELECTRIC SECRET SERVICE CO.,

45 BROADWAY, NEW YORK.

Owning the patents of Mosher, Gill, Hatch, Foote, Kintner and Moore for

INDIVIDUAL TELEGRAPH CALL AND CUT-OUT APPARATUS.

OTHER PATENTS PENDING.

The only practical and reliable system of electric selection invented.

Use either *Morse Key* or *Automatic Transmitter*.

From every station selected an *Automatic Answer Back* is received.

Gong rings until shut off by operator.

Any office on line can be selected without disturbing the others and either called up or cut out. No interference with regular telegraph service. No resistance added to main line. Easily applied. Economical. Convenient. Reliable.

Applicable to arc lights, singly or in groups; fire alarm service; police telegraph; electric motor circuits; railroad signals, etc.

The public is warned against infringing companies and dealers.

For terms and other particulars, address as above.

"WARD" ARC LAMPS,

FOR CONSTANT POTENTIAL CIRCUITS.

THOUSANDS IN USE

On both Isolated and Central Station Plants.

WE GUARANTEE OUR LAMPS ELECTRICALLY AND MECHANICALLY.

In corresponding please give full particulars and state voltage.

ELECTRIC CONSTRUCTION AND SUPPLY COMPANY,

Phenix Bldg., CHICAGO, ILL. 18 Cortlandt St., NEW YORK CITY.

ESTABLISHED 1881.

ELECTRICIAN PUBLISHING COMPANY'S

HAND-BOOK SERIES.

22,000 Copies published to date. An Astonishing Record.

Dynamo-Tenders' Hand-Book.

By Lieut. F. B. Badt.

Fourth Edition, Eighth Thousand.

94 Pages, 70 Illustrations, Flexible Cloth Binding, Type Page 6x3 inches.

The only PRACTICAL Dynamo-Tenders' Instruction Book in the English language. Just the book for Dynamo-Tenders, Linemen, Stationary and Marine Engineers who wish to learn how to operate and care for electric light or power plants. Moonlight schedule for 1891.

Bell-Hangers' Hand-Book.

By Lieut. F. B. Badt.

Second Edition, Fourth Thousand.

106 Pages, 97 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches.

Designed for those engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat regulating apparatus, etc. The only book of the kind published.

Incandescent Wiring Hand-Book.

By Lieut. F. B. Badt.

Third Edition, Seventh Thousand.

72 Pages, 42 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches. Five Tables, 12x18 Inches.

These tables give *at once* and without any calculation the size of wire required in each case for any percentage of loss.

It is a book for practical wiremen and learners, and does not require any previous knowledge of wiring. It differs in this respect from other wiring tables, or computers.

The book contains full illustrations and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, wiring of fixtures, elevators, buildings, etc. The only book of the kind published.

Electric Transmission Hand-Book.

By Lieut. F. B. Badt.

First Edition, Three Thousand Copies.

97 Pages, 22 Illustrations, and 27 Tables. Flexible Cloth Binding. Type Page 6x3 Inches.

This book contains all practical information for power-producers, capitalists, agents of hydraulic and electric companies, engineers, motor inspectors and other persons interested in electric power transmission. By means of the tables anybody can find at once cost of plant for least operating expenses, or for minimum first cost of installation.

The book gives all necessary information concerning motors, and rules for ascertaining horse power of motors, driving various classes of machinery, as hoists, pumps, street or tram cars, fans, etc.

Twenty-seven new and original tables give more information on the subject in a small space than any book heretofore published on the same subject.

Each Work Sent Postpaid on Receipt of One Dollar.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

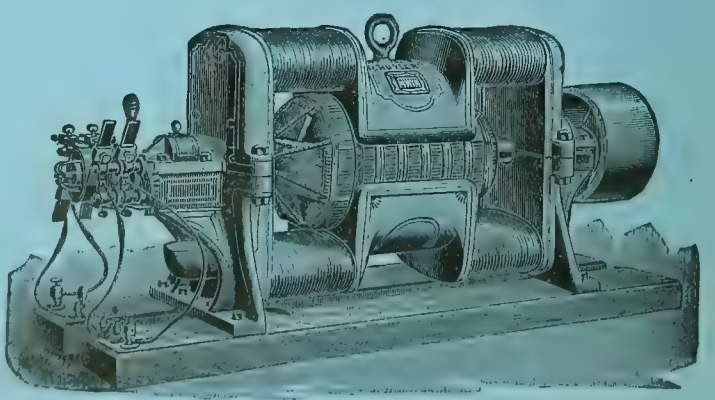
FACTORIES AND GENERAL OFFICES. BALTIMORE, MD.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES.



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, AUGUST 29, 1891. No. 9

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

SPEAKING TUBES AND WHISTLES.
Oral, Electric, Pneumatic and Mechanical
ANNUNCIATORS & BELLS.
FULL LINE ALWAYS IN STOCK.
W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE. Out August 1st.

HIGH INSULATION,
LOW STATIC CAPACITY
And Resistance, according to Mr.
JACQUE'S FORMULA, makes
Telephonic transmission through Our Cable an easy
CAME.

An Electro Static Capacity of .08 OF A MICRO FARAD PER Mile has been obtained by us. Write for Particulars and Prices.
Standard Underground Cable Co., New York, Pittsburgh, Chicago.

WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

DO YOU WANT
A THOROUGH INSULATING PIPE?
AN INDESTRUCTIBLE PIPE?
PIPE TESTED SUCCESSFULLY?
THE PATENT INDURATED FIBRE PIPE
Costs less than iron and does better work in electrical subways and elsewhere.
SOLE AGENTS:
Engineering Equipment Co.,
143 Liberty St., NEW YORK.
126 Pearl St., BOSTON.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International OKONITE COMPANY, LIMITED.
13 Park Row, New York.
INSULATED WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.
OKONITE TRADE MARK
BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF
THE Packard HIGH GRADE INCANDESCENT LAMP
AGENTS
J. W. PEALE, 1 BROADWAY, NEW YORK.
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.
Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.
STANDARD ELECTRICAL MEASUREMENT APPARATUS.

D. M. CLOWER, C. O. HARRIS E. T. LEWIS. B. W. BRYAN
CLOWER, HARRIS & CO.,
CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.
The largest Electrical Supply House west of the Mississippi River.
Everything Electrical.
289 ELM STREET. - - DALLAS, TEXAS.

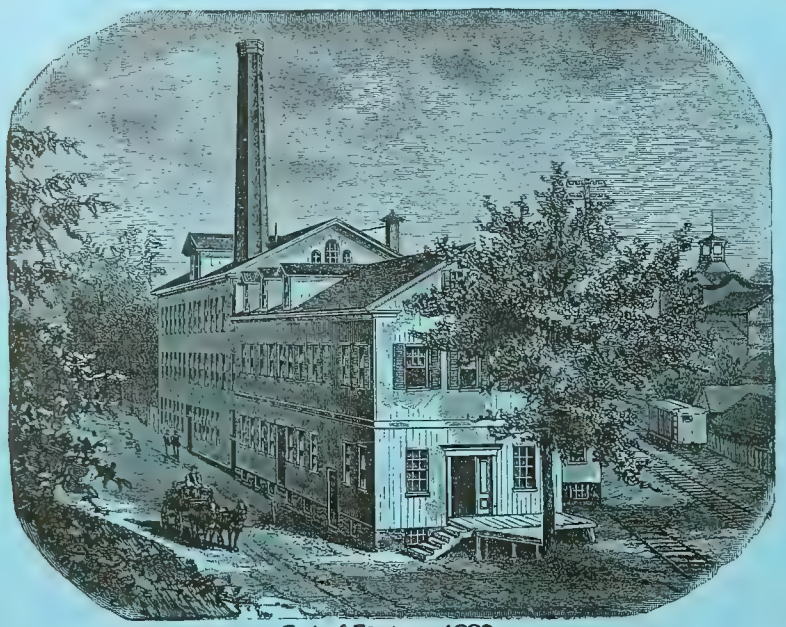
ELECTRIC SLATE
Switch-boards a Specialty.
Small samples of plain and marbleized free.
T. J. MURPHY,
Electrical Exchange Bldg. Room 215. 136 Liberty St., NEW YORK.

THE 1891 ELECTRIC MOTOR AND BATTERY.

SIMPLE. DURABLE.
ECONOMICAL. EFFICIENT.
For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at
ONE-HALF PRICE.
Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IS THE THOMSON-HOUSTON ELECTRIC CO.'S SYSTEM OF LIGHTING A SUCCESS?



Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, 1,653 Lamps.	None.	None.

Cut of Factory, 1886.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, 21,840 Lamps.	29 Companies, 11,275 Lamps.	None.

Read the Answer on Page XX.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The........xxvi
Abendroth & Root Mfg. Co...——
Alexander, Barney & Chapin.....i
American Electrical Works.....xiii
Andrews & Co., A. H..........xiv
Automatic Switch Co.......... x
Baggot, E.......................xiv
Bain Electric Mfg. Co.........xvi
Ball Engine Co..................xix
Baxter Electric Motor Co......xxvi
Bernstein Electric Co..........viii
Blatz, L.........................——
Borden & Selleck Co............xv
Braun Illustrating Co..........xix
Brownlee & Co..................xii
Brookfield, Wm..................xii
Brush Electric Co..............xvii
Butler Hard Rubber Co.........——
Buxton, Geo. B..................xxii
C. B. & Q. R. R...............xiv
C. & C. Electric Motor Co. ... xvi
Card Elec. Motor & DynamoCo——
Central Electric Co........... v
Chicago Electric Mfg. Co...... viii
Chicago Electric Motor Co......xiii
Clower, Harris & Co.............i
Chicago Insulated Wire Co.... xvii
Colburn Electric Mfg. Co...... xiv
Coolidge, Fuel & Supply Co...——
Consol. Elec. Mfg. Co., The..——
Cowles Electric Smelting and Aluminum Co............ xiv
Crocker-Wheeler Electric Motor Co............................xiii
Day's Kerite Insulation...........i
Dayton Globe Iron Works Co..xix
Eastern Electric Cable Co.......xiii
Edison General Electric Co.,—Motor Dept.............. vi
Edison General Electric Co., Cable and Wire Department......vii
Electric Construction & Sup. Co. xxii
Electric Merchandise Co........ iv
Electric Secret Service Co..... xxi
Electrician Pub. Co...xiv, xviii, xxv
Elec. Construction Co., The.....xiii
Electrical Engineering Co.......xiii
Elec. Eng. & Supply Co., The.——
Electrical Supply Co., The.. xxiv
Elektron Mfg. Co...............xvi
Empire China Works........ xiv
Engineering Equipment Co.......i
Erie Electrical Supply Co........xii
Evans Friction Cone Co....... xvii
For Sale........................xiii, xiv
Foster, O. A.........................i
Fort Wayne Electric Co...... xxvi
Freeman, Coleman & Co....... xxii
Globe Carbon Co............... xv
Great Western Elec. Supply Co. viii
Greeley & Co., The E. S...........i
Hale Elevator Co............... xiv
Heisler Electric Light Co........ xxi
Hill Clutch Works.............. xxii
Hine Eliminator Co...........——
Holmes, C. H....................xiii
Holmes, Booth & Haydens.... xvii
Hood, Wm...................... x
India Rubber & Gutta Percha Insulating Co.............. xxi
Interior Conduit & Insulation Co...iv
International Okonite Co...........i
Kartavert Mfg. Co................xii
Knapp Electrical Works.......xxiii
Law Telephone Co..............xiii
Leonard & Co., H. Ward....... iv
Leffel & Co., Jas................xiii
Loud, H. M. & Sons Lumber Co. xiv
McLaughlin, James xiv
Manhatten Elec Supply Co.... viii
Mason, James H.................xiii
Milliken Bros.......................iv
Minneapolis Street Railway Co..——
Monitor Electric Co............. x
Mosher Arc Lamp Co..........xiv
Munsell & Co., Eugene..........xiii
Murphy, T. J.........................i
National Carbon Co...............iv
National Electric Mfg. Co........ix
N. Y. Belting & Packing Co... ——
New York Insulated Wire Co.... x
New York & Ohio Co............. i
N. W. Elec. Specialty Co.....——
Nuttall Company, R. D........ i
Ohio State University.......... xii
Ostrander & Co., W. R...........i
Paiste, H. T.......................xii
Page Belting Co.................. xiv
Partrick & Carter Co............. x
Payne & Co., Geo. W............——
Pearson & Co., W. B.............xix
Phoenix Glass Co................xxii
Pond Engineering Co............ xix
Powell Co., The Wm............——
Queen & Co......................xiii
Rochester Railway Co............xii
Rockford Electric Mfg. Co..... xii
Sargent & Lundy.................xiii
Sawyer-Man Electric Co..........xi
Schieren & Co. Chas. A.........xi
Schoonmaker, A. O..........xii
Schuyler Electric Co........ ... viii
Short Electric Railway Co...... xii
Shultz Belting Co............. xxii
Standard Underground Cable Co....i
Standard Paint Co...................xii
Stanley Electric Mfg. Co.... .xviii
Star Iron Tower Co...........——
Stearns Mfg. Co.................xix
Stephenson Co., Jno..............xvi
Sterling, W. C.................... xv
Stilwell & Bierce Mfg. Co....xiv, xv
Sunbeam Incand. Lamp Co xv
Taussig, S......................... viii
Temple, J. C...................... xv
Thomson-Houston Electric Co. Lighting Department... ii, xx
Turner Brass Works............xiii
Union Electric Mfg. Co., The..——
Union Electric Works..............iv
Union Hardware Co..............xii
U. S. Electric Lighting Co.....xi
Van Nuis C. S.........................i
Vulcanized Fibre Co............. xv
Wanted xiii
Wenstrom Consolidated Dynamo & Motor Co., The x
Western Electric Co............ vii
Westinghouse Elec. and Mfg Co. —
Westinghouse Machine Co..... xix
Weston Electrical Instrument Co...xii
Williams Engine Works........ xix
Windsor Hotel, The......... ..vii
Woodbridge & Turner Engineering Co xv
Woodhouse & Rawson, Ltd....——
Worthington, Henry R............xii

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Manhatten Elec. Supply Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Manhatten Elec. Supply Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Rochester Railway Co.
Stephenson Co., John.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Engineering Equipment Co.
Fort Wayne Electric Co.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Manhatten Elec. Supply Co.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hotels.
Windsor Hotel, The.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus, Electric.
[illegible]

Motors.
[illegible]
Chicago Electric Motor Co.
[illegible]
Motor Co.
[illegible]

Name Plates.
Blatz, L.
[illegible]
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
[illegible]

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment
Minneapolis Street Ry. Co.
Rochester Railway Co.

Supplies, Electric Railway
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co
Electric Secret Service Co
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Universities.
Ohio State University.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.

CLEVELAND, OHIO. **THE NATIONAL CARBON CO.** CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

UNION ELECTRIC WORKS,

207 SOUTH CANAL STREET, CHICAGO, ILLINOIS.

The BEST ELECTRIC BELL in the market; Nickel plated Gongs: Double magnet, Platinum Contacts, side adjustments with set screw. The simplest and most durable Annunciator, all sizes, for elevators, hotels and offices.

—WRITE FOR PRICES.—

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class Work.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK. MANUFACTURED BY **MILLIKEN BROS.** 59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

H. WARD LEONARD & CO.,

ELECTRICAL ENGINEERS.

GENERAL ELECTRICAL INTELLIGENCE BUSINESS.

Under the above heading we have considered a very important feature of our business, which will be entirely unique and commendable. To any Isolated Plant we offer, at a very moderate subscription price ($25.00 a year), the privilege of corresponding upon any electrical subject of practical interest. Thus, an isolated plant will be able to secure expert information as to its own plant, the best methods of operating it, and about any new electrical apparatus or methods and the principles underlying various devices and the prices thereof. For Central Station Companies, whose queries would go further into Steam Engineering and methods of distribution and also would cover business questions as to relations with consumers, systems of accounts, etc., the annual subscription charge for this electrical intelligence will be $50.00.

In case the expert judgment of the Company be desired as to comparative merit of various competing apparatus or methods, such expert judgment will be given by special arrangement although the Company prefers to merely supply full information under the subscription arrangement and allows the purchaser to form his own conclusions.

SUBSCRIPTION CONTRACT.

H. WARD LEONARD & CO.

GENTLEMEN:—Please enter the subscription of the undersigned for such electrical information as may be requested of you, subject to the following conditions:

FIRST.—The subscriber shall have the privilege of calling for any information which he considers may be of practical value to him in the operation of his plant.

SECOND.—All queries shall be by correspondence only.

THIRD.—H. Ward Leonard & Co. shall not be called upon under this yearly subscription to give its expert judgment on the comparative merit of various apparatus or systems, but shall furnish full descriptive information regarding the character, principles, methods, forms, catalogues, prices, etc., involved by the questions as far as they are able to.

FOURTH.—All information supplied to the subscriber shall be confidential and for his information only.

FIFTH.—This subscription shall be for one year from date and at the rate of Twenty-five dollars per year.

Signed, ...

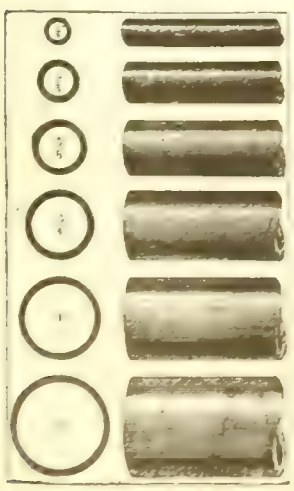
The usual subscription is by the year. To enable subscriber to judge of the merits of such a plan, we will make the following special offer:

To all parties signing the above subscription contract and returning same to the Company promptly, it will agree that the date of expiration of the contract is December 31st, 1892.

To parties other than Isolated Plants and Central Stations, special quotations will be made for these services on application. Address

H. WARD LEONARD & CO., - Electrical Exchange Building, NEW YORK.

The SOLUTION of the PROBLEM of SAFE GUARDING ELECTRIC CONDUCTORS



Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

THE INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

[illegible] Engineering Co., [illegible] Dearborn St., Chicago, Ill.
[illegible] Electric Co., Baltimore, Md.
[illegible] Co., [illegible] Sutter St., San Francisco, Cal.
[illegible] Provident Bldg., Philadelphia, Pa.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 LOCUST ST., ST. LOUIS, MO.

BANNER WIRE.

GATE CITY ELECTRIC COMPANY,
522 DELAWARE ST., KANSAS CITY, MO.

A NEW WEATHER-PROOF WIRE.

Double, Triple and Quadruple Braid.

This is the best finished, best insulated, most durable and generally the most satisfactory of all the ordinary weather-proof Wires. Send for samples before placing your construction orders.

PRICES LOW. SHIPMENTS PROMPT.

Also GENERAL WESTERN AGENTS for

AND

IMPROVED CANDEE WEATHERPROOF WIRES.

These Wires are positively the best of their respective classes.

BRANCH BLOCKS, SOCKETS,
MAIN CUT-OUTS, PAISTE SWITCHES
AND GENERAL ELECTRICAL SUPPLIES.

CENTRAL ELECTRIC COMPANY,

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., OMAHA, NEB.

116 & 118 FRANKLIN ST.,
CHICAGO.

Connected by private wire with Postal Telegraph-Cable Company's System.

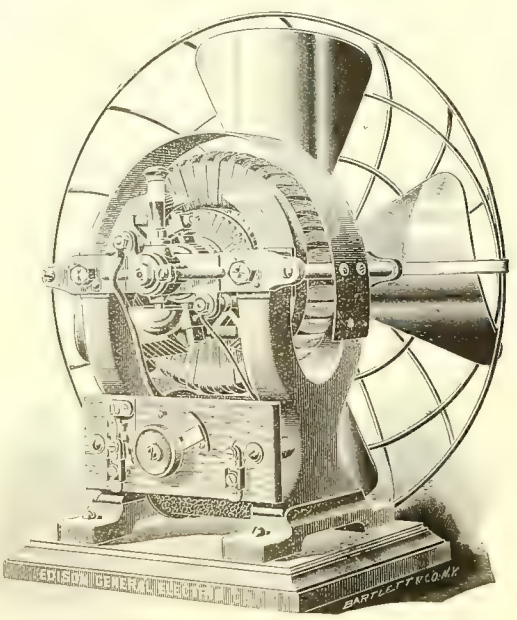
ELECTRIC POWER AND TRANSMISSION CO.,
DENVER, COLO.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.

ELECTRIC FANS.

These Fans are operated by new Edison Slow Speed Motors, requiring Minimum amount of attention and lubrication.



They are compact and especially suitable for office desks and similar places.

Will operate on any ordinary Lighting Circuit without Wasteful Resistance.

List Price, Motor and Fan, $42.50, less 45 per cent. to Users. Net, $23.36.

For Particulars Address Nearest District Office.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, 173 and 175 Adams St., Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

The Windsor Hotel,

HEADQUARTERS OF

The National Electric Light Association.

It is situated on Dominion Square, in the fashionable quarter of Montreal, is the finest hotel in the Dominion, and in constructive substantiality, architectural chasteness, elegance of equipment and modern appointments compares favorably with any hotel in the world. It is within a few steps of the Canadian Pacific and Grand Trunk Railway stations, from which trains diverge to all points in the Dominion and the United States. Equally convenient are the wholesale and retail business quarters and all objects and places of interest to tourists, including the cathedrals, churches and convents; the great financial institutions, markets and quays, as also the public squares, parks and boulevards. It is the recognized headquarters for tourists, and affords special accommodations to wedding parties, families and commercial and other conventions. The cuisine and wines are of the first quality, and the establishment is maintained up to the best standard.

G. W. SWETT, Manager.

WESTERN ELECTRIC COMPANY,

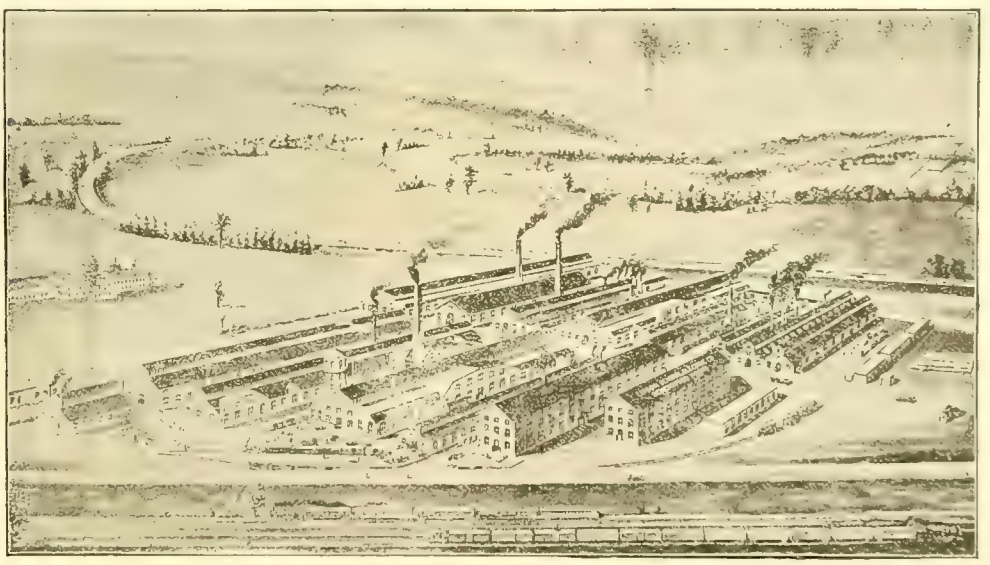
CHICAGO,
NEW YORK,
LONDON,
ANTWERP,
BERLIN,
PARIS.

MANUFACTURERS AND DEALERS IN

Arc and Incandescent Electric Light Apparatus, Patterson Underground and Overhead Cables, I. C. Weather-proof Wire, Washburn & Moen's Hard Drawn Copper Trolley and Galvanized Iron Wires, House Goods, Testing Apparatus, District Telegraph Apparatus, Line Supplies, Tools and all other Electrical Appliances.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

LIGHTING SUPPLIES. HOUSE GOODS.
RAILWAY SUPPLIES. FIXTURES.

Great Western Electric Supply Co.,

201, 203, 205, 207 SOUTH CANAL STREET, CHICAGO, ILL., U. S. A.

73-75 W. Jackson St. RELIABLE

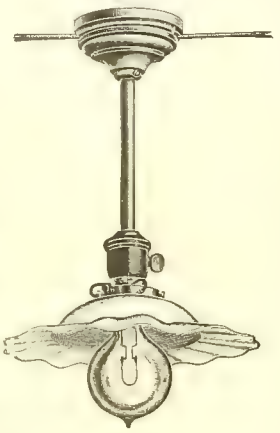
WE ARE FITTED WITH RELIABLE Machinery and Tools,
And Employ RELIABLE Workmen.
All Kinds of Electrical Apparatus to Order.
CHICAGO ELECTRIC MFG. CO.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,
BOSTON, - MASS.

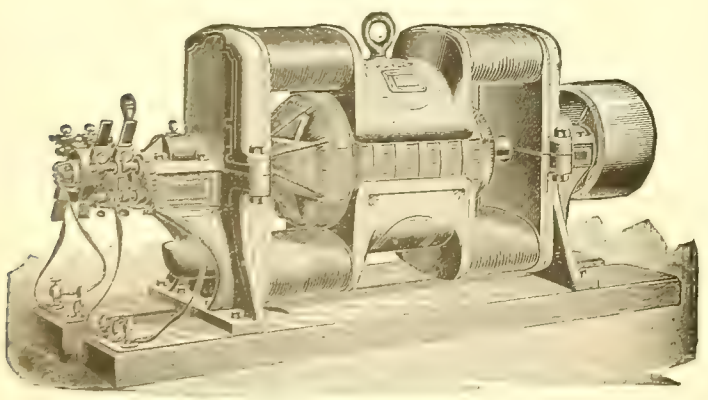
REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

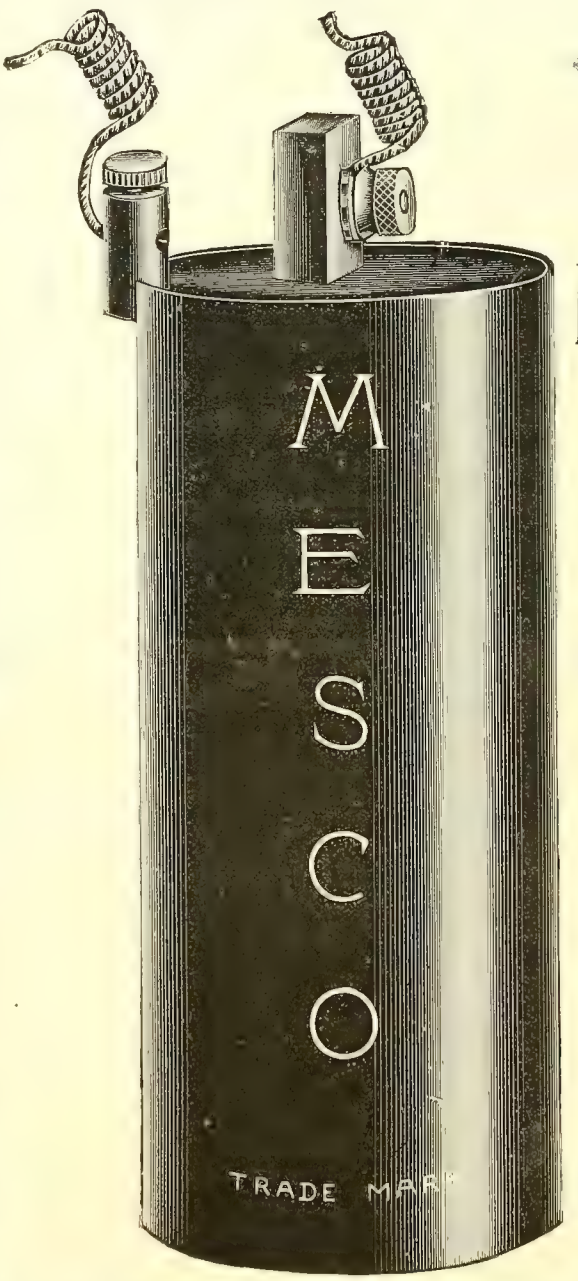
THE SCHUYLER ELECTRIC CO.,
MIDDLETOWN, CONN.

STAR GAUGE GLASS CUTTER.

A necessary tool in every engine room. Sent by mail on receipt of price.

No. 1. Cuts over 5 inches $1 50
" 2. " " 8 " 2 00

S. TAUSSIG, 45 River St., Chicago. WESTERN AGENT.



THE MESCO DRY Battery.

(CUT FULL SIZE.)

PATENT Applied For.

For Call Bells, Annunciators, Burglar Alarms, Telephones, the Laboratory, and all OPEN CIRCUIT USE.

PRICE, 80 CENTS.

Guaranteed equal to any Dry Battery made, in E. M. F., Durability and Recuperative Power. No infringement on any existing patent.

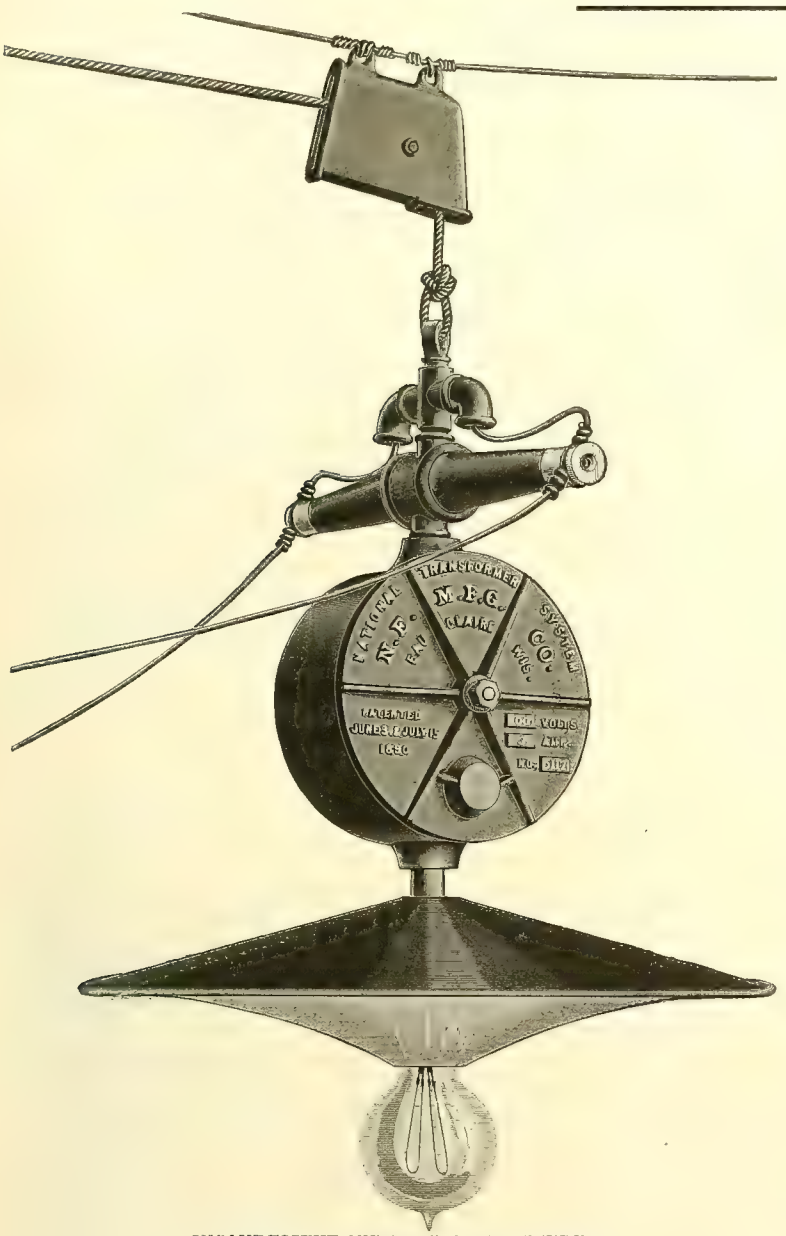
Exhausted Batteries Replaced at a Nominal Price.

LIBERAL DISCOUNTS TO THE TRADE.

MANHATTAN ELECTRICAL SUPPLY CO.,
36 CORTLANDT ST., NEW YORK.

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



INCANDESCENT STREET LIGHT FIXTURE,
SERIES TRANSFORMER, REFLECTOR CANOPY AND 32 C. P. LAMP.

WHY

USE ARC LAMPS

WHEN THE

NATIONAL

SERIES TRANSFORMER

ENABLES YOU TO DO

STREET LIGHTING

ECONOMICALLY
EFFICIENTLY
SATISFACTORILY ???

Send for Circulars and Prices.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND
PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

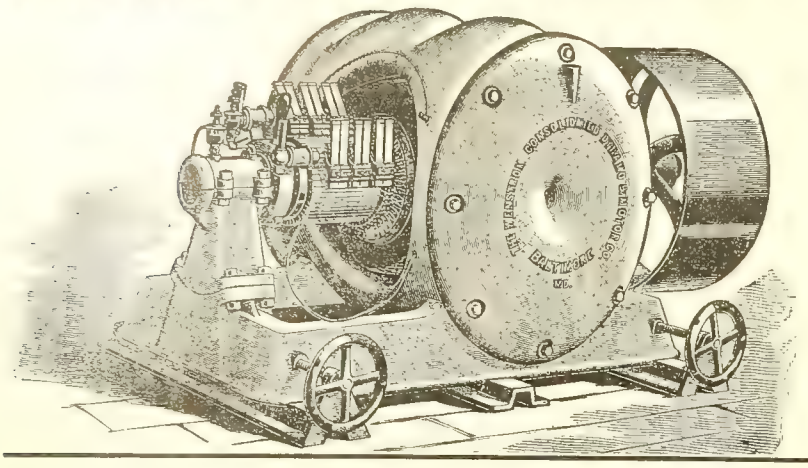
AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	**ST. PAUL, MINN.,**	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	**DETROIT, MICH.,**	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	**DENVER, COLO.,**	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	**WINNIPEG, MAN.,**	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	**SAN FRANCISCO, CAL.,**	National Electric Development Co
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.	**KANSAS CITY, MO.,**	Thomas Wolfe, 515 Main St.
SEATTLE, WASH.,	Chas. H. Baker & Co.	**DULUTH, MINN.,**	The Electrical Eng. & Supply Co

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

WM. HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

MONITOR

CARBON

BATTERY

Unsurpassed in Strength and Durability.

LIBERAL DISCOUNT TO THE TRADE.

Write for Quotations.

C. A HARMOUNT, M'gr,

Monitor Electric Company

149 WABASH AVENUE,

. . . . Chicago, Ill.

Western Agents Alfred F. Moore's Wires and Cables.

WE ARE IN IT

AND HAVE WITH US AT

OUR NEW BRANCH WAREHOUSE, Nos. 78, 80 & 82 FRANKLIN ST., CHICAGO,

SEVERAL CARLOADS OF OUR CELEBRATED

GRIMSHAW "WHITE CORE," "B. D." BRAIDED and COMPETITION

GRIMSHAW TAPES AND COMPOUNDS.

WIRES.

You can buy from us at Manufacturers' Prices.

NEW YORK INSULATED WIRE CO.,

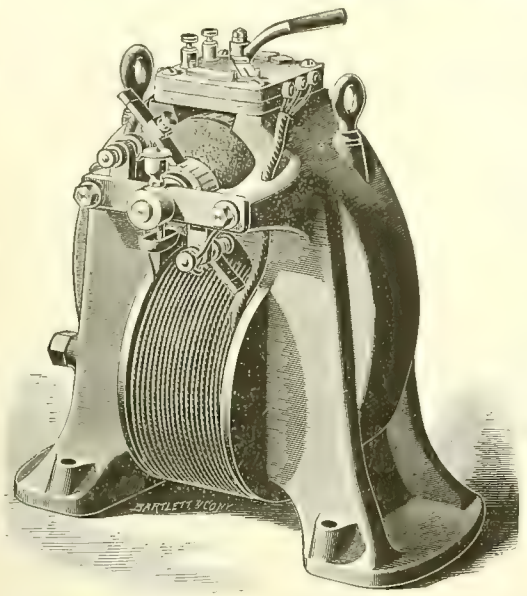
MAIN OFFICE, 649 & 651 BROADWAY, NEW YORK.

G. H. MEEKER, Western Manager.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos. — Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

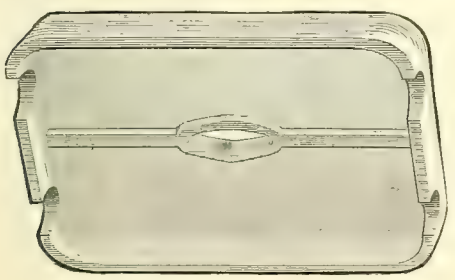
MOTORS and GENERATORS

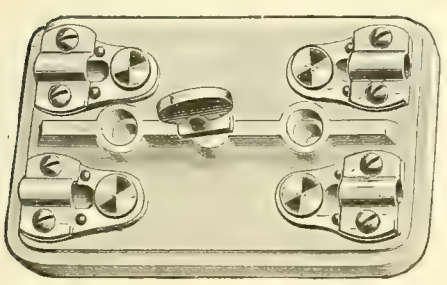
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

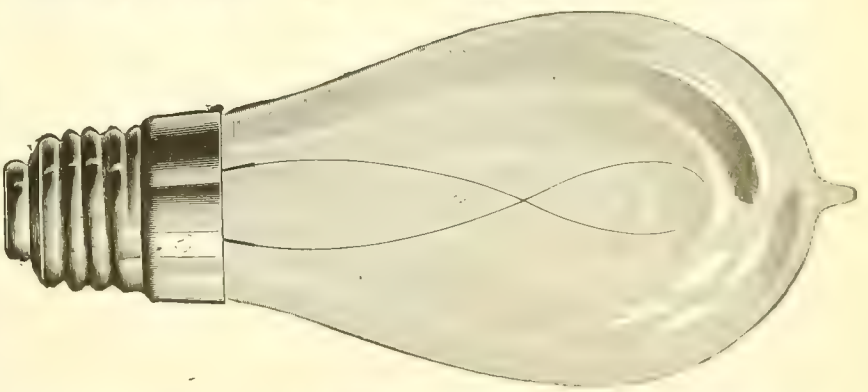
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

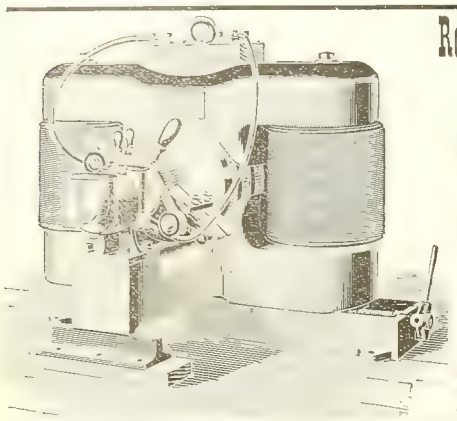
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway.)

Incandescent Dynamos and Generators

(MAYO SYSTEM)

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

FOR SALE.

One 3 Horse Power Electric Motor.
One 6 Horse Power Electric Motor.

Both in excellent condition, having been used but little.

ERIE ELECTRICAL SUPPLY CO.,
ERIE, PA.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,
158 William St., NEW YORK.

FOR SALE.

STREET CARS.

ONE HUNDRED 12-FOOT CARS,

Built by the John Stephenson Co. and Jones, one end type, with fare box, in good order; gauge, 4 ft. 8½ in.

Six Hundred Tons 38-lb. Tram Steel Rails and One Hundred 30 ft. Steel Poles.

ROCHESTER RAILWAY CO.,
ROCHESTER, N. Y.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

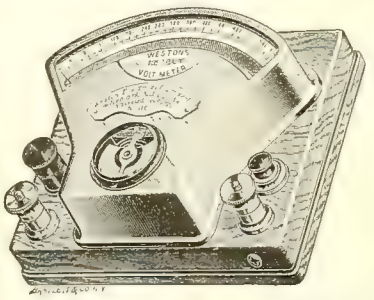
CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO. ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, Newark, N. J.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

THE

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

AND

95 CHAMBERS STREET, NEW YORK.

ELECTRICAL ENGINEERING, OHIO STATE UNIVERSITY, COLUMBUS, OHIO

A new and commodious building. Dynamos of commercial size, for arc and incandescent lighting, by direct and alternating currents. Motors, storage batteries, etc., etc. A fine collection of standards, testing instruments, etc. Extended practice in well equipped mechanical and physical laboratories. Entrance requirements modified. Special courses given. Send for catalogue.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

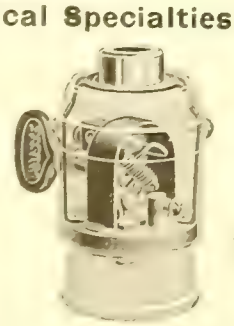
H. T. PAISTE,

MANUFACTURER OF

Paiste Electrical Specialties.

Western Office and Warerooms:
341 THE ROOKERY,
CHICAGO, ILL.

Eastern Office and Factory:
1201 MARKET ST.,
PHILADELPHIA, PA.



PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.

CHICAGO OFFICE

OF

THE SHORT ELECTRIC RAILWAY COMPANY,

225 Dearborn Street.

FREDERICK J. WILLSON, - - Special Agent.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

P. AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

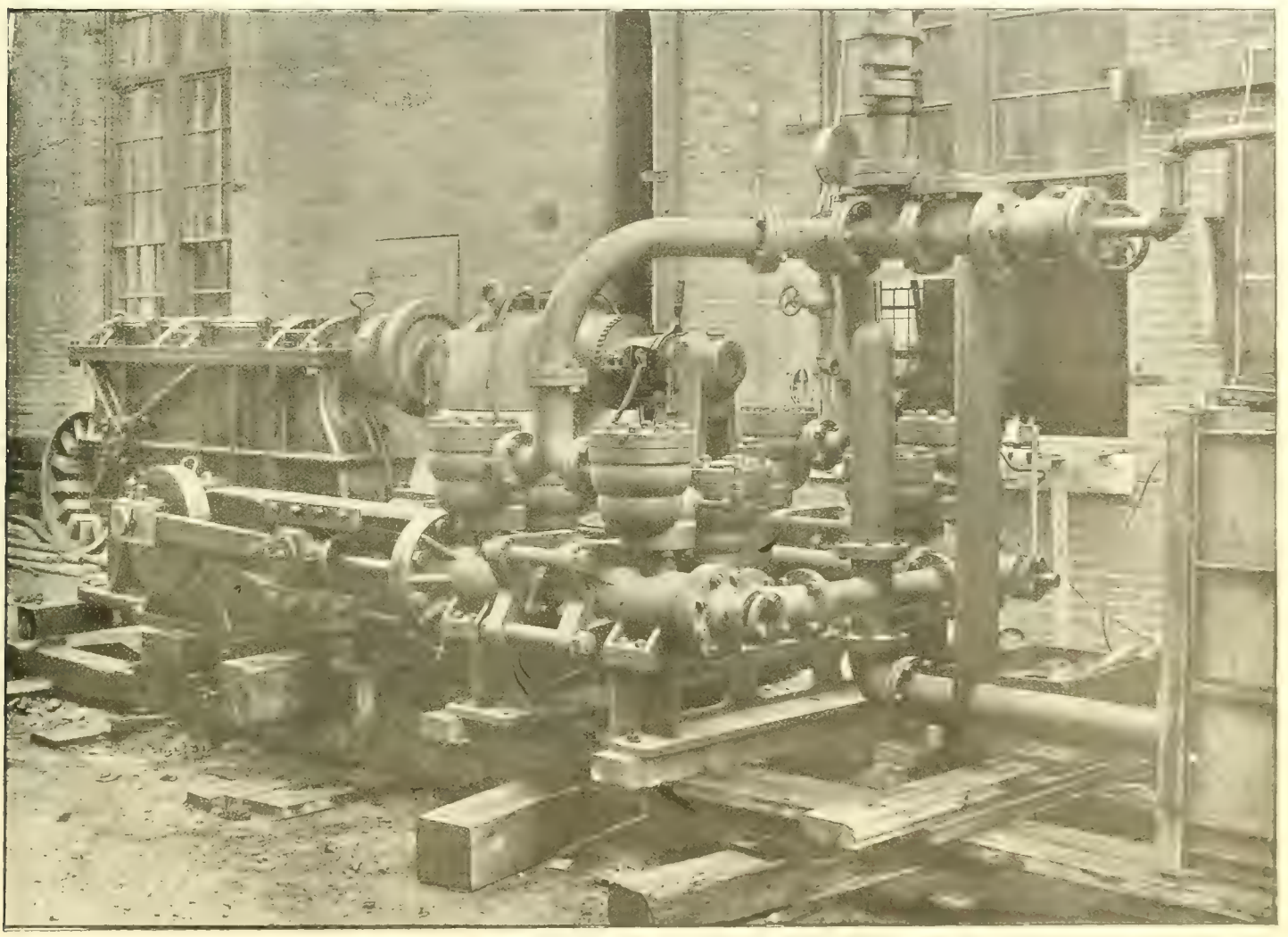
Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, AUGUST 29, 1891. No. 9

Largest Electric Pump in the World.

The imposing mass of machinery illustrated in the accompanying picture possesses a peculiar interest from the fact that it is believed to be the largest electric pump in existence. It is only within the last three or four years that mine proprietors have awakened to the many notable advantages possessed by electricity over other methods of transmitting power to mining machinery. Now, however, the idea has taken a firm foothold, especially in the United States, and the installation of electric mining plants promises to become one of the most important features of the business of the electrical manufacturing companies. Of machinery of this character pumps operated by electric motors are especially useful, and the one shown in the illustration is undoubtedly the most powerful that has thus far been made.



LARGEST ELECTRIC PUMP IN THE WORLD.

This machine has been built by the Thomson Van Depoele Electric Mining company for an iron mine at Iron Mountain, Mich. It is operated by a 60 horse power motor geared to the crank shaft of the pump by a worm gearing. Its capacity is 100 gallons per minute against a head of 1,400 feet at one lift. The generator is of 80 horse power capacity and will be located about 3,000 feet from the pump, the latter being employed, of course, to keep the mine clear of water. Copper conductors will be used, calculated for a loss of five per cent. in the line. The details of the wiring and insulation, however, have not yet been determined.

This interesting installation is in charge of the western power and mining department of the Thomson Houston company, at Chicago. The pump has not yet been put in actual operation at the mine, and the photograph shows it mounted for testing at the company's factory. A more detailed account of its working will be given later.

Electricity at the World's Fair.

A substantial victory for the committee on electricity and the electrical department was achieved at the meeting of the executive committee on the 19th. This committe is composed of the chairmen of the other committees and is vested with great authority. After discussing the conflict of authority between the committee and department of electricity and the department of construction the executive committee adopted a resolution directing the grounds and building committee to allow the chief of construction to enter into no negotiations for light or power plants without the approval of the committees on electricity and machinery. Of course the committee on grounds and buildings will make the awards for all contracts, as usual.

In commenting on this move the *Tribune* says:

This action means two things. First, that the committee on electricity intends to know what is going on in matters presumably under its jurisdiction; and, second, that Chief Barrett of the department of electricity will have considerable to say about the character of the electric power and lighting plant for the exposition. It means also that considerable restriction will be placed on Chief of Construction Burnham, and that he will have to secure the advice of department chiefs in reference to this particular matter. The action is right in line with the [illegible] trol to the effect that department chiefs should have almost exclusive jurisdiction in the installation of exhibits. As it is intended that the power plant shall be installed as an exhibit, there is nothing left now for the chief of construction to do but advise with the chiefs of machinery and electricity as to the character of the power plant.

"While this action curtails the authority of Mr. Burnham," said a member of the committee on grounds and buildings, "it was not done in a spirit of antagonism. We have an experienced man for chief of the department of electricity, and expect to have an efficient man for the department of machinery. We shall have to pay them salaries for [illegible] that since they are our employes we might as well secure the benefit of their experience and knowledge."

It was through the wish of the committee on electricity that the resolution mentioned was carried, and as that committee thinks well of Chief Barrett and has practically been championing his cause, it is not unlikely that he will be made the committee's adviser and so become a most important factor in the placing of the electric light and power plant.

The adoption of this resolution will certainly go far toward the establishment of a definite understanding in relation to disputed questions of authority between the departments of electricity and construction, for which the WESTERN ELECTRICIAN has contended. It is to be hoped that this decision, as the first step, will lead to a complete adjustment of harmonious relations. The committee on electricity, which is in accord with the [illegible] of the same name, has obtained recognition of [illegible] trical machinery that may become a [illegible]

cannot be installed without its authority. The power of both parties to the controversy is thus defined and limited, and there should now be but little difficulty in arriving at a complete understanding.

On Saturday of last week the committee on grounds and buildings formally adopted the resolution which the executive committee instructed it to pass. The language of the resolution is as follows:

Resolved, that the grounds and buildings committee hereby instruct the chief of construction to first obtain in writing the concurrence of the committee on electricity, electrical and pneumatic appliances on all matters pertaining to electricity, electrical and pneumatical appliances, and all plants connected therewith, before submitting the same to the grounds and buildings committee for action.

This settles one important question that has been in controvery between the departments of electricity and construction in favor of the former.

It is said that one million five hundred thousand feet of lumber has been delivered for the electricity building, and nearly one-half of the foundations of the structure are completed.

The grounds and buildings committee will probably abolish the "loop" of railway tracks entirely, together with the circular "machinery annex," the design of which is now said to be preposterous. The "stub" terminal system will undoubtedly be adopted at Chief Burnham's suggestion, and the annex will probably be a square building west of Machinery hall. This subject is one of much interest to electricians, as the big power house for the generators will undoubtedly be adjacent to the "annex," wherever that may be located.

The contract for roofing the electricity building has been awarded to James A. Miller & Bro. of Chicago for $22,100.

On Thursday of last week Secretary Hornsby received the detail plans of the electrical building from the construction department. Under the direction of Chief Barrett the secretary will be required to indicate as nearly as possible the location of the aisles and the space to be devoted to these passageways. It is proposed to lay railway tracks on the ground in the building, before the floor is laid. The heavier exhibits will then be brought directly into the structure on the cars and transferred to the place designated for them by huge electric cranes. The flooring will hide these transportation tracks from view before the building is open to the public, and the same means of taking the machinery away will be made use of after the exposition is closed.

The [illegible] has heard of a marvelous microscope, with electrical attachments, to be shown at the Chicago exposition by the Munich Poeller Optical institute. The instrument is said to have cost nearly $9 000, [illegible] a magnifying power of 11,000 diameters. The electricity furnishes and regulates the source of light, which, placed in the focus of a parabolic aluminum reflector, reaches an intensity of [illegible] The [illegible] provides the means of an ingenious automatic mechanism for the centering of the [illegible] and illuminating the lenses. There is an arrangement for the exact control of [illegible] is the cooling machine, which is indispensable on account [illegible] The apparatus with ordinary objectives, as has been stated, is about 11,000 diameters, but with the oil immersion it can be increased to 16,000."

A Paris newspaper publishes a ridiculous statement to the effect that the great feature of the opening of the exposition will be the electrocution of six people, "two of whom are innocent."

Electric Light Plant on the Virginia.

Much attention has been attracted to the handsome new passenger steamer, the Virginia, plying between Chicago and Milwaukee, on the Goodrich line. The Virginia arrived in Chicago, glistening in her new dress of white paint, and manned by a full crew of sailors, who were proud of their fine new uniforms, and prouder still of the gallant ship, under whose colors they were to serve. The new boat is said to be more complete in her appointments than any other on the lakes.

The steamer was constructed by the Globe Iron Works of Cleveland, Ohio. The dimensions of the hull are 278 feet over all, 260 feet keel, 38 feet beam and 25 feet deep. The water bottom is separated into six sections, and contains a tank of 4,500 gallons capacity. Her gross tonnage is 2,500, and her carrying capacity 750 passengers.

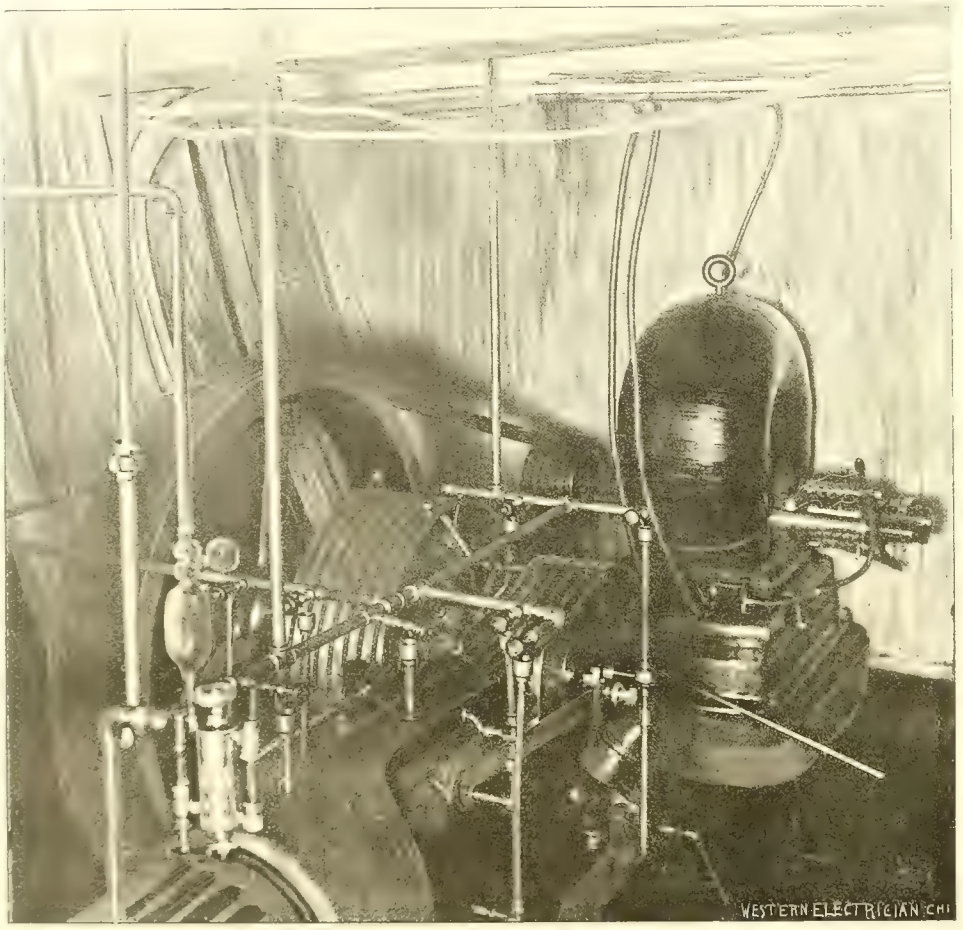


FIG. 1. ELECTRIC LIGHT PLANT ON THE VIRGINA.

The advent of the steamship Virginia marks a new era in the construction of boats for lake transportation. While ocean steamers have been provided with first-class accommodations and even luxurious fittings, little attention has been given this matter in the construction of lake craft. The Virginia is modeled after the finest of ocean steamers, and consequently lacks nothing conducive to the comfort and care of her patrons. She is the first Chicago passenger boat equipped with twin screws. The screws are 11 feet in diameter. In addition to this feature she excels in her electrical equipment, which is undoubtedly finer than that of any other lake steamer.

The boat is provided with double cap mouldings, and is wired in duplicate, there being about 700 lamps—of these about 12[illegible] are used for lighting the large dining salon. This room deserves special mention. The sides are finished in rich mahogany, and the prevailing tone of decoration is ivory and black. The lamps are lavishly distributed about the handsomely paneled ceiling. The main cabin, state rooms and other apartments are all furnished with [illegible] taste and [illegible].

The dynamo room, separated into two compartments, each [illegible] feet in size contains two 500-light compound dynamos of the Mather type. Fig. 1 shows one compartment of the dynamo room, with dynamo and 100-horse power Beck engine. Fig. 2 shows the switchboard, which is placed in a convenient position between the two compartments of the dynamo room. A 35,000 candle power search light, which is soon to be placed on the boat, will complete the electrical equipment. The lamp fixtures are all of the finest workmanship. They were especially designed and made for the Virginia by the Chicago Gas & Electric Fixture company. The Chicago branch of the Mather Electric company had charge of the electrical equipment and installation.

Electricity on Our Great Railways.

HUBERT S. WYNKOOP, M. E.

On May 4th Frank L. Perry read a paper before the Chicago Electric club on "Substituting Electricity for Steam, from the Standpoint of the Steam Railroad Man." In the discussion that followed Lieutenant F. B. Badt made the following statement, which I shall take as my text: "It seems to me that it is not a question between steam and electricity as to the speed at which we shall travel, but simply the question of construction of tracks; *and that we can obtain a much higher speed with steam if we can only construct tracks in accordance with his* (O. T. Crosby's) *ideas.*"

In order to prove that the adoption of tracks of new and improved design will have no bearing upon the question of steam railway speeds, I shall assume throughout this discussion an ideal road bed, or one free from heavy gradients, sharp curves and grade crossings.

The word "speed," as applied to railway travel is so ambiguous that I shall discard it entirely, substituting therefor either "velocity" or "endurance" to express the rate of motion at any given instant or the average rate of motion for an hour. A few interesting facts will clearly demonstrate the distinction between velocity and endurance.

In the spring of 1885 locomotive No. 169 of the Central railroad of New Jersey, with 5 feet 8 inch coupled drivers, hauling four coaches, containing 65 passengers, touched a velocity of 80.33 miles per hour on a level track going east through Crawford, N. J. (The same engine is credited with a velocity of 84 miles an hour, but in the absence of any authorized report I shall not use this figure in the discussion.) In 1888 John Wolff, M. E., and the writer tested locomotive No. 171 of the same road. With five well filled coaches going west through Dunellen, N. J., down a gradient of one in 260, the highest recorded velocity was 78.89 miles per hour, the velocity figures as calculated from the number of revolutions and the diameter of the drivers tallying closely with results obtained by noting time between mile posts by means of a stop watch, when the acceleration was zero.[1] Searching English records for velocity figures, we read in London *Engineering* for June 29, 1888, the following: "The highest speed ever known to have been attained in this country is recorded of the ten-wheeled tank engines with nine feet single driving wheels, built for the Bristol and Exeter line in 1852, which actually touched 80 miles an hour, with no load, down a gradient of one in 89, and 78 miles an hour on a level with two coaches." Contrast the size of drivers and weight of cars in England with those in America, and note how much swifter is the American locomotive.

I have just adduced figures proving the superiority of our locomotives over those in England in the matter of velocity; and, if I shall by the aid of figures show that English locomotive haul trains at a higher average velocity or endurance than ours do, it will at once become evident that my determination to discard the word "speed" was

1. It might be well to mention here that the [illegible] driver [illegible] engine at high speeds, [illegible] H. W.

advisable. For illustrations of endurance we may again refer to London *Engineering*. "Mr. Martin records three splendid runs at which a sustained speed of about 60 miles an hour was kept up, with the Great Northern Manchester express between London and Grantham he twice covered 100 miles in 103 minutes, and on the Great Western between Swindon and London 72 miles in 71 minutes, the engine in each case being an eight feet single driver. With a Midland seven feet coupled engine having nineteen inch cylinders he traveled fifty miles an hour, and the same was done in a train drawn by a London & Northwestern 'Precedent.' Although these are somewhat exceptional examples, yet there are in summer no fewer than 105 runs timed to make daily from start to stop at an average speed of fifty miles an hour and upward. The highest average speed at which a train is timed from start to stop is just fifty-four miles an hour. This is the Great Northern Manchester up express, which performs the longest run in the world without a stop[1]—105 miles 26 chains—to be done in one hour 57 minutes. The Great Western Exeter express s stand third with 53¼ miles an hour. Over the first 77 miles out of London the down trains and one up train are timed at this speed. The Great Northern has no fewer than seven trains, and the Great Western three, timed at an average running speed of over fifty-three miles an hour between stopping stations. Besides these there are in the country twenty-five trains at fifty-two to fifty three miles an hour, twenty-seven at fifty-one to fifty-two, and forty at fifty to fifty one miles an hour, running time. It is no wonder, in the face of these speeds, that locomotive engineers are feeling in all directions to get engines of greater power. Mr. Webb is going in boldly for the compound system, and appears to be getting splendid results out of it. Mr. Worsdell is also adopting the compound system— worked out in another way—very freely, while others are waiting to see the results. *On our great competing lines we have come to the limits of the capacity of the ordinary locomotive* whatever the form it takes and if trains are to be increased in weight, or speed to be materially augmented, some new departure must be made."

In America we have as yet been unable to obtain such endurance. Numerous grade crossings, heavy gradients, new and shaky track, and exceptionally heavy cars conspire to make our road beds far inferior to those in England, which approximate closely the ideal.

The Pennsylvania railroad runs its Congressional Limited from Jersey City to Washington, 227 miles, in five hours two minutes, or 45.04 miles per hour. The Chicago Limited of the same line covers the distance from Jersey City to Pittsburg, 443 miles, making four stops, in eleven hours seventeen minutes, or at an average velocity of 39.27 miles per hour. The fastest train on the New York Central runs from New York to Buffalo, 440 miles, making four stops, in ten hours forty-five minutes, or at the rate of 40 93 miles per hour. This is the South Shore Limited, which runs from New York to Albany, 143 miles, without stopping, at an average velocity of forty two miles per hour. The Boston & Albany runs a train from New York to Boston, 234 miles, at a mean velocity of thirty-nine miles an hour. The Saratoga Limited on the New York Central makes from forty to forty three miles an hour for a distance of 150 miles. On her Western trial trip in 1888 the Strong locomotive ran 116 miles in 116 minutes with a heavy train; but this is exceptional, and for a trial trip only, whereas the above figures are taken from printed time schedules.

Considering runs of less than 100 miles, we find that the Bound Brook express on the Central railroad of New Jersey runs from Bound Brook to Jersey City, thirty-one miles, making one stop, in thirty-seven minutes, or 49 8 miles per hour. The Pennsylvania railroad Congressional Limited runs from Jersey City to Philadelphia at the rate of 46.2 miles an hour, the distance being 89 miles.

These illustrations of the difference between velocity and endurance show us, then, that engines that excel in the one quality are frequently of comparatively little value as regards the other. This idea will be clearly brought out presently.

A tentative classification of the conditions of railroad traffic in this country would be as follows:

1. Light local—requiring locomotives with large drivers and quick, though comparatively light, steaming qualities.
2. Heavy express—requiring locomotives with smaller drivers and unlimited steaming capacity.

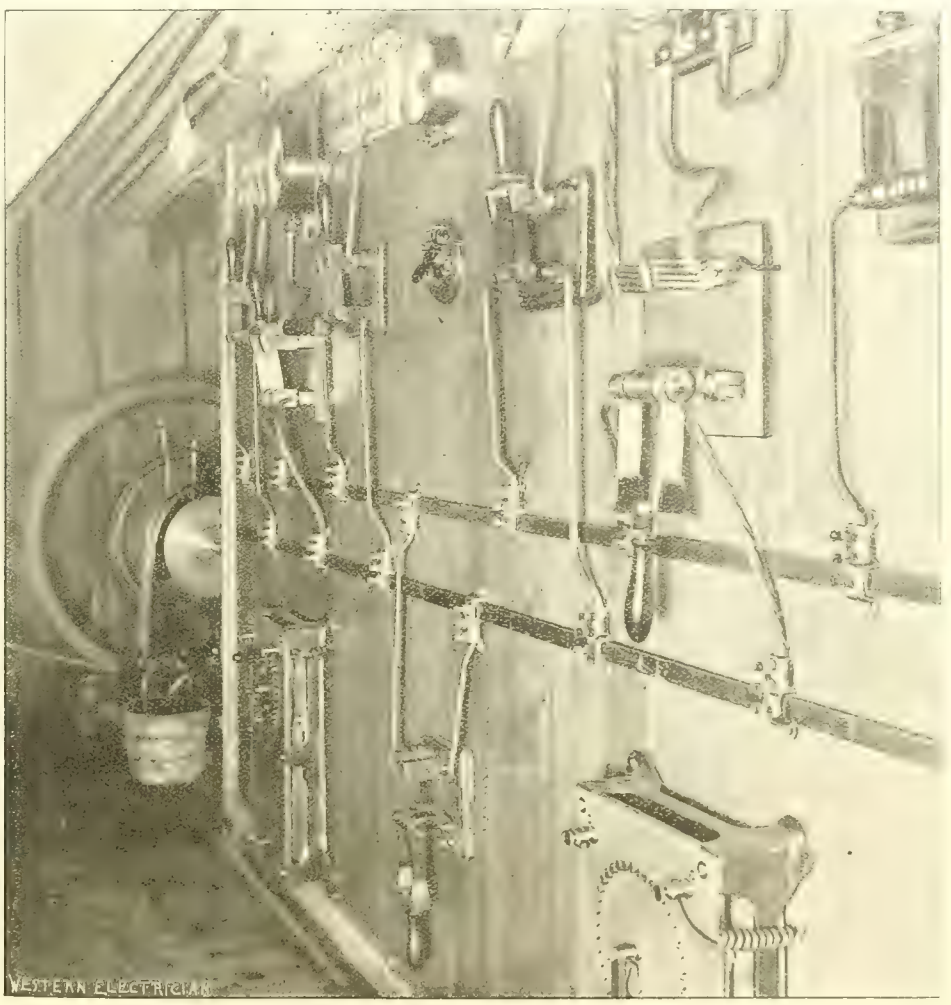


FIG. 2. ELECTRIC LIGHT PLANT ON THE VIRGINIA.

3. Mixed—such as excursion, suburban and freight trains, where the conditions are so varied as to preclude the designing of any one general type of locomotive, as will be seen upon comparing the enormous freight decapod with the far lighter four-wheel coupled engines, both of which are used in this class of service. On account of the varied character of this service, necessitating a special design in each instance, we can at once dismiss the third class from further consideration.

Class 1. Light local traffic so called, includes those trains that run back and forth between towns from ten to fifty miles apart, stopping at stations averaging from four to five miles apart. Such trains usually consist of four or five cars only, and sometimes as few as three. If we ride in the cab of a locomotive hauling one of these trains, and watch the engineer, we shall observe that he is constantly manipulating the mechanism in his charge. He starts up quickly, with his reversing lever down in the corner, thus admitting steam during nearly the full stroke; and within a minute he "hooks her up," or draws the lever up so as to cut off at an eighth or three-sixteenths, at the same time pulling out the throttle. This is the first phase. After running a couple of miles he closes the throttle, throws his lever down into the corner, and "lets her roll awhile."

and we may, if you please, consider this the second phase.

locomotive jars the pointer down a degree at least. Anxious

pound mark, we heave a sigh of relief at seeing the engineer close the throttle firmly. Round climbs the pointer as we roll along without steam, and soon we glide briskly up to the station with the escape valve roaring merrily.

What have we

must have large drivers—as large as is compatible with quick starting—in order to get

70 miles an hour

That she must make steam

large quantity. Endurance is of no importance in this class of engines; but the

essential.

Class 2. Now let me ask you to climb aboard another locomotive, standing at the head of a ten-car train of Pullmans. She has a hard task before her, as the run must be made from New York to Albany, 143 miles, without a stop. Starting out very slowly, with the greatest deliberation, the engineer begins to set her pace at twenty-five miles an hour. Little by little the lever is drawn up, little by little the long train responds to the pulling out of the throttle. Watch the gauge—160 when we started, it is now 155, after a half hour's run. At the end of the first hour the dial indicates 153 pounds of steam; and just then we slow down to scoop water. By the time the scoop is drawn up again we have 160 pounds pressure in the boiler. At last we run across the bridge into Albany with the gauge indicating 155.

This time we have learned: 1st. That the drivers must be considerably smaller than before in order that there may be enough leverage to start the train at all. 2d. That the boiler must be very much larger than in the former case, so as to easily deliver steam in enormous quantities for a period of three or more hours. This time velocity gives way to endurance in the matter of importance.

In response to the clamoring of the public for faster transportation, let us now endeavor to design a locomotive for the first class. To begin with, we must have large drivers in order to attain a velocity of 75 or 80 miles per hour. With a 5 feet 8 inch driver, 80 miles an hour means about 400 revolutions per minute, or with the ordinary two-foot stroke, a piston speed of

ute. We shall find in practice that

about the limit of piston speed in locomotives, as at that point the exhaust steam begins to choke so badly as to run the back pressure up alarmingly

mit the more steam we have to force

stroke.

But we can increase the exhaust orifice and thereby offer less resistance to the escaping steam

goes; but an increase in exhaust

in draft on our fire. Mr.

periments in that direction some three years ago, and found that a given

haust nozzles when serving in the

is working in the second and

with our experimenting and our figuring we learned that a

1. The editor of *Engineering* was evidently not well posted on American runs. At the time he wrote this article the Chicago Limited on the N. Y. Central was making a daily run from New York to Albany, 143 miles, without a stop.—H. S. W.

well-known [illegible] back in the sixties had patented a variable [illegible] regulated at will by means of a lever in the cab. This invention never came into practical use, however.

Well, we can certainly increase the size of our drivers, thereby causing one revolution to mean nearly twice as much as it does now, and all this without increasing the piston speed—just as the English have accomplished in designing locomotives with 9-foot drivers. I think the records will show, however, that the English are cutting down the diameter of their locomotive drivers at the rate of an inch a year. We must remember that our trains are much heavier than those of the same class in England;

FIG. 1. ELECTRICAL METHOD OF SHAPING METAL BARS.

and if we designed our locomotives with such large drivers we should raise the center of gravity to an alarming degree, and be unable to start up at all. To overcome this last difficulty we might increase the power of our engines; we might add another inch or two to the diameter of our cylinders—and then run up against the old problem of how to get the increased volume of steam out again without killing our draft, or creating an abnormal back pressure.

So, we see, the light local locomotive of the present day owes its existence to the eternal fitness of things. The only apparent method left to us of increasing the velocity attainable with this locomotive lies in doing away with an exhaust steam blast, and substituting therefor a live steam blast. Suggest this, and you will become the legitimate prey of every division superintendent in the country. The most economical locomotive of to-day is a more wasteful machine than the old marine engine and boiler of forty years ago—and that is saying a great deal. Don't attempt any missionary work on the division superintendent; he'll get square with you by suggesting that it isn't worth while to make the exhaust nozzles of greater area than the exhaust part of your cylinder; and this leads to a consideration of valves, which I am not quite ready to enter upon.

Having considered possible improvements in the design of locomotives intended for the first class, we may now turn our attention to the second class, and endeavor to ascertain what modifications in our design will become necessary.

The drivers can be made somewhat smaller than before, as the velocity to be attained is not so great. Thus we can get the necessary leverage without sacrificing any other important quality. A heavy draft is, however, a necessity; and, leaving out of consideration the possibility of employing a steam blast (from questions of economy), we are obliged to wrestle with the old, old problem of how to eat our cake and keep it too—how to have small exhaust nozzles, and at the same time provide suitable egress for the dead steam.

The condition of unlimited steaming capacity demands a very large boiler. The problem growing out of this is,

FIG. 2. ELECTRICAL METHOD OF SHAPING METAL BARS.

[illegible] without raising [illegible] dangerously high [illegible] by day that, as [illegible] three years ago, [illegible] to the limits [illegible] whatever the [illegible]

[illegible]

Von Waldegg and Fink obtain to a limited extent; but [illegible] pared with the others, prevents the general introduction of any new designs.

The great drawback to the use of this standard link is due to the fact that there is only one valve, the action of which is such that the earlier the cut off the higher becomes the compression of dead steam behind the piston. To overcome this evil it has been proposed to employ a second valve, acting in conjunction with the main valve in such a way as to regulate cut off only (the main valve performing all the other functions), thus relieving the main valve in a measure of its overwork. This introduces complicated mechanism again, and for that reason is looked upon with disfavor. It is generally admitted, however, that when the ordinary steam pressure carried by our locomotives is increased to 190 or 200 pounds per square inch the double valve will become a necessity.

Nearly four years ago the then novel Strong locomotive created great interest in railway circles on account of its peculiar double legged boiler and its valve motion. Strong endeavored to apply to his locomotive what might be termed a modified Corliss principle. At the middle of the valve movement, the valve moved very slowly, but when admitting, cutting off or exhausting steam, it moved with a jump. A complicated gear, involving trip motions, accomplished this result. To-day the Strong locomotive is, I believe, but little mentioned, and then more as a historical machine than as one of the world's lasting inventions.

To sum up the argument briefly, we have found that the limit of velocity of the present locomotive is 80 miles an

FIG. 5. ELECTRICAL METHOD OF SHAPING METAL BARS.

hour, and of its endurance 60 miles on hour. This proves conclusively: First, that even with improved roadbeds we can obtain an endurance of only 60 miles an hour; second, that our present method of laying tracks and ballasting them is such as to enable them to stand a train velocity of 80 miles an hour and over. Now, if our present roadbeds will stand a train velocity of at least 80 miles an hour, and if this velocity is the limit of our present locomotives, our only hope of more rapid steam transportation lies in increasing the endurance of our engines—and *not* in adopting a roadbed in accordance with Mr. Crosby's ideas, which had in view velocities of about 150 miles an hour. It is simply a question of designing a locomotive capable

FIG. 6. ELECTRICAL METHOD OF SHAPING METAL BARS.

of greater power and higher velocity; and, whether this locomotive be intended for steam or for electricity, it must be a radical departure from any of our existing forms. We know that electricity can be employed as power in the coming locomotive; but whether it be *possible* to thus use steam remains to be seen.

THE BOOK TABLE.

DIE ELEKTRISCHE KRAFTÜBERTRAGUNG UND IHRE ANWENDUNG IN DER PRAXIS (Electric Power Transmission and Its Practical Application). By Edward Japing; edited by J. Zacharias; 3d Edition, 1891; 232 pages, 6x3½; 61 illustrations; A. Hartleben, Vienna.

The latest edition of this useful book contains many new and interesting data. It deals in plain language, avoiding the use of higher mathematics, with the problems of the generation, transmission, division and transformation of electric currents. One chapter is devoted to conductors and insulators and another relates to accumulators and their application for power transmission. We can recommend the study of this book to all those interested in electric power transmission and who are conversant with the German language. In another place is presented an abstract of the chapters treating of the "Rotary Current" (*Drehstrom*) and "Rotary Current Motors."

During the year ending July 31, 1891, according to the United States corporation bureau of Chicago, the total number of new incorporations reported was 14,854, with a total capitalization of $6,672,694.539. Of these, 1,139 were light, heat, power and transportation companies, with a capital of [illegible].

The South Galveston & Gulf Shore Railroad company will build an electric railroad from Galveston, Tex., down the island to the suburb of South Galveston, a distance of about 20 miles. The city council has been petitioned for right of way on certain streets. Engineers are now surveying the route.

Electrical Method of Shaping Metal Bars.

The accompanying cuts illustrate several devices for bending and straightening metal bars and shaping metals by means of electricity. Heavy currents are, of course, employed. The current is passed through the section or bar to be operated upon until it reaches the required temperature, when it may be bent, straightened or shaped into any desired form by hammering or applying other suitable pressure. Fig. 1 shows a device for bending metal rods, such as steel bars suitable for heavy coiled car-springs. A shaft or mandrel, supported rigidly upon a pillar, similar to a lathe head, carries a dog or grip-piece adapted to grasp one end of the bar to be bent, the other end of which can be clamped in a guide or holding-clamp so as to allow

FIG. 3. ELECTRICAL METHOD OF SHAPING METAL BARS.

the bar to slip through it endwise. Current is conveyed through cables to the grip-piece and clamp between which the bars is held, thereby placing the bar in circuit. The current will be sufficient to heat the bar, while the other parts of the circuit should be made massive enough and of such good conducting material as not to be heated to any considerable extent. The pillar may be used to convey current, or a sliding contact held firmly with a spring will suffice to convey current to a revolving surface carried by the mandrel. A few moments after the current is turned on the bar will heat and soften, and when the mandrel is turned the bar will be easily turned into a spring or coil. The size of the bar that can be treated in this manner depends upon the capacity of the current to heat it and the massiveness of the apparatus.

In the device shown in Fig. 2 the clamps hold a flat bar of metal and they are also employed as conductors. The distance of the clamps is capable of variation by a slot in the bed-plate upon which a clamp can slide or be fastened by a bolt. Suitable guiding devices may be used to prevent the clamps from getting out of line. The clamp is attached to a shaft that may be rotated by the hand-wheel. When the current is passed through the apparatus, it heats the metal bar between the clamps. If the wheel is turned simultaneously with the passage of the current or shortly thereafter, the result of the operation, as shown in Fig. 3, will be a form suitable for a wood boring auger-stock.

In Fig. 4 a heavy shaft or bar is shown bent and gripped by the clamps, which are of considerable length, and are provided with V-shaped grooves to receive different sizes of bars. On account of the bend in the bar the movable clamp is not resting firmly on the bed. The passage of the current through the conductors brings the section of the bar containing the bend to a heated and flexible condition, allowing the movable clamp to be set down on the bed in line with the other clamp. If the current be cut off, the bar will cool while so held.

In Fig. 5 the section of bar between the clamps after being heated by the current is arranged to be formed with four bends by a depressed plunger or die *J*, which comes down on an anvil *A*, the clamps *D* and *E* approaching each other at the same time. The result is a crank-shaft, as indicated at Fig. 6. If the clamps *D* and *E* are actuated so as to permit the ends of the bar *B* to approach

FIG. 4. ELECTRICAL METHOD OF SHAPING METAL BARS.

in an axial line, the parts *D* and *E* will be true with each other. The system was devised by Elihu Thomson.

Edison Removal in Chicago.

The removal of the office of the central district, Edison General Electric company, took place on August 15th. Leaving the Rialto building, the company has now taken possession of the fine five-story building at 173 and 175 Adams street, Chicago. This will afford ample accommodation for the extensive establishment of the Edison company. The offices are situated on the second and third floors. The main floor is being fitted up as an exhibition room, where will be shown samples of the numerous appliances handled by the company. The arrangements are not all finished as yet, but when completed the establishment will lack nothing conducive to the comfort and convenience of employes and patrons.

Diminutive Electric Light Plant.

E. A. Maxwell thinks that the little plant illustrated herewith is the smallest of its kind in the country. He installed it in his workshop in Salina, Kan., on March 3rd, and regards his work with considerable pride. The room is 30x14 feet, and is lighted from this lilliputian plant by seven incandescent lamps. The little dynamo is driven by a two horse power engine, coupled directly to the generator, as shown in the illustration. The plant has been in operation every day since its first installation, and has worked satisfactorily.

The Montreal Convention.

The committees having in charge the arrangements for the Montreal Convention of the National Electric Light association have about completed their labors, and the outlook for the meeting is unusually promising. A large number of electrical concerns have applied for space for exhibits, and the display of electrical devices and supplies will be highly interesting and creditable to the association.

The committee on transportation announces for the benefit of eastern delegates and visitors that arrangements have been made for a special train leaving the West Shore station at Weehawken, N. J., at 10:05 Sunday morning, September 6th, and arriving at Montreal at 10:15 P. M.

For the convenience of New York delegates a representative of the railroad company will be at the Electric club, 17 East Twenty-second street, New York city, on Saturday, September 5th, from 3 to 6 P. M., to furnish tickets and information. Boats connecting with the train will be run as follows: West Shore ferry house, foot Jay street, 9:45 A. M.; West Forty-second street ferry house, foot West Forty-second street, 10:00 A. M.

The following list of exhibitors at the convention has been prepared by the secretary: Eureka Tempered Copper company, North East, Pa.; Chas. A. Schieren & Co., New York; Standard Underground Cable company, Pittsburg, Pa.; W. J. Johnston company, limited, New York; Standard Electrical Time company, New Haven, Conn.; Standard Paint company, New York; Fort Wayne Electric company, Fort Wayne, Ind.; Electrical Engineering & Supply company, Syracuse, N. Y.; Eugene F. Phillips Electrical Works, limited, Montreal, Canada; Felten & Guilleaume, Cologne, Germany; International Okonite company, New York; Weston Electrical Instrument company, Newark, N. J.; The Johns-Pratt company, Hartford, Conn.; the Ball Electric Light company, Toronto, Canada; the *Electrical Engineer*, New York; Interior Conduit & Insulation company, New York; Robert Mitchell & Co., Montreal, Canada; Thomson-Houston International Electric company, Boston, Mass.; Toronto Construction & Electrical Supply company, Toronto, Canada; H. Ward Leonard & Co., New York; Dominion Wire Manufacturing company, Montreal, Canada; T. W. Ness, Montreal, Canada; Edison General Electric company, New York; Norwich Insulated Wire company, New York; Excelsior Electric company, Boston, Mass.; Canadian Electrical Construction, Manufacturing & Supply company, Montreal, Canada; Russell Electric company, Boston, Mass.; *Electric Power*, New York; McGill University, Montreal, Canada; La Boiteaux Electric Motor & Fan company, Cincinnati, O.; WESTERN ELECTRICIAN, Chicago.

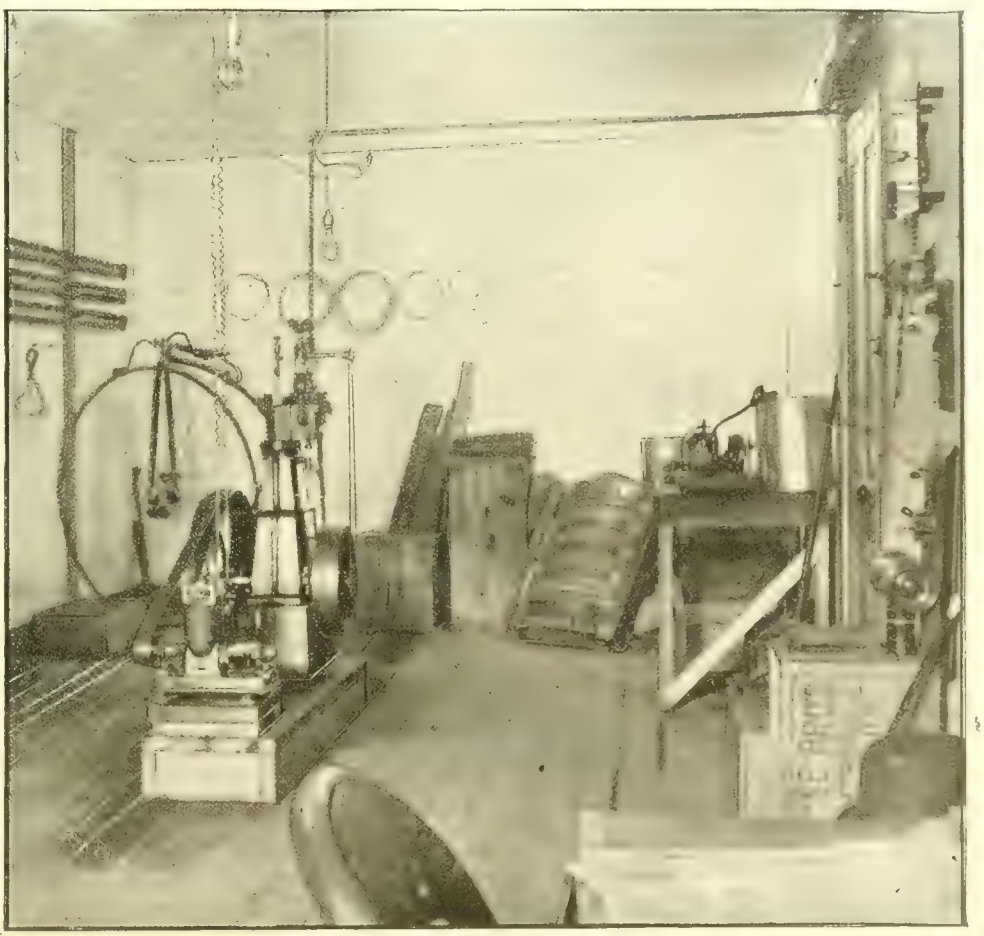
American International Telephone Cable.

The completion of the St. Claire tunnel had a peculiar interest to the telephone people as it marked the completion of the first American International telephone cable. Inaugural opening ceremonies of an international character will be held September 19th. The tunnel passes under the St. Claire river between Port Huron, Mich., and Sarnia, Canada, on the line of the Chicago & Grand Trunk and Grand Trunk railways. It is finished from the American to the Canadian portals, and the work on the approaches is rapidly nearing completion. Ground was broken on this great work on new year's day of 1890. It is estimated that $2,500,000 will have been expended on the tunnel before a train passes under the water. The tunnel itself, from portal to portal, is 6,025 feet long. The American approach is 1,500 feet long from the starting point on the surface level to the mouth, and the Canadian approach is 2,000 feet long.

The telephone cables are already placed in position, and the line will probably be formally opened about the same time as the railroad business.

Amateur Electricians.

On the evening of Aug. 20th a meeting for the formation of a national association of amateur electricians was held at the Grand Pacific Hotel, Chicago. O. E. Cozzens presided, and a constitution and set of by-laws were adopted. Nearly sixty members were enrolled, with every indication that this number would shortly be increased to several hundred. Applications for membership were received from



DIMINUTIVE ELECTRIC LIGHT PLANT.

Atlanta, Ga., and Toronto, Ont. The society intends to encourage the study of electricity among young men who propose making it a profession, and those who are merely interested in such studies. Arrangements have been partially made for an exhibition at the World's Fair. The name adopted is the American Society of Amateur Electricians.

The Alternating System and Long Distance Transmission.

To the Editor of the WESTERN ELECTRICIAN:

In one of your esteemed contemporaries I find a review of the "Electric Transmission Hand Book," in which the following sentence occurs:

"Mr. Badt apparently is no believer in alternating current transmission of power, but if he had followed the progress of the times a little more sharply he would have been aware that the alternating system for long distance transmission is looming up in a way that leads one to the conviction that it will find a very large amount of use in the class of work before mentioned."

I cannot see what put this erroneous idea in the reviewer's head, unless it is my statement on page 47 of the handbook: "As long as alternating motors cannot be made self-starting and automatic in regulation, of high commercial efficiency, and be built in as large units as continuous cur-

[illegible] the multiphase alternate current transmission between [illegible] that this experiment will differ vastly from Brown's preliminary experiments at Oerlikon. The latter experiments, which I mentioned in the book, still remain "experiments."

[illegible] friend, C. [illegible] "Please find inclosed photograph of a 300 horse power three phase alternator. This machine will enable me to carry out my previous experiments, for the first time, from Lauffen to Frankfort."

Telegraphers' Conventions at Washington, D. C.

The conventions of the Old Time Telegraphers' and the Military Telegraphers' [illegible] last week proved very satisfactory. Steps were taken [illegible] different [illegible] association complete historical data with a view to the publication by the association of the history of the early development of the telegraph in America.

The election of officers for the ensuing year resulted as follows: President, Edward Rosewater, Omaha; vice president, George M. Dugan, Jackson, Tenn.; secretary and treasurer, William J. Dealey, New York.

The Military Telegraphers' association re-elected the officers of last year. The principal topic discussed was the subject of securing recognition from Congress for the surviving members of the corps. The next meeting of the convention will be held in Omaha, Neb., on the third Wednesday in August, 1892, in connection with the meeting of the Old Timers' association at that place.

The Washington convention gave the members and guests an opportunity of visiting many interesting spots. The grand reception was one of the most attractive features of the meeting. Messages were received in the hall from all quarters of the country, many notable men sending greetings and expressions of good will. One of the most interesting dispatches was the following:

"To the Old Timers and Military Telegraph corps: The operators in the land of the Montezu[illegible] [illegible] City of Mexico."

During the evening speeches were made by many government officials. Assistant Secretary of War Grant's remarks were eulogistic of the work of the "boys," as he called them, during the war, and the secretary called forth loud applause when he said there was but little difference between the telegraph line, the line of duty, and the line of battle. During the war it was generally a race between the operator and the army, and the operator was generally ahead.

"I think," said Secretary Grant, "these boys should be recognized as soldiers, and recognized by this government." As he concluded the secretary paid a tribute to the work of the profession generally and the usefulness of the "mysterious click, click, as mysterious as old Nick."

Chicago Edison Company.

At a meeting of the stockholders of the Edison company held last week it was decided to increase the capital stock of the company from $[illegible] to $[illegible]. The extension is to go into effect probably within the next six months. The additional stock will undoubtedly all be taken by the present stockholders. The proceeds will be used to defray the cost of recent improvements.

The Montgomery, Ala. [illegible] company has applied to the city council for authority to change its street railway to the electric system. The estimated cost of the improvement is $80,000.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, ... Editor and Publisher.
J. B. O'HARA, ... } Associate Editors.
F. L. PERRY, ...
W. E. KEILY, ... }
J. L. BAKER, ... Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—The WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Largest Electric Pump in the World. Illustrated	113
Electricity at the World's Fair	113, 114
Electric Light Plant on the Virginia. Illustrated	114, 115
Electricity on our Great Railways, by H. S. Wynkoop, M. E.	114, 115, 116
The Book Table	116
Electrical Method of Shaping Metal Bars. Illustrated	116
Edison Removal in Chicago	116
Diminutive Electric Light Plant. Illustrated	117
The Montreal Convention	117
American International Telephone Cable	117
Amateur Electricians	117
The Alternating System and Long Distance Transmission (Communication), by F. B. Badt	117
Telegraphers' Conventions at Washington	117
Chicago Edison Company	117
Editorial	118
New Feeding Mechanism for Arc Lamps. Illustrated	119
Telephone Stock and the Bell Patents	119
The [illegible] Electric Meter. Illustrated	119
[illegible] Electrical Exhibition	119, 120
Michele's Ingenious Device for Avoiding Dead Centers. Illustrated	120
Statistics of Street Lighting	120
[illegible] Multiphase Current. Illustrated	120
Electric Traction in London	120, 121
Electric Power Transmission, by F. B. Badt. Illustrated. (Electric Transmission Hand-Book)	121
Heating Houses by Electricity	121, 122
[illegible] Electric Wires	122
[illegible]	122, 123
[illegible]	123

DEPARTMENTS.

[illegible]	123, 124
[illegible]	124
[illegible]	125
[illegible]	125
[illegible]	125
[illegible]	[illegible]
Telegraph	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible] system of electric railways, lights and [illegible] proposed for Staten Island by Erastus Wiman. [illegible] that with the proposed improvements [illegible] the island that would [illegible] Mr. Wiman has [illegible]

[illegible] in London [illegible] ure of this system, but these statements invariably emanated from unreliable sources and in every instance it has been shown that they were circulated in the interest of the elevated roads. Authentic reports of the business transacted by the London company show a handsome profit and increasing patronage. Of course there have been drawbacks—they were to be expected—and many alterations and improvements may yet be required but the advocates of the "L" roads can not boast of a perfect system. In fact, so little advancement has been made by the "L" management that it is is hardly noticeable. The London underground railway to-day is far superior in every respect to the New York "L" system.

The Rapid Transit commission of New York should lose no time in pushing forward a comprehensive scheme for underground electric railways.

THE convention at Montreal from a social standpoint will doubtless surpass all former meetings. The preparations have been made on an elaborate scale and the attendance will no doubt be much larger than is customary at mid-summer conventions. There is much to interest visitors in Montreal, and the presence of a representative gathering of electrical men will stimulate interest in the advancement of electrical industries in Canada. The preparations for the literary part of the convention are on a scale commensurate with other features of the meeting.

WILL the new three phase alternating current prove of sufficient commercial utility to warrant its general introduction in power transmission? This is a question that is now exciting wide attention from the electricians of both Europe and the United States. The rotary current, or *drehstrom*, originated in Germany, and its first application in long distance transmission will be between Lauffen and Frankfort. Until the result of this experiment is known the query forming the first sentence of this paragraph will remain unanswered. The test, therefore, assumes a double importance, as the trial of a new system and as the most extensive feat of electric transmission yet attempted. This and Mr. Tesla's experiments in New York are undoubtedly the greatest features of electrical advancement of the year. The outcome of the former is awaited with keen interest. Meanwhile the American reader can obtain a good general idea of the new current by reading the translated abstract from Herr Japing's book, presented on another page of this issue. A motor whose armature is practically without winding is a sufficient novelty to challenge the attention of every electrical engineer.

THE electrical interests will not be disposed to indulge in any unseemly exultation over the decision of the executive committee of the directors of the World's Columbian Exposition to the effect that the chief of construction must "first obtain in writing the concurrence of the committee on electricity, on all matters pertaining to electricity, electrical and pneumatical appliances, and all plants connected therewith, before submitting the same to the grounds and building committee for action." Nevertheless, the decision is exactly in line with the principle for which the committee on electricity and the electrical department have been contending, and it is gratifying that the position taken by the electrical fraternity has been sustained. By the terms of this resolution it will be impossible, it would seem, for the construction department to totally ignore the electrical representatives in matters appertaining to electrical installations, as was done when Chief Burnham advertised for bids for the temporary electrical plant. This is a great point gained. On this basis of fair play a harmonious agreement should now be speedily reached. The WESTERN ELECTRICIAN earnestly hopes that such an understanding will be arrived at, and that hereafter the departments will work together in perfect accord.

THE discussion of electric mining machinery is just now of more than ordinary interest. In another column is presented a synopsis of an interesting discussion of this topic before the Institute of Civil Engineers of England, where a comparison of compressed air and electricity was favorable to the latter.

An interesting point discussed was the alleged danger from explosions in coal mining. In the case of a motor in constant service for many hours, it was necessary to guard against the accumulation of explosive atmosphere around the brushes it was claimed. For this purpose it was suggested to inclose either the whole armature or the commutator only in a practically air-tight casing. The method had been successfully applied to a motor of 10-horse power. The temperature had been kept down to 70 deg. Fahr. above that of the atmosphere by allowing a sufficiently large cooling surface, namely 2.3 square inches per watt. To meet the objection that if the fire-damp should leak into these covers the resulting explosion might be as disastrous as if they did not exist, it was pointed out that "whenever the proportion of marsh gas to air exceeded 3 to 4 per cent. combustion would take place quietly, and the resulting carbonic acid would tend to prevent explosion in the case of further leakage." Precautions were also suggested for the switches. Many devices were minutely described and their advantages discussed. The conclusions reached were highly satisfactory from an electrical standpoint.

AN advocate of electric heating in dealing with the question of expense calls to mind the fact that in other departments of domestic and commercial life refinements and improvements have only been secured at increased cost. In illustrating this point he says: "The electric light is more expensive than gas, but also is gas more expensive than oil, and oil than the tallow candle, yet, even considering the item of expense, who would not prefer the incandescent lamp to the candle, oil or gas? Thus the cheap wood fire gives place to the more expensive coal fire, and the coal fire to the more expensive natural gas fire, and it, in turn, to steam."

There are many advantages attending the adoption of an electrical system of heating, and many disagreeable accidents are avoided. Even the item of cost may be brought reasonably near that of older systems. It is proposed for example to establish one power station for 20,000 inhabitants to which fuel may be brought by railroad, and where a half dozen men can perform the necessary labor. It is shown that the expense of installing this plant will not equal the "initial cost of the separate furnaces necessary to the population; nor will the wages of the station men amount to that of coal heavers, draymen and separate assistants in the homes. The wear and tear of the apparatus cannot equal that of small heat systems which also call for wear and tear upon trucks, horses, public and private property." Another advantage of electric heating is the absence of dirt and noise. The power stations from which current could be supplied for heating purposes would be located some distance from the residence district of the city. The fuel which otherwise would have been wheeled through the streets of the city, dumped upon lawns and sidewalks, thrown into cellars, creating dust, dirt and noise, and later requiring the labor of hundreds of people to feed it to furnaces, and to carry it to stoves and grate, and which would require the attention of the family to accomplish satisfactory and economical combustion would be in the furnace of this power station, consumed under the direction of two or three men skilled in such labor.

VALUABLE statistics on street lighting in the principal cities of the country are presented in another column of this issue. The data were prepared by the census department and published in an official bulletin. It appears that of the twenty-two cities named, each of 100,000 inhabitants or more, St. Louis leads in the actual number of electric lights employed in street lighting. Rochester follows with Denver third, Brooklyn fourth and New York fifth. Many of the smaller western cities make a far more creditable showing than the older and larger cities of the East. New York is far behind in the race and Chicago has only recently entered the lists. It should be borne in mind, however, that the figures presented in this statement do not fairly represent the development of electric lighting in the cities named. In New York for instance, there has been a bitter fight between the local lighting companies and the city officials. The war on overhead construction of course greatly injured the business of electric lighting companies in the metropolis and this is shown by the small number of street lights. But it should not be forgotten that in many of the large buildings in New York and Chicago there are isolated plants whose capacity is greater than that of the combined output of the plants of many pretensious towns.

Cincinnati is the only city of importance in the country that has no electric street lights. It should be, and probably is, heartily ashamed of itself. The table of lights given on another page would be more valuable if it showed the number of arc and incandescent lamps on the streets of each city, with the average cost of each. The figures showing the relative cost of electric lighting would then possess much greater importance. They would explain why in Rochester, for instance, where a large number of 32-candle power incandescents are used on outlying streets, the average rate is so much lower than in most other cities. In San Francisco the high rate is probably caused by the greatly increased initial cost of plant and the high rate of wages prevailing, while the low prices ruling in New England towns are undoubtedly due to lower prices for labor and machinery, and, in many cases, to the employment of water power. On the whole, the bulletin is one of the most useful so far issued by Superintendent Porter.

New Feeding Mechanism for Arc Lamps

An improved automatic feeding device, by which the position of the carbons in an arc lamp is not affected by gravitation, enables C. & E. Fein of Stuttgart, Germany, to make a novel and attractive exhibit at the Frankfort exhibition. On a large iron drum rotating on a shaft and resting on an iron framework are placed six large arc lamps extending radially from the periphery. The drum is

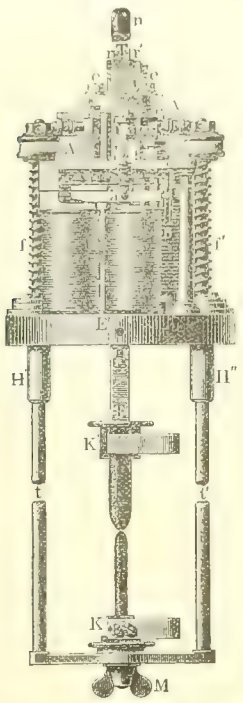


FIG. 1. NEW FEEDING MECHANISM FOR ARC LAMPS.

kept rotating by a small electric motor at the base of the frame, and the lamps continue to burn, as the drum rotates, either vertically, horizontally or in an inclined position. Neither is the steadiness of the light in anyway disturbed.

The construction of this lamp is shown in Fig. 1 The upper carbon holder *K* is fastened to a square brass tube *T*, which is guided by three friction rollers. These are placed in a movable frame, which, when operated, causes the upper carbon to approach the lower. The action of the friction rollers is governed by a set of levers and gear-wheel *B*, and operated by a shunt magnet E^1, and the approach of the carbon is proportional to the degree of attraction of the armature *A* on the magnet. The connection to establish the arc is made through the main current magnet *E*, its anchor *A* and the lower carbon K^1. The mechanism of this lamp is very compact, and it is intended that its regulation shall be perfect. The fact that it will work successfully in any position gives the lamp a very wide field, and makes it especially well adapted for marine installations, for portable lamps and reflectors. It is asserted that the lamp is peculiarly adapted for search lights.

The mechanical construction of the lamp when used in connection with a reflector, as a headlight, for instance, is somewhat different, as shown in Fig. 2, although the prin-

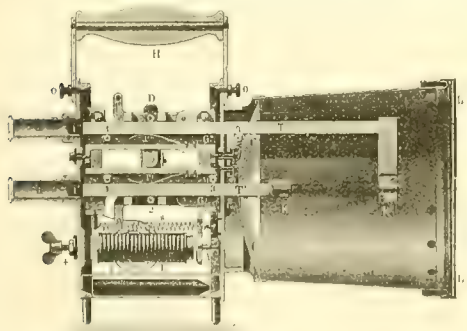


FIG. 2. NEW FEEDING MECHANISM FOR ARC LAMPS.

ciple is the same. The efficiency claimed for this lamp is remarkably high. Three different sizes—5,000 candle power, 1,000 candle power and 200 candle power—are made. The last and smallest size is said to require only one-fifth of a horse power, with two amperes current. If this is correct, there can be little doubt that a small lamp like this is the most economical form for utilizing electrical energy as light.

Fig 3 gives a perspective view of the lamp arranged with a reflector. The illustrations are reproduced from *Electrical Engineer*.

Telephone Stock and the Bell Patents.

The impression that the telephone field will be open to all comers within a short time has taken possession of many capitalists and speculators, and the effect of this belief is plainly seen in the direction of their operations. The *Daily Financial News* recently presented the following "advice about Bell telephone" stock which will be read with interest by the electrical fraternity generally:

There is one prominent stock in the market that it would be well for holders to get out of, not because there is anything wrong either with its present earning capacity or with its management. It is simply due to the fact that the ravages of time have cut down the period which its principal patents have to run, and at the end of this time, now only about two years, the many advantages it now enjoys from the protection of its patents will cease.

The stock in question is the American Bell telephone. It has already fallen 50 points from the price at which we began to recommend its sale, and we believe it is good for a further decline of 70 points within the next year.

The strength of Bell telephone has been its patents.

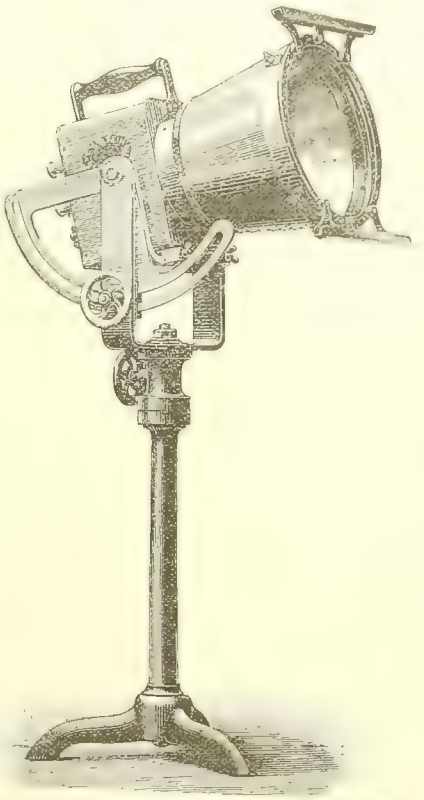


FIG. 3 NEW FEEDING MECHANISM FOR ARC LAMPS.

The most valuable of these expire soon, and some of the English patents have not very long to run. Hence the question arises, How will that leave the American patents? Is the Bell telephone in a position outside of its patents to maintain its present earning capacity? We don't think so.

One thing in this connection is worthy of note. The opinion has prevailed for some time that the patent of the Blake transmitter ran out in July last. This is not so. It will not have passed the existence of her gracious majesty's patent laws for at least another year, or perhaps until early in 1893.

At all events, the Bell telephone will soon have to encounter the most active and aggressive competition. Hence, to the wise who want to unload their stock, these words of warning ought to be both timely and sufficient.

The Grassot Electric Meter.

The accompanying illustrations represent a new electric meter devised by Emile Grassot It belongs to the group of quantity-meters or ampere-hour meters, and, like the Edison meter, is based upon the chemical action of the current. Fig 1 is a front view, while Fig 2 is a side elevation of the instrument. It is composed of a stone or glass jar *A* containing a solution of acetate of silver in the proportion of 1 to 10, and has an anode *b*, and a cathode *a*, each of which is made of a fine silver wire equal in size to number 24 B. and S. gauge. The anode *b* is placed inside a glass tube *B*. It is pointed at its lower end and has an opening large enough to admit the passage of the silver wire. This wire rests against a point *c* of a glass hook *C* fastened to the cover of the jar. The part of the anode which is exposed to the action of the solution is about ¼ of an inch long. The glass tube *B* is made in two pieces, of which the lower part is fastened in the center of the cover *D*, which also serves as a support for a registering movement or counter insulated from the cover.

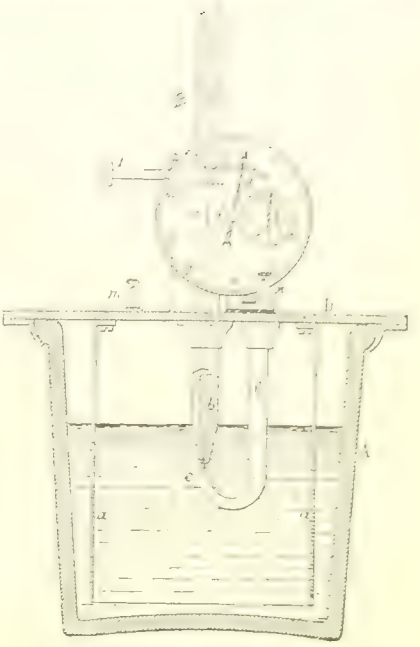


FIG. 1. THE GRASSOT ELECTRIC METER.

of this meter will now be easily understood. Under the action of the current the anode *b* dissolves, and the metal is deposited on the cathode *a*. As the dissolution of the anode takes place gradually at the point, the silver wire is forced down by its weight, at the same time rotating the drum *d*, thereby registering the amount of wire consumed, or by transformation the number of ampere-hours consumed. The placing of the meter in the circuit is done in the same way as an incandescent lamp, excepting that sufficient resistance must be inserted to reduce the current to about 1-1000 part of the total current.

This meter is in operation at the station of the Halles in Paris, and is spoken of very favorably in regard to accuracy and simplicity of manipulation. The cuts are reproduced from *L'Industrie*.

English Electrical Exhibition.

The West of England and South Wales electrical engineering exhibition was opened at Taunton on Aug. 1st by Field-Marshal Sir Lintorn Simmons, late governor of Malta. Prior to the opening ceremony Sir Lintorn was entertained at luncheon at Clarke's Hotel, at which were present a large number of influential residents, including the mayors and other officials of many of the neighboring

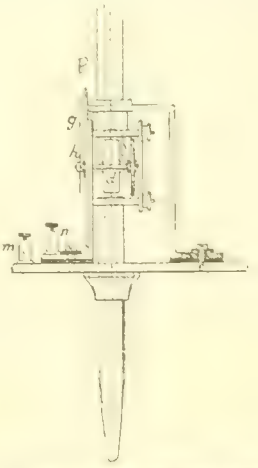


FIG. 2. THE GRASSOT ELECTRIC METER.

towns and districts. Sir Lintorn, in replying to the toast of his health, gave some interesting details of the most recent applications of electricity in connection with naval operations. H. G. Massingham gave a few details of the history of electric lighting in Taunton which was inaugurated by him in 1885. At that time he purchased his own cost an experimental installation to afford the

[illegible] judging of the merits of the Thomson-Houston system of arc lighting.

The exhibition is held on the premises of the electric light company, a large inclosed yard having been covered with temporary shedding, so as to afford, with the permanent buildings, sufficient area for a satisfactory collection of exhibits, of which the machinery and apparatus of the central station itself form the most prominent feature. F. M. Newton of the Newton Electrical Engineering Works, Taunton, has a good display of machinery and fittings, including a Taunton dynamo charging accumulators, electric motors driving sewing machines, lathe and fan, and a variety of lamps and holders. He also shows a switchboard of novel construction, the object of which is to render the connections at the back more readily accessible than in the case of the usual fixed board. This is accomplished by hanging the switchboard on a horizontal post, after the manner of a gate. Another new invention shown here is Elton's electric incubator, intended for the hatching of eggs only, it being explained that the chicks are then transferred to a supplementary apparatus called the electric mother. Gas engines are well represented, the Otto, the Stockport, the Midland and the Express being all shown at work. The Edison phonograph is on exhibition for a week, and on the river Kerbey Bowen of Ray Mead has an electric launch for hire. An endeavor was made to have an electric omnibus plying between the station and the exhibition, but this could not be accomplished.—London *Electrical Review*.

Michele's Ingenious Device for Avoiding Dead Centers.

Unfortunately, engineers in electric light stations have, like those in care of other power plants, just the same trouble in keeping engines of the single cylinder type from coming to rest on the "dead center." A description of a simple but ingenious method of overcoming this difficulty will therefore be appreciated by practical men.

As will be seen in the illustration, the crank pin is fixed to the connecting rod and works against a semi-cylindrical brass, which is attached to the end of a powerful coiled spring. This spring is arranged in an inclined slot in the crank disk. When the crank disk is in the dead center, and steam is turned on, the pressure is transmitted from the connecting rod to the inclined spring and a turning effort is obtained. The spring is equally efficient at each

MICHELE'S DEVICE FOR AVOIDING DEAD CENTERS.

end of the stroke. The spring is so proportioned and adjusted that it will not yield appreciably until the full boiler pressure is on the piston. From the fact that when the engine is starting the pressure on the piston is considerably more than is the case when running at full speed, a spring is employed stiff enough to resist any movement of the crank pin during ordinary running of the engine. As the crank pin is rigidly fixed to the connecting rod, it is necessary to have one brass only. It will be noticed [illegible] the thrust is always in the one direction, there is no liability to knock. The brass is made so as to slide in the slot which forms a suitable guide, and is kept up to [illegible]. A spare brass is carried in the slot and forms the opposite recessed plate to hold the end [illegible]

[illegible], from which the cut is reproduced, says, in commenting upon this device, that it [illegible] personal inspection. [illegible] it would be [illegible]

[illegible]

Statistics of Street Lighting.

One of the most interesting of the recent bulletins from the census office is that giving the social statistics of cities. Central station men will be especially interested in that portion giving figures for street lighting. Taking the twenty-two cities of the country having over 100,000 inhabitants each, the following table, showing the number of electric and gas lights, with the cost, has been made up:

Cities.	Number lights.	Gas	Electric.	Vapor.	Annual cost.	Cost of each lamp. Gas	Electric.	Vapor	Cost per head pop.
New York	26,978	25,4[illegible]	1,360	126	$9[illegible],217	$18 83	$121 55	$23 00	$ .43
Chicago	[illegible]	24,578	122	6,714	940,781	20 00	68 00	16 00	.58
Philadelphia	25,903	18,17[illegible]	1,045	6,478	736,605	22 50	177 05	21 00	.70
Brooklyn	10,[illegible]	9,381	[illegible]	.	474,082	21 18	182 50	......	.50
St. Louis	4,001	661	3,241	109	195,041	37 00	71 95	27 06	.43
Boston	13,810	9,058	708	48	551,070	32 07	237 25	26 08	1.24
Baltimore	7,772	5,700	667	1,375	304,442	33 00	146 00	18 00	.70
San Francisco	5,323	5,200	123		281,063	43 80	440 67	......	.94
Cincinnati	9,883	8,168	..	1,715	217,541	22 18	......	21 21	.73
Cleveland	8,267	4,830	106	3,322	160,074	18 54	201 83	14 92	.91
Buffalo	5,600	4,377	1,223	...	285,040	21 78	155 13	......	.11
New Orleans	1,808	758	[illegible]	...	171,317	50 00	135 17	...	.71
Detroit	827	....	827	..	115,821		140 05	......	.59
Milwaukee	[illegible]	2,350	312	[illegible]	120,620	24 17	150 00	20 00	[illegible]
Washington	[illegible]	5,340	105	..	156,705	[illegible] 00	210 00	......	.77
Newark	3,770	3,382	388	.....	122,070	19 50	140 00	.....	.67
Minneapolis	5,527	2,954	475	1,772	166,617	15 60	150 00	21 40	1.01
Omaha	1,341	[illegible]	[illegible]	510	36,448	34 00	150 00	17 75	[illegible]
Rochester	2,716	840	[illegible]	...	141,705	18 25	67 40	....	[illegible]
St. Paul	5,000	2,750	50	3,100	141,790	33 00	128 00	14 40	1.06
Denver	1,750	......	1,750	..	101,300	.	58 40	......	.95
Indianapolis	2,700	[illegible]	[illegible]	[illegible]	[illegible]	15 00	[illegible]	[illegible]	[illegible]

These are very interesting figures, although, of course, to compare gas and electric lights merely by numbers, without giving the relative candle power, places the latter at a disadvantage. Still the table well illustrates the marvelous progress made by electric lighting during the last twelve years. It shows that of the larger cities, St. Louis, New Orleans, Detroit, Rochester and Denver have absolutely more electric than gas street lamps.

Besides the lamps shown in the table, Chicago has 779 oil lamps, Boston 3,000, Milwaukee 1,000, Wahington 360, and Minneapolis 720, costing about $15 per lamp. St. Louis is shown to have more electric street lights than any other city, while Rochester comes next. The cost per lamp for electric lights ranges from $155 in Buffalo, $237 in Boston, and $440 in San Francisco, down to $26.21, paid by Lawrence, Mass., for each of her 584 electric lamps. The cities which have discarded gas and oil and are wholly lighted by electricity are Detroit, Denver, Toledo, Lynn, Hartford, Los Angeles, Lawrence, Dallas, Portland, Me., Duluth, Davenport and LaCrosse. The only city without electric lights is Cincinnati.

The Rotary or Multiphase Current.[1]

Very little has been published so far in the electrical press regarding the "rotary current," which the Germans have named *drehstrom*. The rotary current is a system of alternating currents whose respective phases succeed each other. Generally three alternating currents are employed, although their number may be increased for certain purposes. These currents are generated by a specially constructed alternating current dynamo, whose field is magnetized by a separate exciter. The armature of the alternator is provided with a number of collector rings corresponding with the number of currents—generally with three.

When three currents are employed the phases of these currents succeed each other at an angle of 120° and induce a rotating magnetism. In this sense the rotary current has a certain direction in which it differs from the alternating current.

The difference between the direct, alternating and rotary currents may best be explained by their different effects when flowing around a magnetic needle.

The direct current deflects the needle to a position of equilibrium between its effect and the effect of the earth's magnetism. With constant current strength the needle will remain in this position.

The alternating current makes the needle vibrate to either side of its normal position, caused by the earth's magnetism.

The rotary current gives the needle a continuous rotating motion.

If we replace the magnetic needle by an iron cylinder we have a rotary current motor, whose armature has neither wire, commutator nor collector and which does not necessarily [illegible] a part of the electric circuit. As a matter of fact the armatures of smaller rotary current motors consist of solid iron cylinders fastened to a steel shaft.

[illegible]

The rotary current dynamo usually yields 50 volts and a large amperage. The current of the three primary circuits is delivered to a special step up transformer.

These motors and generators will no doubt play an important part in the future development of electrical power transmission. They need for their operation, however, three complete metallic circuits. The cross section of the wires may be made small when employing a current of very high pressure and oil transformers, but the number of insulators would be increased threefold, and this would result in a rather expensive line construction.

In the proposed electrical transmission of 300 horse power from Lauffen to the Frankfort exposition, a distance of 110 miles, a rotary three phase current of 30,000 volts is to be used and of course three circuits with six conductors

FIG. 1. ROTARY OR MULTIPHASE CURRENT.

are necessary. The result of this experiment is awaited with great expectations. The preliminary experiments at the Oerlikon Works were not conducted on this plan, but the ordinary alternating current was employed.

In using the latter current the motors must have special apparatus to bring them up to a certain speed, at which a perfect synchronism is established.

A multiphase alternating motor is illustrated in Figs 1 and 2.

The multiphase alternating currents form in the iron magnet poles *K* which continually change their position and make the armature *A* revolve. The winding of the rotating armature *A* consists of a few thick insulated copper rods *S*, which also serve to clamp together the soft iron discs which constitute the iron core of the armature. These copper rods are electrically connected with each other on one end, while the other ends are connected to the line circuits. There are always twice as many rods as there are poles or phases; therefore there are four rods in distances of 90° with two phases, six rods in distances of 60° with three phases, etc.

As there is the same potential in the various line circuits from the generator to the motor the copper rods of the motor may be electrically connected on one end without causing a current by a difference of potential.

It is quite possible that we may see in a short time the multiphase alternating generator and motor as powerful rivals of the direct current machines. Both systems will

FIG. 2. ROTARY OR MULTIPHASE CURRENT.

be employed, and in many cases they will be used in the same stations and will be complementary to each other.

Electric Traction in London.

Reference was recently made in this paper to the inroads made by the new City and South London Railway company into the receipts of competing steam lines. The official report of the directors for the half year ending June 30th, now at hand, shows a satisfactory financial condition. The report states that occasional and very short delays to the traffic have occurred through defects in the rolling stock, and that these delays might have been expected during the working of a new and untried system of locomotion. The receipts during the half year from all sources amount to £19,688 2s. 4d., and the expenses for the same pariod to £15,520 16s. 5d., leaving a net profit of £4,167 5s. 11d. The net revenue account shows a balance of £4,693 [illegible]s. [illegible]d., of which amount the interest on debentures absorbs £4,137 16s. 6d., leaving a balance of £555 7s. 2d. to be carried forward. The directors state that some of the items of expenditure have been already reduced. The number of passengers carried during the half year was 2,412,343. The uniform charge of twopence for passengers has been reduced one penny between certain stations, and during certain hours, in order to compete with the omnibus and tramway traffic. Two additional locomotives are now nearly ready, and one train of the new carriages has already been received. In view of the

extension of the line from Stockwell to Clapham, for which the company already has parliamentary powers, the directors are making arrangements for a considerable extension of the generating plant at the Stockwell station. They have placed the order with Mather & Platt of Manchester, for a fourth generator, similar to the three at present working the line. The dynamo is to be of Mather & Platt's "Edison-Hopkinson" type, for an output of about 400 horse power. The company has also ordered a fourth engine from John Fowler & Co., similar to the three existing engines, and has made arrangements for an increase of the rolling stock.

Electric Power Transmission.[1]

By F. B. Badt.

A certain percentage of electrical energy must be lost in the conductors. This loss, of course, involves continuous operating expen e, as the prime mover (steam, water, etc.)

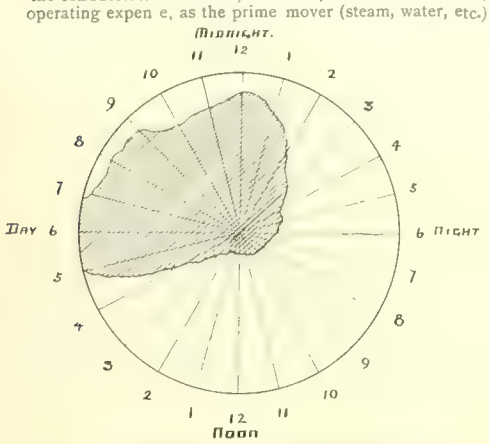


FIG. 1. ELECTRIC POWER TRANSMISSION.

and the electric generator must produce an additional amount of energy, which is lost in the conductors. It is a loss in a commercial sense only, as this so-called "lost" energy reappears as heat in the conductor.

This loss can be decreased and power economized by using conductors of greater cross-section which, of course, would involve a greater outlay for copper. On the other hand, to reduce the first cost, we should employ conductors of the least possible cross section. We can now easily see that for any given case the cheapest in the long run will be a certain size of conductor for which the interest on its first cost, plus the annual cost of energy wasted in the conductor, becomes a minimum.

Sir William Thomson's law states that the most economical area of conductor will be that for which the annual interest on capital outlay equals the annual cost of energy wasted.

We might write this in the form of an equation:

Annual cost of energy wasted=Interest on capital outlay for conductor.

The cost of one electrical horse power hour at the terminals of the generator, including interest and depreciation on the building, motive power and electric generator, multiplied by the number of horse power hours per year wasted in the conductor, must be considered "cost of energy."

The interest on capital outlay for conductor, plus allow-

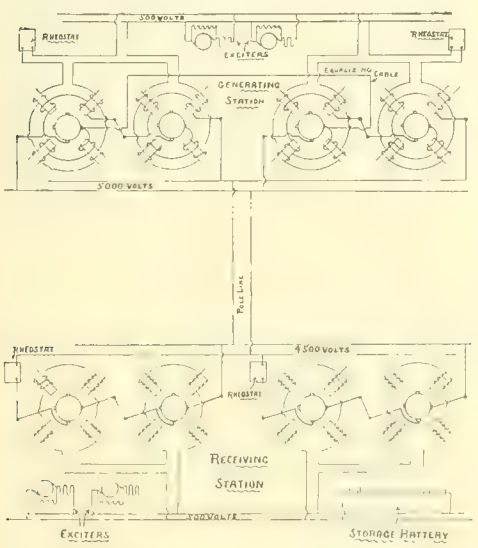


FIG. 2. ELECTRIC POWER TRANSMISSION.

ance for repairs and depreciation taken for the year, gives the other side of the equation.

Both sides of the equation added together give the annual cost of transmitting the electrical energy.

George W. Patterson, A. B., B. S., Instructor in Physics, University of Michigan, has suggested an ingenious little device for getting the proper mean current to use in the application of Sir W. Thomson's law for size of conductors.

Divide a large circle, represented in Fig. 1, into twenty-four equal arcs, representing the twenty-four hours of the day, and draw the radii. Lay off from the center of the circle on the radii distances proportional to the currents at the several hours. Then draw a curve through the points thus made on the radii. Then find the area of the shaded curve in the figure by means of a planimeter. Find the radius of a circle having the same area as this shaded curve. It will be the mean current required, for each elementary area of the shaded figure is proportional to the square of the corresponding radius vector. If still greater accuracy should be desired, the circle may be divided into forty eight equal arcs, representing ½ hours or into ninety-six arcs representing ¼ hours.

In practice it will be very often almost impossible to predetermine some of the factors which are necessary to employ Sir William Thomson's or Kapp's formulæ. Take, for instance, a prospective power transmission plant in our western country. Who could even approximately determine the cost of one horse power hour number of hours per annum that the maximum current, and the number of hours that three-fourths, one-half and one-quarter of this amount would be required?

These items will change rapidly in a country which is fast growing up; and while, for instance, the cost of one horse power hour at the generator terminals may be five cents to-day, it might be only two cents in a year hence; and again, while the market for renting power may be very limited to-day, a rapidly growing mining industry, for example, may cause a great demand for power, and customers would be willing to pay comparatively higher prices for current delivered every hour of the year. Nevertheless, it is true that no system of transmission will be profitable if the cost of the power at the distant end is not less than the price which would have to be paid for its production there by water, steam, or some other agency. Power producers investigating the advantages of electric power transmission will in most cases be satisfied to calculate the conditions for the minimum initial cost of the plant, leaving the exact determination of the cost of one horse power hour and the price at which they can profitably rent power to future developments.

To a certain extent, of course, a plant which requires the smallest investment of money will be the cheapest to operate. As a matter of fact, the same elements which are employed in sir William Thomson's law enter into our computations with the exception of the items: Number of annual running hours and cost of one horse power hour at generator terminals. The whole question of minimum initial cost of plant again hinges on the proper size of the conductors.

A. L. Rohrer of the Thomson-Houston Electric company applied a modified plan for a large power plant by which 5,000 horse power is being transmitted a distance of twelve miles.

The diagram, Fig. 2, will serve to illustrate this idea. By this arrangement the generators are coupled mechanically in pairs as one unit on one shaft driven by one turbine, and electrically the armatures of each unit are connected in series.

Each armature has a potential of 2,500 volts. This gives 5,000 volts for each unit at the generating station. The generators are separately excited, and have also series winding, which will compensate for the loss in the line. At the receiving station there are the same number of units, each consisting of two similar machines, with their armatures in series, and their fields separately excited, but without series winding. Each receiving unit is coupled to the same shaft in the same manner as the generating unit. At the generating station exciters only are used for charging the fields, while at the receiving station, exciters are used in connection with a small storage battery, which is necessary to start the first unit. The m echanically and electrically coupled units at the generating station are united electrically in parallel in one system by an equalizing bar, as shown in the diagram. It seems advisable to leave the storage battery in the circuit, permanently, to keep the fields of the motors fully excited, in case the speed should drop.

In another instance, 250 horse power is transmitted a distance of ten miles with single series wound units. Each machine is wound for a potential of 3,000 volts, and for this purpose a special commutator with 798 segments was constructed.

The plan of employing single series wound units for transmitting power from one point to another at high potentials is a most excellent one.

The shunt motor is wound with the field magnets in shunt around the armature, and in the circuit from the armature is placed a variable resistance or rheostat. On starting the motor it is necessary that all this resistance be in circuit; otherwise, because of the low resistance of the armature, excessive current will flow, and damage may be done the motor. This resistance is contained in a box on which a sliding arm moving over segments adjusts the current. Before starting the motor the arm should be against the stop, in which position the circuit is open. After closing the switch the movable arm should be turned slowly, when the motor will gradually start up and set up a counter electromotive force, which will act as additional resistance in the circuit. As the motor approaches full speed the arm should be turned as far as it will go, thus cutting all resistance out of circuit. It is necessary that the movement of the rheostat should be slow and regular, for if it is not, excessive current will flow, and the fusible plug will be melted.

The rheostat should never be used to regulate the speed of the motor, but merely for starting. Never allow the rheostat arm to rest on an intermediate segment.

To stop the motor, open the switch, and then turn the arm of the rheostat back to its first position.

Fig. 3 and Fig. 4 illustrate the mode of connecting the motor and rheostat to the constant potential mains.

An incandescent lamp arrangement for showing the interior of boilers while under steam has been made by a German inventor.

Heating Houses by Electricity.

will show the trend of Mr. Willcox's strong argument:

"It would be absurd to provide every house with gen-

more expensive than oil, and oil than the tallow candle.

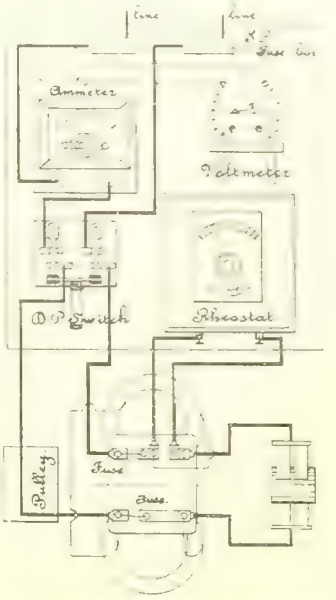


FIG. 3. ELECTRIC POWER TRANSMISSION.

yet, even considering the item of expense, who would not prefer the incandescent lamp to the candle, oil or gas? Thus the cheap wood fire gives place to the more expensive coal fire, and the coal fire to the more expensive natural gas fire, and it in turn, to steam. Now, there exists a place for electric heating. The advantages for the latter will soon be worth the difference in cost.

"I would call particular attention to the advantages which Mr. Whigham considers 'minor items of not much importance.' At a distance from the community in which the houses are warmed by electricity an electric power station will be situated. The fuel which has hitherto been wheeled through the streets of the city, dumped upon lawns and sidewalks, thrown into cellars, creating dust, dirt and noise, and later requiring the labor of hundreds of people to feed it to furnaces and to carry it to stoves and grates, and which requires the attention of the family to accomplish satisfactory and economical combustion is, in the furnace of this power station, consumed under the direction of two or three men skilled in such labor.

"Mr. Whigham has conceded to electric heating the advantages of permitting greater facility in regulating temperature, and of being free from losses such as steam

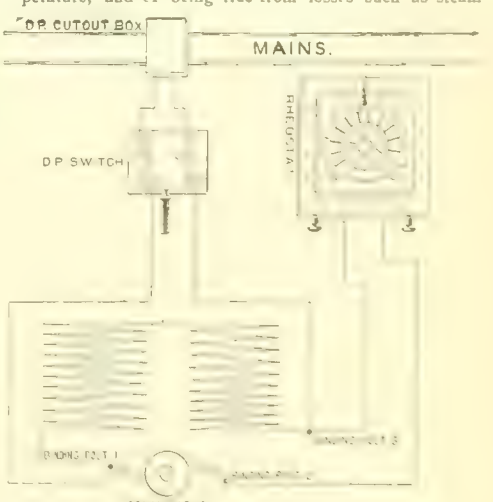


FIG. 4.

heaters are liable to, [illegible] vantages he gives [illegible] the victim of an [illegible] audience of clanging steam [illegible] frescoes and [illegible] by escaping water [illegible] use of the electric heater.

"I do not agree with Mr. Whigham that the 'relative cost of the two plants and of the outlay for wages, wear and tear, interest and depreciation [illegible] steam.' One power station [illegible] which fuel is brought [illegible]

1. From the "Electric Transmission Hand-Book," published by the Electrician Publishing company, Chicago.

men perform the necessary labor, cannot have the initial cost of the separate furnaces necessary to such population; nor can the wages of the station men amount to that of coal heavers draymen and separate assistants in the homes.

"The wear and tear of the apparatus cannot equal that of small heat systems which also call for wear and tear upon trucks, horses, public and private property. Besides, the danger of fire is removed.

"Therefore, while I admit in some instances an excess of cost of electric over steam heating, I consider its accompanying advantages full compensation. But there is a case where heat may be furnished by means of the 'dynamo and its adjuncts' at a less cost than by steam. That is where water power may be utilized. Electrical energy is, in such a case, produced at the cost of the wear and tear on apparatus, and such sources of power may be drawn upon without limitation. With the possibility of transmitting energy from distant waterfalls, as is contemplated in the case of Niagara, together with the erecting of large steam plants for generating current, may I not predict for electric heating a place in modern life corresponding to that held by electricity in the fields of power and light?"

Electric Mining Machinery.[1]

At a late meeting of the English Institution of Civil Engineers Llewelyn B. Atkinson and Claude W. Atkinson, associate members of the institution, read a most interesting paper upon "Electric Mining Machinery, with Special Reference to the Application of Electricity to Coal-cutting, Pumping and Rock-drilling," a paper deduced from four years' experience in applying this class of machinery to mines and in experiments connected with the difficulties to be encountered. An abstract of the salient features of this paper follows:

The principal uses to which electrical power can be applied in mines are the driving of pumps, of hauling and underground machinery, of coal-cutting machines, drilling machines, and in certain cases fans for subsidiary ventilating purposes. In referring to compressed air and the utilization of the exhaust as an assistance to ventilation, the authors think this is the most costly form of ventilation that can be devised in its expenditure of power. To use compressed air economically, with least bulk of machinery and pipes, it is necessary to work at as high a pressure as feasible. But this increase of pressure, economical and more efficient in the use of steam, reduces the efficiency with compressed air. This is shown by the experiments of Messrs. J. Fowler & Co., at Leeds, who give the following table as to the gross efficiency of compressed air in the transmission of power:

Lbs.	Per cent.
40.0	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Brake H. P. of motor ÷ I. H. P. of compressing engine.

These results are borne out by the recent experiments of Prof. A. B. W. Kennedy on the transmission of power by compressed air, in Paris, on the so-called Popp system. These experiments showed that the brake horse power of the motor (10 horse power) is 31 per cent. of that of the engine driving the air compressor, if the air is not heated before use in the motor. Heating and expanding the air before passing it to the motor increases its efficiency to 45 per cent. In mining work this is generally difficult; but [illegible] Hardt, in 1872 placed a heating apparatus in the [illegible] in which the oxygen for the combustion of the fuel (a mixture of coke and scrap iron) was supplied by the air working the motor. By this he carefully avoided the possibility of explosion by fire damp and the formation of ice.

In practice 40 lbs. to 50 lbs. is about the pressure now adopted for working compressed air machinery; though in rock drills, where lightness, portability and smallness of connecting hose are of more importance than efficiency, pressures of 70 to 90 lbs. per square inch are frequently used. The final result, however, is that it is impossible with compressed air to transmit to the distant motor more than from 20 to 30 per cent. of the power expended at the engines, and taking into the account friction and loss by piping, the average efficiency is nearer 20 per cent. In the case of electrical transmissions, except when distributed in very small units, there is little difficulty in obtaining 50 per cent. of the power expended, and there are cases in [illegible] transmitted without extraordinary precautions being adopted. As these figures [illegible] of compressed [illegible] as

A long table is given in the paper showing the losses in each part of an electrical pumping system; first with a pump delivering 150 gallons per minute in a 900 feet vertical lift and a six inch pipe line 1,800 yards long; and second a similar pump delivering 200 gallons per minute 480 feet high through the same pipe line. The result shows that an efficiency of 67 per cent. can be readily obtained even when transmitting nearly 100 horse power to a distance of more than two miles, without any attempt to get specially good results, and the whole plant capable of being worked by unskilled men.

One of the most important points raised against the use of electricity in mines is that relating to its safety in view of the explosive nature of the gases existing in some parts of most mines. The authors resolve this problem into two parts: (1) Will a motor working under ordinary and satisfactory conditions be likely to cause an explosion, assuming that it is placed in the positions where motive power is usually required in mines? (2) Is it possible under what may be termed extraordinary, but perfectly realizable conditions, to produce an explosion under similar circumstances?

The following is presented as a summary of the results of experiments bearing upon these questions. In the case of an ordinary motor working up to, say, 500 volts, having the brushes properly adjusted upon the commutator, no sparking can be perceived. But, if from wear of the contacts during the long runs, or variation in load, slight sparking should occur, it is produced in contact with large masses of a highly conductive metal (copper), with the result that the rise in temperature is not sufficient to form explosive mixtures of coal gas and air, or ordinary marsh gas and air. The temperature required to explode these gases at ordinary pressures may be taken to be, for a mixture of 1 volume of coal gas with 5 volumes of air, or for a mixture of 1 volume of marsh gas with 9.4 volumes of air, from 900° to 1,100° centigrade.

Copper combines with oxygen in air to produce oxide of copper at about 700° C., and as under normal conditions the formation of oxide is not observed, either on the collector or point of the brush, this fact may be taken as further evidence that the temperature existing there is not sufficient to form an inflammable mixture of gases. But while not dangerous under ordinary circumstances, the extreme wear of a brush or its serious displacement may cause an amount of sparking that will raise the temperature sufficiently high to oxidize the copper of the brushes and ignite gas. The question then arises, how it is possible to obviate this danger.

The authors have adopted a method of their own as a means of excluding from the armature the atmosphere in which the machine is working. It is assumed that the machine will not normally be placed in an explosive mixture, but it is intended to guard against the accumulation of such gases in the case of motors unattended for some hours at a time. Means should also be adopted for stopping the motor when placed at the coal-face or in a heading, in case of an in-rush of fire-damp, from the fall of roof, or from other reasons. It should be stopped before the explosive gas reaches the motor.

To effect this the authors either inclose the whole armature, with its commutator and brushes, or when this is inconvenient, the commutator and brushes only, in a practically air tight casing. This plan has been successfully applied to motors developing from 1 to 45 horse power. It is now recognized that in the winding of field magnets any desired temperature of working may be obtained by allowing well defined amounts of external cooling surface for the dissipation of the heat developed. This proposition for a final temperature of 70 degrees Fahr. above the atmosphere may be taken as 2.3 square inches per watt to be dissipated. The armatures of ordinary dynamos and motors are constructed to revolve in contact with the air, and the continual cooling thus obtained allows the surface for each watt to be reduced to about 0.7 square inches.

The argument of the mining engineer is that if these casings should become filled with an inflammable mixture and ignited, the result would be as disastrous as if they did not exist. The answer to this is that under certain sections of the Coal Mines Regulation Act it is not allowable to work when the proportion of explosive gas exceeds about 1 in 30, and it is not likely that any electric motor will be placed in such a position as to run continuously in any explosive atmosphere for a longer period than two or three hours at the outside. These casings are tightly fitted at all points, many of them packed with rubber, and it is not likely that an inflammable mixture could penetrate to a dangerous degree in that time. Should there be any leakage, however, into the covers, as soon as the proportion of marsh gas in the air reaches 3 to 4 per cent combustion will take place quietly, producing carbonic acid gas, which will tend to prevent explosions.

If it is required to work for long periods in such an atmosphere, the authors provide means for the introduction into the armature of an inexplosive mixture. This is most simply done by attaching to the motor a steel cylinder containing cabron dioxide under pressure, and connecting this with the armature casing by a pipe, which would allow a slow, constant stream of this gas to reach the interior of the casing. The value of this method is evident when it is pointed out that the presence of 14 per cent. of carbonic acid gas in the most explosive mixtures of fire-damp renders them [illegible] until mixed.

In the opinion of the authors the switches present a more serious difficulty than the motors, and they have endeavored to [illegible] in two ways: by diminishing as far as [illegible] tendency to sparking, and by arranging a [illegible] even in the event of a spark would be safe [illegible] to occur. The plan adopted [illegible] to provide a resistance coil of small self induction, which is always connected with the [illegible] to form a path through which a current in the latter may continue, even when the [illegible]. In the same way they have [illegible] that before breaking the circuit the coil of the magnets is short circuited.

By this means the act of breaking the circuit reproduces the conditions which exist in the case of a shunt wound generator and shunt-wound motor, and the only sparking which results is that due to the self-induction of the line and armatures. To diminish this latter, the switch itself has, on its lower side, a resistance coil connected to the several points with which it makes contact, the wire being large enough to carry the current for the short time during which the switch is passing over them. Even when the generator is short-circuited, the current is so far diminished that if the switch be moved slowly over the contacts, it is less than what has been termed the critical magnetizing current of the dynamo. The result is that by the time the circuit is open the series-wound dynamo has practically ceased to excite itself, the electromotive force and current are very small, and the sparking is practically nil.

As an additional safeguard, the switch itself is made in the form of an air-tight box, which will exclude an explosion mixture for many hours.

The paper continues with a semi-historical sketch of the application of these principles to working machinery by the authors and by others. But this portion and the discussion which follows are too voluminous for insertion here, though an abstract is given of the latter. The authors conclude, however, with the following summary of the advantages of the electrical transmission of power as deduced from general experience:

(A) Electrical power is destined to become an important factor in mining mechanics, on account of—

1. The greater facility with which it can be used with machines which require to be moved from time to time as the work advances.

2. The great economy in first cost and reduced cost of working, owing to its efficiency being higher than that of compressed air or any other medium of power transmission.

3. The smaller cost of maintaining the cables, as compared with piping, on shifting floors, in roadways, etc.

(B) That the methods described are sufficient to obviate all objections to the use of electric motors in coal mines, either by excluding inflammable gases or by constructions which allow of their safe combustion.

(C) That experiments, trials and practical work, extending over four years, show that—

1. Electrical pumps may be used with advantage and economy for mine draining.

2. Electrical coal cutters can replace hand labor, with saving in cost and increased production of coal.

3. Electrical drilling machines are available in place of machines worked by hand or compressed air.

In the discussion which followed the reading of this paper, the following points may be selected from much relating to coal-cutting machinery: Mr. Snell laid special stress on the kind of cable employed in wet and dry mines. Lead-covered cables protected by an outer serving of braided and ozokerited hemp he found best suited and most durable for wet pits and shafts. They were also used for permanent main roads and levels; but in rough roads, with falling sides or heaving floors, he preferred an insulation of vulcanized rubber well served with braided hemp, as being more flexible. In shafts he always boxed the cable to protect it from falling stones. He thought that wherever water power was available electricity was the cheapest form in which power could be transmitted. At St. John's colliery, Normanton, electricity had been substituted for compressed air for main haulage and main and dip pumping, with result that the original engines and boilers had given rather more than twice the useful effect previously obtained. His company had several convenient forms of portable motors for coupling to Ingersoll percussion and rotary drills.

Prof. Arnold Lupton objected to the comparison made by the authors as to the relative cost and efficiency of electricity and compressed air. He thought a 3-inch pipe would have been large enough, at $1,000 less cost, and that proper electric mains would cost $500 more than stated. He also thought there would be trouble in distributing power in running machines at half speed, but he gave no figures for his objections. Mr. Grothe called attention to the fact that the United States was far ahead of England in the application of electricity to useful work, and gave statistics of street railways, street lighting, mines, etc. Mr. Bainbridge said that in the case of pumping there was no comparison between electricity and compressed air. He was operating a pump that raised 50 gallons per minute, 400 feet high, at a distance of 2¼ miles from the engine, with a first cost less than one-half that of compressed air.

John Taylor referred to a California gold mine, where water power was to be secured within two miles of the mine. This was utilized by a Pelton wheel, 87 inches diameter and developing 125 horse power, with 400 miners' inches of water under 160 feet head. This wheel drove a 100 horse power Brush generator, and the current was transmitted to the mines, 1,400 feet above the power station and 10,890 feet distant, by a No. 2 insulated copper wire less than ¼ inch in thickness. The length of the circuit wire was 22,588 feet. At the mines was a Brush motor working up to 60 horse power actual; this drove a ten-stamp battery and three Huntington mills, or the equivalent of a 40-stamp battery, and a large rock-breaker in addition. It also lighted all the works. Experiments made showed that from 83 to 85 per cent. of the horse power generated was practically received at the mills, two miles away. A wire two sizes larger would have transmitted 92 per cent., and the electricians of the Brush company stated that they might safely depend on 70 per cent at a distance of 12 miles.

Prof. Henry Robinson, who was interested in the compressed air plant at Birmingham, stated that the average efficiency of 34 motors worked by compressed air at 45 pounds was 42.66 per cent., and this could be taken as a fair average of the good with the bad compressing machines. In another case a 40 horse power engine worked with the

air heated showed an efficiency of 73 per cent. In other words, he wished it understood that great advances had been made in a few years in air-compressing machinery.

Frederick Hurd said that he was using electrical coal-cutting machinery, and thought the dangers were exaggerated; he had seen machines sparking at a rate that would amaze some people, without causing explosions. His firm was contracting to take out coal at 1s. 6d. (36 cents) per ton, finding the machinery, keeping it in order and providing the men. They were receiving large royalties, and had declined to sell the machinery to the mine owners, who would have been glad to close the existing contracts.

E. R. Dalby thought that the risk from sparks from picks was almost as great as that from the commutator of a motor. He referred to the experiments made after the disastrous explosion at St. Etienne in France, and to the fact that the board of investigating engineers found that picks of aluminum bronze with 2 per cent. silicon alone produced no sparks. This board, however, failed to produce explosions with the sparks from any of the picks used.

Howard D. Pearsall objected to the statement made regarding efficiency and cost. He said that Mr. Taylor had stated that the efficiency transmitted at the California mine was 85 per cent.; but that was solely the efficiency of the conductor, and meant that 15 per cent. of the power was lost in transmitting it two miles. The loss in transmitting compressed air through three miles of pipe, at Paris, was only 2 per cent., on the authority of Prof. Kennedy. In the Paris installation the efficiency of the prime mover was 84.5 per cent., and that of the compression was 61 per cent. The product of these was 51.5 per cent In compressing air by water power he had obtained an efficiency of 85 per cent. and a net efficiency of 67 per cent. at a distance of three miles.

In answering Prof. Lupton's objections, the authors stated that their prices were average market prices, and they had adopted a 4-inch pipe in the table given because this had been recommended by all makers of compressed air machinery whom they had consulted. To meet an objection that the distance of transmission was not sufficient, they had prepared the following table, with a transmission equal to 10,000 yards:

COMPRESSED AIR VS. ELECTRICITY.

System.	Size Pipes	Engine B. HP.	HP. given by Generator.	HP. lost in Main.	HP. put into Motor.	Motor B. HP.	B. HP. Motor Engine	Cost Complete and Erected.
	ins.							
Air	3	62.1	38.6	19	19	10	0.16	$12,500
	4	39.0	23.6	4 6	19	10	0 26	15,500
	5 & 4	35.8	21.8	2 8	19	10	0 28	17 225
Electricity	10-17	19.2	16.6	1.6	11.4	10	0 52	7,000

As to the danger and annoyance from stoppage and break-downs, the author said that as a matter of fact a dynamo driving the author's coal-cutting machines was used regularly for two years without any repairs or breakdowns. As to Mr. Pearsall's remark that compressed air with an efficiency of 85 per cent. was an accomplished fact, the authors regret that he did not specify where it was to be seen, as a large number of engineers would be certainly interested in this unique result.

A Weather Prophet's Views on Electric Wires.

Prof. E. S. Wiggins, the weather prophet, speaking of his theory of the relation of electric wires and droughts, made the following statement in the *Chicago Herald* recently:

The theory I announced in 1887 that telegraph wires prevent the formation of electric clouds and destroy those already formed and therefore cause drought has been variously commented on by the press of America and Europe. The German and French philosophers have accepted it. To test its accuracy the former have traced the origin of electric clouds to the hilltops, showing they originate in terrestrial electricity; for, as is well known, electricity always collects at elevations on the surface of globular bodies. For many years one of the provinces of France had been subjected to frequent visits of electric clouds—hailstorms and tornadoes—which, forming on the hills, swept down upon and devastated the fertile fields below. To prevent this they have now stretched wires everywhere across the hills and over the plains, which, by equalizing the electric force, prevent the formation of electric clouds. The wide-awake American has also laid low the telegraph poles in some of the larger cities. If telegraph wires covered our whole continent no electric storm could originate even on the peaks of the Rocky Mountains themselves and North America would be unable, at all events for some years, to raise its own bread. Telegraph wires by depleting the air of its electricity conduct away the vital principle that promotes the growth of vegetation, which is none other than electricity itself."

H. Ward Leonard & Co.

The prospectus of H. Ward Leonard & Co. says: This company has been organized with the special object of undertaking work involving the necessity of a wide comprehensive experience in the electrical field, and such a knowledge of electrical, mechanical, chemical and mining work as is necessary for the intelligent application of electricity to new uses, and such as does not at present exist outside of the large electrical companies.

It is well known that the best experts of the large companies are kept so busy on profitable routine work that they are not so readily available to develop a new application of electricity as would be similar experts whose work would lie entirely in that direction.

In other words the best electrical engineers are largely occupied with the planning and constructing of electric railway plants, arc light plants and incandescent plants, and find little, if any, time in which to give attention to the development of new applications of electricity.

A prospective purchaser to-day who wishes power transmitted great distances, and then utilized as far as possible in a good sized town, finds himself confronted by conflicting statements as to what is possible and necessary, and also finds that the parent companies whose shops are full of profitable standard work do not exert themselves to secure a contract involving the services of their best engineers at great distances from home, and upon plants no two of which are likely to be sufficiently alike to allow of mere duplication as in railway or lighting plants.

Furthermore the parent companies are primarily manufacturing companies, and do not do construction work, except for the purpose of insuring the sale and proper installation of their manufactured goods, and they have of course no interest whatever in selling or installing the goods of a rival manufacturing company

Suppose a prospective purchaser wants to develop a water power, and transmit it ten miles to a town, where he wishes to use it for incandescent lighting, arc lighting, operating stationary motors, a railway, charging storage batteries and the operation of welding machines. He may wish Edison incandescent lamps on a Westinghouse alternating system for scattered lighting, an Edison street railroad, Eddy stationary motors, a Thomson-Houston arc lighting plant, Julian storage batteries and Thompson welding machines. He wishes the entire responsibility in some competent hands. Which one of the above companies would care, for the sake of selling such a small amount of its own apparatus, to develop the water power, construct the entire plant, and purchase from other competing companies and become responsible for apparatus which they themselves may have no faith in? It is evident that each company will endeavor to sell f. o. b. as much of its own apparatus as it can. The purchaser cannot determine whether to transmit by alternating or continuous currents, whether to use storage batteries or not, nor any one of the perplexing points which change with almost every plant, and which only those most experienced are competent to judge.

It is for just such work that we are organized, without any prejudice for or against any apparatus or system, except that based upon our honest judgment after a thorough experience extending over the entire development of electrical engineering since 1883. Having nothing whatever to sell, and having no alliances with any manufacturing concern, we are able to say to the prospective purchaser: "We are organized to serve your interests in the best way possible, and to give close and expert attention to every point in connection with your plant, from the original selection and purchase of your property to the details of the methods of operation after we have installed it for you."

We believe that all first-class manufacturing companies will be glad to have in the field an electrical engineering concern who will always recommend and install their apparatus for purposes to which it is the best adapted, and especially if they have confidence that the installation will be one which will reflect credit upon their apparatus, which confidence we believe will not be lacking.

The supply companies having special devices of undoubted merit will be glad to have a concern in the field which will use that device in the market which is the very best for the purpose, and who have no agencies of any kind for the sale of competing devices, and hence no possible prejudices.

The electrical construction concerns are paying attention principally to the construction of street railways, arc light plants and incandescent plants of types which have become standard because of the large number which have already been installed, and because the conditions are so nearly the same in different plants of such kinds.

Hence it seems evident that our work will be of a character such that we will not be in conflict with the various interests in the electrical field to-day.

Our policy will be to operate as far as possible in harmony with these existing electrical interests, as will be indicated by the following lines of policy:

1st. We shall have no exclusive relations with any electrical manufacturing company.

2d. We shall take no selling agencies for anything.

3d. We shall do no manufacturing.

4th. We will undertake any electrical engineering work within our means, and in any manner consistent with the above.

5th. We shall endeavor to operate as far as possible in the newest fields of electrical engineering, and shall not make any special effort to secure construction work which is merely imitative in character.

6th. We shall endeavor in every way to be non-partisan, and to work in perfect accord with all electrical manufacturing, selling and supply companies.

The prospective purchaser will now be able to secure thoroughly competent service for any portion of the work in connection with the purchase, installation and operation of his plant, and at an extremely moderate rate, as indicated by the following schedule of charges based upon the contract price:

For making preliminary plans, designs, distributions and estimate	1 per cent.
For making final plans and specifications	1 "
For drawing and executing contract on behalf of purchaser	1 "
For supervising an installation made by another contractor	3 "
For inspecting and reporting on the work of another contractor	1 "
For acting on behalf of the purchaser in making the settlement with another contractor	1 "
For acting as the agent of the purchaser, from	

[illegible] methods in the market, and the prices and terms relative to [illegible] and at the very moderate charge of $25 per year for isolated plants, and $[illegible] per [illegible] goes without saying that competent experts can make valuable [illegible] believe that from the thousands of plants whom we shall approach with this proposition the large proportion will consider it a good [illegible] information upon a subject as yet too new to be commonly well understood, and [illegible] from the parent companies with a necessary bias in favor of their own methods and apparatus.

We shall also act as the agent of any prospective purchaser, and in about such a way as architects now act. That is, on the basis of receiving a certain percentage of the cost of the plant.

Every concern contemplating the purchase of a street railway, an incandescent lighting plant, an arc light plant, and in fact any electrical plant of any kind can well afford to arrange to have us act as their representative in securing such a plant of the best possible kind purchased for the least possible amount consistent with the proper standard of excellence, installed in a thoroughly safe and scientific manner, and operated in accordance with the best practice as developed by years of experience.

Whenever desired we will install any reputable apparatus already decided upon and purchased, and this feature of our business will be of special importance to purchasers who wish to use in a single plant apparatus of various companies, and who nevertheless wish no division of responsibility.

H. Ward Leonard & Co. is a corporation organized under the laws of the state of New Jersey. Its present authorized capital is $200,000. The original subscription was for $50 000, $32,000 of which was subscribed by the incorporators.

It will be noticed that the revenues of the company will be of a character such that comparatively little capital will be required, considering the net revenue.

The shares of the company are $100 each. The present stockholders include some of the most prominent officials of the leading electrical companies.

None of the stock of the company will be issued for anything but absolute cash or its equivalent, and every shareholder is on exactly the same terms as every other shareholder. That is, there will be no issue of stock for contracts, patents, franchises or similar considerations having an indefinite value.

CORRESPONDENCE.

New York Notes.

NEW YORK, Aug. 22.—Staten Islanders are feeling the force of the saying that it is always darkest just before dawn. They are naturally and justly indignant at being left in darkness when temporary plants were promised and could have been put in operation to feed the Richmond company's uninjured circuits. But now that so good a reason for the delay is given there should and doubtless will be more rejoicing than impatience. The fire will, in all probability, prove a blessing in disguise.

As was stated last week, it is the purpose of the Richmond company to rebuild the station in another site closer to the water's edge. But nothing was said about a great scheme which President Erastus Wiman is now pushing with his characteristic energy. New York and its environs have been backward in appreciating the many advantages of electric railways. It is with genuine satisfaction then that one sees a man of Mr. Wiman's reputation come to the front, as he did on last Tuesday afternoon. To be brief, Mr. Wiman now proposes to cover Staten Island with a network of electric lines and equip the new station with apparatus to furnish the current for the entire railway system as well as for the lights. Such is his plan in a nutshell. On Tuesday afternoon he laid his scheme before the Richmond county board of supervisors, and asked that he be granted an exclusive franchise. No action has as yet been taken, but the members of the board have accepted an invitation from Mr. Wiman to visit Boston as his guests and inspect what, it will be remembered, was called by the facetiously inclined New York editor the "intolerable trolley system in an aggravated form."

The importance of the proposed work will [illegible] understood by outsiders. As was stated by Mr. Wiman, the interior of Staten Island is greatly lacking in development, while its edges are provided with most excellent facilities of transit. If the electric system goes in as projected, it is prophesied that the whole center of the island would in five years be as thickly populated as the shores are now.

[illegible] from Albany that Frank W. Sabold, [illegible] Western Union company's office in that city, has resigned to accept the position of manager of the Westchester Telephone company, whose office is in Yonkers. Mr. Sabold has been with the Western Union company since 1882. His resignation goes into effect September 1st.

In all probability when District Attorney Nicol gets through with his electrical execution indictments he will have been impressed with the fact that there is one subject at least upon which the press can talk freely. "Nicol a Conspirator"—such a headline appearing, as it did, on the editorial page of the New York *Mail and Express*, could not have excited any feeling of gladness in the heart of the district attorney. It is generally believed that the newspaper defendants have been instigating this prosecution against themselves, and that matters will be so conducted by Mr. Nicol that when their counsel shall make the motion to annul the indictments, it will be assented to.

David G. Weems, whose high speed electric railway system was described several months ago by O. T. Crosby before the American Institute of Electrical Engineers, is now in New York. Mr. Weems is still enthusiastically working on this all important problem. During an interview with your correspondent he stated that although the project was progressing slowly it was nevertheless surely going ahead. "Things are now in a more practical shape," said Mr. Weems. "Our experiments have shown us that the solid ground was the place for the rails. Recent tests at 90 miles an hour with a Pullman car and a steam locomotive on a grade on an ordinary railway have convinced us that much higher speeds are practicable."

"You see," continued Mr. Weems, "our first idea included an elevated road and an automatically propelled train—that is, no motor-man on board. We have now come down to the ground and put a man at the motor. Our present idea, and one which we propose to carry out, is the building of a 1,200 horse power locomotive. With this we are going to pull a train of Pullman coaches. You see if the mountain won't come to Mahomet, Mahomet must do the walking. So, as the railroad people won't come to us, we propose to leave the rolling stock just as it is pulled now by the steam engine."

In reply to the question as to where the 1,200 horse power locomotive would be first put in operation, Mr. Weems said: "We expect to get our power from a certain large station now building. This is all I can tell you at present." He further explained, in answer to a number of queries as to details, that a metallic return would be employed and also that the motor to haul the train of Pullman coaches would be without gearing.

Orange, N. J., is to have better street car facilities. The Orange Cross-Town & Bloomfield Railway company has projected two important extension lines. There has been not a word said, though, about the electric system being employed to give the people what they will otherwise be without—rapid transit.

Brooklyn [illegible] is waiting—but that is all. The policy of the Brooklyn City Railroad company is to think a long time, and it doesn't propose to hurry. It is understood that this company has already secured the consent of a majority of property owners on all the lines to the introduction of electricity. President Lewis, however, says that the application for the use of electric motive power may be allowed to lapse as far as the entire system is concerned. The directors want to find out, if possible, what [illegible] before making any change.

Speaking of conservatism it would never do to leave out Jersey City. In that city there is a street railway, the Jersey City & Bergen Railroad company's, on which electric motors have been employed for months to draw the cars [illegible] to induce the city authorities to permit the use of motors from the foot of the [illegible] permission, so the [illegible] the horse.

There are, as yet, no more very important particulars relative to the rapid transit question here to be chronicled. [illegible] that at [illegible] Mon- [illegible] and adopted:

[illegible] severest criticism and condemnation of the people of the [illegible]

of the WESTERN ELECTRICIAN, paid the New York office a visit this week. From appearances, politics and electricity have, in one case at least, come to a mutual and satisfactory understanding. Mr. Durborow is looking well.

There was a rumor afloat last week to the effect that a corner in crude rubber had been formed. The moving spirit in the enterprise was thought to be one John C Goncaloes Vianna, a Spaniard of Brazil, who once before, in 1883, tried to corner the rubber market. Joseph Earle of Earle Bros., a large importing firm in New York, admits that the rumor was correct. He said that it was estimated that the syndicate controlled 90 per cent. of the rubber supply. The present stock of Para rubber is figured at from 3,600 to 3,800 tons.

Commodore Gerry of the New York Yacht club, whose cruise has just ended, is more or less of an electrical decorator. He has tried a number of experiments with the lights on board his flagship "Electra." This season bright red lamps were strung in a row from a line reaching from the bowsprit up over the topmast heads down to the stern of the yacht. Some of the lamps in the string went out while the "Electra" was anchored in Huntington Bay, and the commodore is quoted as giving his expert opinion that the trouble was due to the mosquitoes having eaten the insulation of the wires.

It may show a lack of proper courtesy to doubt Mr. Gerry's statement, but this opportunity must be taken advantage of to say that someone must be in error. The mosquitoes were not at Huntington Bay at the particular time specified. They were elsewhere, and persons desiring the name of that locality can get it by applying to your correspondent.

The "Electra" is said to carry a search light as powerful as that on the "Chicago."

The damaged electric light buoys in Gedney's Channel, which were referred to in last week's letter, have been repaired and were to have been lighted last night.

F. L. P.

Pittsburg, Pa.

PITTSBURG, Aug. 22.—The Duquesne Traction company of this city has now had its road in operation for about three months. At the outset much difficulty was encountered in getting the cars to run properly, on account of the heavy grades and sharp curves. This trouble has gradually disappeared, and everything appears to be running smoothly at the present time. It is stated, however, upon reliable authority that the company has perfected arrangements for the disposition of its present cars, and will within a short time have on the ground a full outfit of lighter cars. The cars now in use are extremely heavy, and would be much better suited to a company operating a road with light grades. It is said that the Duquesne company contemplates the reduction of its fare to the three-cent basis, to the end that it may more advantageously compete with its cable arrival, the Pittsburg Traction company, which, for a couple of months, has been doing business at the three-cent rate and apparently prospering. Pittsburg is undoubtedly the only city in the country where a passenger can ride five miles upon a street railway for the sum of three cents.

The borough officers of Homestead, Pa., are negotiating for the purchase of an electric lighting plant to be used for the illumination of the streets of the town. It is the intention to do residence lighting also, in case citizens of the borough desire to avail themselves of the opportunity to have their houses lighted by electricity.

At Harrisburg, Pa., a few days ago, the People's Electric Street Railway company, with a capital of $50,000, was chartered. The headquarters of this road are in the town of Bridgewater, Beaver county, Pa. The road, as projected, will connect the towns of Bridgewater, Rochester, Freedom, St. Clair and Economy.

McKeesport, Pa., is to have a telephone system in full operation by the first of October. The rates for the service are to be three dollars per month, and already more than a hundred subscribers have been secured. It is expected that three hundred names will be upon the list of subscribers before the time for starting.

Cincinnati, O.

CINCINNATI, Aug. 22.—The Cincinnati Electric Subway company, organized for the purpose of building a general subway for the accommodation of the various electric light, telegraph and telephone companies, is pushing its interests vigorously, in spite of the fact that the Edison company [illegible] franchise some months ago for the use of the streets, and has laid several miles of its underground system. Should this subway company succeed in securing a franchise giving it the right of way in all the various streets and alleys, the Edison company will be put to great expense changing the lines which are already down. However, a general subway, such as the Cincinnati company proposes to put down, seems to be the only way to solve the problem of underground wires; and such a subway would prove of much value, not only to the electric companies, which would all be placed on an equality, but to the public.

The South Covington & Cincinnati Electric Railway company has just added to its plant a battery of tubular boilers of 400 horse power capacity, a 300 horse power Lane & Bodley Corliss engine, several new Short generators, together with shafting, clutches, etc., and a fine switch-board, making the most complete station of its size in this vicinity. The company has dispensed with horses on all its lines.

F. E. Perry has purchased the entire outfit of the Electric Supply & Contracting company of this city, and will continue the business, making a specialty of repair work of all kinds. The shops are in the Nevada building, Fifth and Sycamore streets.

The contract for wiring the Alms & Doepke building for the arc system was secured by the Edison General Electric company, the price being $7,850.

An electric road is projected from College Hill, a suburb of Cincinnati, to the city. The franchise has been secured and work will be commenced soon.

J. H. Rhotehamel, president of the Columbia Incandescent Lamp company of St. Louis, was in the city a few days ago looking up business. He reports good sales in this territory.

Schulman & Reynolds, contractors for general electric work, have secured contracts for wiring 1,000 lights in the Central Union Passenger station, 250 lights in the Methodist book concern; also for wiring the Neave building, a new eleven-story structure, in which they will use exclusively interior conduits encased in glass tubing covered with brass.

G.

PERSONAL.

B. E. Sunny, manager of the western department of the Thomson-Houston company, returned from an eastern trip last week.

D. M Clower of Clower, Harris & Co., electrical engineers and dealers in electrical supplies at Dallas, Tex., was in the city last week.

J. A. Colby, secretary and manager of the Des Moines Edison Light company, stopped in Chicago last week while returning from the Edison convention at New York city.

Chas. S. Pease has resigned the general managership of the Brush Electric company. He will form a copartnership with James Humbird for the manufacture of electric railway apparatus at Cumberland, Md.

E. R. Gilman, president of the Great Western Electric Supply company, Chicago, returned from a European trip last week. Mr Gilman was absent from home but little more than a month, passing most of the time in London and Paris.

E. A. Van Wie, secretary and treasurer of the Rockford Electric Manufacturing company, was in Chicago several days during the current week on business relating to the establishment of an agency for this territory for the sale of the Mayo apparatus.

D. B. Dean and W. R. B. Willcox will represent the Electric Merchandise company of Chicago at the Montreal convention. They will be "at home" at parlors 14 and 16, Windsor hotel, Montreal. This company intends to exhibit line material and Burton electric heaters.

NEW INCORPORATIONS.

Bradshaw Lumber company, Suffolk, Va.; capital stock, $50,000; water, gas and electric light works, sawmills, lumber and timber.

Norfolk Street Railway Construction company, Norfolk, Neb.; capital stock, $25,000; to build, equip and manage an electric street railway in Norfolk, Neb.

Roland Avenue Electric Railway company, Baltimore, Md.; capital stock, $25,000; to operate a passenger railway outside of Baltimore less than 12 miles long.

People's Electric Railway company, Sandusky, O.; capital stock, $100,000; electric street railway, furnishing electric power, etc.; Geo. H. DeWitt, Sandusky, O.

Couer d'Alene City Illuminating company, Couer d'Alene City, Idaho; capital stock, $20,000; electric illumination in Kootenai Co., Idaho; H. R. Kellinger, Couer d'Alene City, Shoshone Co., Idaho.

Armour Electric Light, Fuel & Power company of Illinois, Chicago, Ill.; capital stock, $5,000,000; to supply gas and electricity for light, heat and power, W. L. Armour, 205 La Salle street, Chicago, Ill.

Wright & Starr Electric company (incorporated in West Virginia), Philadelphia, Pa.; capital stock, $250,000; manufacturing and dealing in electrical appliances and machinery; Knight & Couch, Charleston, W. Va.

Canada Gas & Fuel company, Chicago, Ill.; capital stock, $5,000,000; the manufacture and sale of electricity for light, heat and power, manufacture and sale of steam for heat and power, etc.; Loftus F. Daucey, 101 Auditorium building, Chicago, Ill.

ELECTRIC LIGHT.

It is proposed to erect an electric light plant at Como City, Ala.

The city council of Taylor, Tex., is negotiating for electric street lights.

The establishment of an electric light plant is projected at New Martinsville, W. Va.

The city of Augusta, Ga., has advertised for bids for lighting the city by electricity.

Guild & White of Chattanooga have received the contract to erect the electric light plant and construct the water works at Union City, Tenn. The cost will be about $54,000.

At Henderson, N. C., the electric light plant of the Henderson Gas & Electric Light company has been sold to A. C. Zollicoffer, J. R. Young, J. D. Cooper and J. P. Taylor.

The Claremont Electric Light company of Claremont, N. H., has been awarded the contract to light the city with arc lights, for a period of five years, at $2,000 per year. The Thomson-Houston system will be used.

The Beverly, Mass., Gas and Electric Light company has started its new station on River street in operation. Two Thomson-Houston 50 arc light machines and a 300 horse power Greene compound condensing engine are included in the plant.

The Chicago Edison company has contracted to wire the Minnesota grain elevator for 116 lights and the Bloomington elevator for 142 lights. The former is owned by the Minnesota Elevator company and the latter by the Armour Elevator company.

The electric light plant at Colfax, Wash., was burned recently, entailing a loss of $11,000, with about $5,500 insurance. The town will be in darkness for some time, as the company proposes to put in a larger plant, which must be purchased in the East.

The Vincennes, Ind., Electric Light & Power company has applied to the common council of that city for a franchise permitting it to construct and operate an electric railway on the principal streets of the city. The Thomson-Houston company is backing the local company.

At a recent meeting of the city council of Coldwater, Mich., the proposition of the Coldwater Electric Light company, to dispose of its plant to the city, was accepted at $7,500, with an addition of one 40-horse power dynamo; also the proposition of the Commercial Electric company, for its incandescent system for $4,200.

George H. Clarke has begun an action for $2,000 against the Rochester, N. Y., Electric Railway company for damages alleged to have been sustained by him in being wrongfully ejected from a car operated by the company. Mr. Clarke alleges that on July 14th last he was riding to the lake on the electric road accompanied by two friends from Syracuse. He presented in payment for his fare a ticket reading from Charlotte to Rochester. The conductor held that this ticket was worthless traveling in the opposite direction, and Mr. Clarke insisted that it was good. The conductor stopped the car and ordered Mr. Clarke to alight As he was stepping off the car, Clarke and his friends allege, the conductor kicked the retiring passenger. The conductor was arrested and upon examination he testified that Clarke had made no resistance when ordered off the car, and admitted "pushing him with his foot."

ELECTRIC RAILWAYS.

It is probable that an electric railroad will be built between Atlanta and Manchester, Ga.

The most expensive street car in the world, it is said, is owned by the Troy Electric Railway Car company of Cleveland, O. It cost $10,000.

The Electric Merchandise company has just secured a very satisfactory contract at Pittsburg from the Citizens' Traction company. This company is operating a cable road, but being compelled to extend its lines concluded to build an electric line six miles in length as a feeder. The Electric Merchandise company has secured every contract for furnishing material.

The Chicago and Evanston electric railroad project seems to be meeting with some opposition among the residents of Chicago avenue in Evanston. At a meeting of the property owners of that thoroughfare, held on Aug. 18th, to discuss the proposition of the company to enter Evanston by that street, W. P. Cooley reported that franchises had been secured as far north as Greenleaf street, which is the boundary between Evanston and South Evanston. A remonstrance was drawn up and a committee appointed to secure signatures to it. It is understood that the property owners are thoroughly in sympathy with the road, but would prefer to have it enter the city by some other route.

The Wilkesbarre & Wyoming Valley Traction company has been formed to consolidate the railways in Wilkesbarre, and the long, narrow valley containing a number of prosperous townships. The roads are to be equipped electrically at a cost of over $200,000, and the Short company has secured the contract for dynamos and gearless motors. About 40 will be required. The Harvey, Ill., Transit company is building an electric railway and has decided to equip it with the Short gearless motor. The Short company will ship gearless motors early in September to St. Louis, Mo., Albany, N. Y., Louisville, Ky., Indianapolis, Ind., Washington, D. C., Lincoln, Neb., Rochester, N. Y., Houston, Tex., Harvey, Ill., Cleveland, O., Pittsburg, Pa., Wilkesbarre, Pa., Brooklyn, N. Y., Hot Springs, S. D., etc. The Brooklyn, Coney Island Railroad company has closed a contract with the Short Electric Railway company for electric equipment to be put upon its line.

A car equipped with the new Short gearless motor was tested at Cleveland recently, and, according to the newspaper accounts, the trial was entirely successful. Absence of noise was said to be a noticeable feature. The *Leader and Herald* says: "For two or three hours the Short car was put into heavy service on the Johnson lines. A trail car was attached and both cars loaded to their full capacity, the 'gearless' easily taking the heaviest grades and sharpest curves to be found in the city. At one point the trail car left the track. In order to test the new motors the brakes were set tight upon the trail car and the full load was drawn on the track and around a curve with entire ease. Hon. T. L. Johnson, the president of the Brooklyn street railroad, was an interested spectator, and was thoroughly delighted by the remarkable tests, particularly the small amount of electric power taken by the motors. Prof. Short himself handled the car throughout the run. The car is to be sent to various parts of the country for exhibition before railway men, its first destination being Albany, N. Y., where a large equipment contract is pending."

ELECTRIC MINING.

"Mr. McAdow, owner of the Spotted Horse, at Maiden," says the *Financial and Mining Record*, "has applied electricity in the process of amalgamation in his mill. Electricity has heretofore been used in various forms of amalgamating processes and has been found to act advantageously in keeping the quicksilver alive and freeing 'rusty' gold of the iron film enveloping it, and will, no doubt, become an important factor in the treatment of milling gold ores."

A Welsh correspondent of London *Industries* writes: "J. C. Howell of Llanelly has recently laid down a plant for haulage by electricity in the 5 feet 6 inch seam of the Abercanaid Pit, to the order of Hill's Plymouth Co., Ld. The surface machinery consists of a compound condensing engine by Messrs. Marshall of Gainsborough, connected with a Crompton compound-wound dynamo of 100 horse power. Steel sheathed cables are laid from the generator under the road, down the pit shaft, and beneath the underground roadways, to a motor about 100 yards from the pit bottom. The power is transmitted from the motor by cotton ropes to an intermediate shaft, to which the drums are geared. The plant, which has a guaranteed efficiency of 50 per cent., as against 25 or 30 per cent. for compressed air, will, it is estimated, enable the output to be increased by 100 tons per day, while dispensing with the labor of 25 horses."

TELEGRAPH.

The Austrian government has agreed to pay the maximum price of 120 per cent. for the shares of the principal private telegraph company in the country, which will hereafter be controlled by the state.

TELEPHONE.

The Leesburg, Fla., Telephone company has been incorporated with a capital of $20,000.

Judge Nelson of Boston in the United States Circuit Court on August 17th granted the United States until December 1st in which to introduce testimony before the examiners in the suit of the United States vs. the American Bell Telephone company. This is the suit to repeal patents granted to Alexander Graham Bell for inventions on the telephone, on the ground that he obtained them by fraud.

It seems, from a recent press dispatch, that the people of Baltimore do not look upon the telephone company of that city with favor. It is stated that on Aug. 18th, at a meeting of the members of the Lumber Exchange, it was decided to call on business men in all branches of the trade to have their telephones removed. The war on the telephone company was started at once by the ordering out of the telephones in the exchange office.

The attempt to connect the pulpit of Christ Church, Birmingham, England, with the telephone system is regarded as successful, says the *Chicago Herald*. The telephone company has lately perfected the arrangements, and is now supplying oral sermons at private residences on a rather extensive scale. Naturally it is the bedridden and the sick who most appreciate the advantage of being able to hear a preacher without attending service. A dozen yards or so of loose, flexible cord is attached to the ordinary receiver and a special U-shaped instrument supplied to fix on the head, with an ear box for each ear. Thus provided it is possible for the sick to hear comfortably while in bed. In a quiet room the tolling of a bell can be heard half an hour before services; the prayers can be followed, the responses emphasized and every word of the sermon distiaguished; while solos in the anthems are, it is said, heard as distinctly as if one stood next the singer. Twenty four calls, representing, it is calculated, some sixty subscribers, are stated to have been received at the telephone office from Christ Church one night last week, and a similar number in the morning. Subscribers in Manchester, Nottingham, London, Coventry, Stafford, Wolverhampton and Worcester have also availed themselves of the opportunity of being supplied with a spoken sermon at a trifling cost.

MISCELLANEOUS

[illegible] trical engineering.

[illegible] was killed. Another death from lightning is reported from Joplin, Mo.

[illegible] the interests of steam, electric, cable and other traction systems. The journal promises to be conducted after the American style of trade papers.

In the latest catalogue of the Ohio State University of Columbus, O., it is stated that the electrical laboratory of that institution was erected in 1889. It is a two-story brick building, about seventy-five feet long and forty five feet wide. Sixty feet of the first story forms the engine and dynamo room. The floor of this room is of asphalt, laid on a solid concrete foundation. The remainder of the space is occupied by a stairway, an office and a washroom. On the second floor are a lecture room, thirty by forty feet, a photometric room, a library room, and three measurement rooms. The building and its outfit are valued at about $16,000, of which $10,000 was appropriated by the general assembly and the remainder was donated by various electric companies.

Electricity has been successfully applied to a pile-driving machine in putting down the foundations of an annex to a paper mill near Paris. As the old section of the mill was provided with an electric light plant lying idle during the day, it was decided to use the power for operating the pile driver. An Edison motor was mounted in the lower part of the pile driver frame and transmitted power to a chain drum fitted with fast and loose pulleys. By means of a suitable cut-out the current could be diverted from the motor to a resistance box when power for hoisting the pile driver was not needed. The machinery weighed 1,100 pounds, and the height of fall ranged from about 16 to 20 feet. A current of 63 amperes and 100 volts was employed, and the generator was about 330 feet distant. The conductor was a copper wire two tenths of an inch in diameter.

A New York dispatch announces that one of Pennnington's 'air ships" has reached the metropolis and will be placed on exhibition there. Where it came from or how it reached New York is not mentioned, but it is probable that the conventional freight train was utilized. The dispatches say that it purports to be a model of the air ship that Pennington and Butler are building in St. Louis. Mr. Pennington still proposes to build a big one out of aluminium and to do some traveling in it. "Mr. Pennington will reach here in about six weeks,' said Dr. Spencer, who is directing the model in New York. Mr. Pennington made several announcements while in Chicago similar to that now presented in New York, yet he never progressed any further toward "sailing" his ship than the limits of the old exposition building, where he exhibited it at so much per head.

Chemists working at electrolytic processes will be interested to know that Prof. Traube, of Breslau, finds that when a solution of sulphuric acid consisting of 40 parts acid and 60 water is subjected to the electrolytic action of a current a crystalline deposit is formed on the anode. This crystal, on being analyzed, gives the formula SO_4. M. Berthelot also noticed the same crystals, but he considered them identical with the oxide S_2O_7, which he had obtained by the action of the silent electrical discharge upon a mixture of sulphur dioxide (SO_2) and oxygen. The compound SO_4 is easily decomposed into SO_2 and oxygen. It is a weak oxidizing agent, though in some cases it acts as a powerful reducing agent. For instance, if an emulsion of peroxide of lead in a 40 per cent. solution of sulphuric acid is brought into contact with a quantity of sulphuric acid which has been subjected to electrolysis, and is consequently charged with SO_4, a rapid evolution of oxygen takes place and the peroxide of lead is converted into sulphate of lead.

TRADE NEWS.

Chas. A. Schieren & Co. will be represented at the forthcoming convention to be held at Montreal. They will exhibit their patent perforated electric belting.

D. M. Clower reports the outlook for electrical business in the Southwest as very promising As an instance of the growth of the business he cites the case of his firm, Clower, Harris & Co., Dallas, Tex., which sold 28 motors in 1889, 109 in 1890 and 200 thus far this year.

Thomas G. Smith, Jr., room 11, Hammond building, Cincinnati, O., is the western agent of Samuel T. Williams, the engine builder, of Baltimore. All inquiries from the West should be addressed to him. Mr. Smith is wide awake and energetic and is working up a fine trade.

The Electrical Supply company, Randolph street and Michigan avenue, Chicago, [illegible] arc lamp for incandescent circuits as steadily increasing. The Chicago company has recently [illegible] of its Universal Incandescent [illegible] several places those of other makes.

The Westinghouse Electric & Manufacturing company of Pittsburg, Pa. has opened an office at Atlanta, Ga., in the Venable building. The new [illegible] direction of D. A. Tompkins, [illegible] company in the South, and [illegible] resentative of the railway department. Mr. Tompkins' headquarters will be at Charlotte, N. C., [illegible]

the Atlanta office will be under the immediate charge of Mr. Osgood.

The Great Western Electric Supply company is fully [illegible] quarters at 205 and 207 South Canal street, and is fully equipped for business. The company [illegible] very satisfactory business connections [illegible] through the efforts of F. R. Gilman.

The Salt Lake Power, Light & Heating company is making further additions to its electric lighting plant, and has just placed a telegraphic order with the Pond Engineering company of St. Louis for another 200 horse power Armington & Sims compound engine. This is the sixth Armington & Sims engine which this company has purchased within a little more than a year.

The Manhattan Electrical Supply company of 36 Cortlandt street, New York, is introducing the Mesco Dry Battery for call bells, annunciators, burglar alarms, telephones, medical apparatus, the laboratory and all open circuit work. The company claims that this battery does not infringe on any existing patent. A new feature of the sale of these batteries by the Manhattan company is replacing exhausted cells with new ones at a nominal price.

The Burton Electric company, through its selling agent the Electric Merchandise company of Chicago, reports sales of the Burton Electric Heater to the West End road of [illegible] cars, and to companies in Jamestown, N. Y., [illegible], Mass., Spokane Falls, Wash., New Albany, Ind., and Sioux City, Iowa. These heaters have passed the experimental stage, and are to-day practical and commercial successes.

C. A. Daigh has just secured a contract for his company, the Electric Engineering Supply company, for an addition of [illegible] lights to a National Transformer plant at Stansbury, Mo. He will also supply the same company with a new engine and boiler of 125-horse power capacity. This company has been at work for some time installing a municipal plant at Audubon, Iowa, which will be completed the present week. The outlook for the coming season is reported as very promising.

The Crocker-Wheeler Electric Motor company has secured the services of Gano S. Dunn to superintend and direct the fine work connected with the manufacture of the Crocker Wheeler motors and other specialties. Mr. Dunn is an expert mathematician and a capable electrician. The company has also engaged A. Hartman as shop superintendent. This gentleman has six years' experience in motor work. The fact that the company is thus increasing its force shows the careful attention it is paying to the manufacture of its electrical specialties.

W. R. Mason returned last week from an Eastern trip taking in Boston, New York, Richmond, Va. and other points. Mr. Mason reports the outlook for the Burton electric heater as most promising, several steam roads having put in experimental plants, and in a number of cases where water power has been available the apparatus has been put into private residences, supplying all necessary heat, it is claimed, at one-fourth the cost of coal. Mr. Mason is president of the heater company, and from present indications a very large business will be done during the coming fall and winter.

The Hotel Savoy, Fifty-ninth street and Fifth avenue, New York city, has purchased for the electric light plant three 100 horse power and one 60 horse power engines through E. T. Copeland & Co., 106 Liberty street, New York. The engines are manufactured by the Ball Engine company, Erie, Pa. The Johnson company, Johnstown, Pa., has just installed a 300 horse power cross compound Ball engine for its electric welding plant. The Tuscarawas [illegible] Power, O., has ordered a 100 horse power engine from the Ball Engine company, Erie, Pa.

The practicability of the storage battery system was again put to a test Tuesday, August 18th. A number of representatives of the electrical press assembled at Astoria, Long Island, to witness a trial trip of J. M. McDougall's, new car. The party was carried to North Beach over the Steinway and Hunter's Point railroad in about half an hour. Power for the McDougall motor was furnished by one hundred cells of Gibson & Co. batteries, and the ammeter upon inspection indicated an average of 23. The party [illegible] Mr. McDougall. Upon reaching the Steinway and Hunter's Point railroad depot at Steinway, a tour of inspection of the stables, car barns and workshops was made. The ride to the ferry on returning [illegible] after wishing Mr. [illegible] of the electric rail [illegible]

[illegible] company of [illegible] and [illegible] important changes. The stockholders recently voted to [illegible]

pany, Chicago, which is devoted exclusively to electric railway material. It is a finely printed and illustrated volume of 140 pages. In addition to a complete list of all conceivable appliances connected with electric railway work, with prices attached, the book contains a valuable appendix of "tables, construction notes and diagrams." The importance of the information thus supplied may be judged from the headings of the tables and articles: "Electrical Units and Formulæ," "Amount of Drop in Wires," "Tables of Limiting Currents," "Size of Wires, etc.," "Table of Dimensions and Resistances of Pure Copper Wire," "Weights of Iron, Steel Copper and Brass Wire," "Breaking Strains of Iron and Steel Wire," "Table of Horse Powers," "Construction Notes," "A Few Suggestions on Running." The last two departments were written by M. M. Wood and are full of boiled down hints that will be of much value to those starting in the operation of electric roads. Altogether, the catalogue, which is said to be the largest and most complete of its kind yet published, will be found of great help to all engaged in electric railway work, whether a purchase is contemplated or not. It also contains illustrations of many new devices.

BUSINESS.

One of the latest of the attractive circulars of the Electrical Supply company, Chicago, relates to the Boston trolley and other line materials supplied by the house.

The Great Western Electric Supply company reports very good business for the past month, especially in K. K. wire, having received several large orders. The Sun Arc Lamp is having a phenomenal success.

The Electric Merchandise company, Chicago, reports a very large business during the last month, both in orders for complete equipments of new roads, and also for a large number of extensions. The reputation of this company is a guarantee to purchasers that material sold by it will be found satisfactory in every respect.

The Springfield Boiler & Manufacturing company of Springfield, Ill., calls attention to its Reliance safety water columns, which, it is said, cause the water in boilers to which they are attached to be carried steadily at the proper level, it being necessary for the fireman to do so in order to prevent the whistle from sounding.

The Maine Electrical Improvement company of Brunswick Me., announces that it will undertake the supervision of electrical installations of every description, inclusive of plans, specifications, tests and reports. Thomas J. Fay is general manager of the company, and the New York office is in the Electrical Exchange building.

Engineers operating electric light and electric street railway plants have been examining the merits of the Buxton Universal ring packing, which is claimed to have a very high efficiency. The principal advantages claimed are its anti-frictional qualities, saving the wear of parts in contact; great durability, freedom from corrosion when machinery is not in use, ability to stand intense heat without melting. The packing is manufactured by Geo. B. Buxton, Somerville, Mass., and is highly recommended by the owners of many large steam and electric plants.

A 35 horse power engine built by the Ball Engine company of Erie, Pa., will supply the power for electric lighting for the Norfolk Beet and Sugar company of Norfolk, Neb. A 100 horse power tandem compound engine manufactured by the Ball Engine company, Erie, Pa., is to furnish power for the Beatrice Rapid Transit company of Beatrice, Neb. J. W. Parker, the Philadelphia agent for the Ball Engine company of Erie, Pa., has sold an 80 horse power engine to the Ivy City Brick company, of Washington, D. C.; also an 80 horse power engine to George Kelly & Co. of Philadelphia. The Bellaire Gas & Electric Light company, of Bellaire, Ohio, is installing a 100 horse power engine built by the Ball Engine company of Erie, Pa.

The Rockford Electric Manufacturing company has recently made some important changes in its generators, incandescent dynamos and street railway and stationary motors that give them a high efficiency. The dynamos are compound wound, and are guaranteed to be absolutely self-regulating, making them specially available for isolated plants. The Rockford company has in actual service in this city motors running from one to forty horse power in every day use, so that they can be seen in all possible conditions, so that any one wishing to buy can see them in actual use. Prominent establishments using them for a year give the company the strongest possible indorsements. The apparatus is made at Rockford, Ill., but an agency will soon be established in this city.

ELECTRICAL PATENTS.

Issued Aug. 18, 1891.

457,778. Closed Conduit System for Electrical Propulsion. William B. Heton, Brooklyn, N. Y.

This invention primarily relates to the method of taking the current from the feeder and transferring it to the car or motor mounted thereon, in which is used for this purpose what is termed a "traveling contact or armature," which travels with the car and through which electrical communication is had between the motor and main feeder, and for this purpose a magnet is employed secured to and traveling with the car and located over the conduit and which when properly energized attracts and carries along with it the traveling armature, electrical connection being established between the feeder, traveling contact or armature, [illegible] motor.

[illegible] Telegraph. David Kunhardt, [illegible]

[illegible] Conductors. [illegible] Minneapolis, Minn.

[illegible] object of the invention is the insulation of electric conductors. The method, stated in a general way, of insulating an electric conductor from an object on which it is supported or carried consists in separating the conductor from the object by means of a non-conducting enamel or glaze of film that is made to adhere either to the object or to the conductor.

457,830. Illuminator for Electric Lamps. John Von Der Kammer, Chicago, Ill.

457,836. Electric Railway Appliance. Frederick E. Degenhardt, Chicago, Ill.

Claim 1 of this invention is the combination of an electrical conductor with a series of chambers through which it successively passes, said chambers made airtight by a fluid seal and contactors disposed along such conductors and adapted to engage the same within such chambers when depressed, and an exterior contact surface connected with such contactors and adapted to be engaged by a conductor connected with a moving motor.

457,838. Electric Stop Mechanism. Washington H. Kilbourn, Greenfield, Mass.

457,855. Railway Signal. Lyman F. Munger, Rochester, N. Y.

457,865. Joint for Electric Conductors. George Thomas Manson, Brooklyn, N. Y.

This invention comprises, broadly, a sleeve of compressible material to surround the conductors at or near the joint, and two rigid tubular clamping devices adapted to be drawn together endwise by means of a screw, the pressure upon the compressible sleeve ceasing. These tubes are drawn together until the sleeve is compressed to a degree at which it will be impossible for moisture to enter.

457,870. Electric Railway System. Milton Shoemaker, Sioux City, Iowa.

This invention provides a means of operating cars by electricity by means of an underground wire completely insulated, without losing power in any way by reason of outside influences.

457,875. Electro Motor Engine. Sebastian Ziani De Ferranti of Hampstead, Eng.

The object of this invention is to start an alterating current motor from a state of rest in a simple and effective way by the direct action of an alternating current, which end is attained by employing a compound motor or two coupled motors, one non-synchronous with the alternating current by which it is driven and the other synchronous therewith. These two motors are so organized that the non-synchronous or starting one has both its field coils and armature excited by an alterating current to start it and raise the armature of the alternating current machine up to or above the proper synchronizing motor at the same time that the circuit through the non synchronizing motor is cut out of the alterating main and converted into a closed circuit through the field coils of both the motors. The alterating motor now drives the armature of the non-synchronizing motor, the revolutions of which produce continuous currents, exciting the field coils of both motors, as above mentioned. This double function of the non-synchronizing armature enables the inventor to dispense with an independent source for generating continuous currents, and of course correspondingly increases the efficiency and simplicity of the apparatus.

457,880. Plate for Secondary Batteries. Albert Franklin Madden, Newark, N. J.

457,902. Electric Motor. Charles J. Kintner, New York, N. Y.

457,906. Electric Door Opener. Richard J. Ward.

This invention relates, principally, to two features, the one being the electro magnet releasing device and the other a safety retaining mechanism. In locks in present use an expert can so shake the door as to vibrate the delicately movable armature in such a manner as to release the latch. By the second part of this invention this difficulty is removed.

457,944. Electric Railway System. Samuel E. Wheatley and John W. Schlosser, Washington, D. C.

This invention relates to that system of electric propulsion wherein each car is provided with an electro motor receiving a current through a brush or contact device traveling upon a working conductor, which is divided into independent insulated sections, which are in turn connected successively through magnetic switches with the main conductor or supply line extending from the generator throughout the length of the road, the arrangement being such that each section of the working conductor is being connected with the main conductor only during the time that a car is passing over.

458,025. Electric Arc Lamps. Elihu Thomson, Swampscott, Mass.

This invention relates to the construction of arc lamps, and is particularly directed toward securing a refined and positive feeding motion for the carbons, together with the features of compactness and moderate length in the lamp structure itself.

458,063. Electric Wire Crossing. Charles H. McKee, St. Louis, Mo.

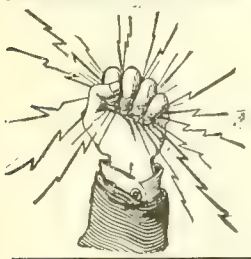
458,115. Method of Electric Bending and Straightening. Elihu Thomson, Lynn, Mass.

This invention consists in passing by suitable clamps a heavy electric current through the section or bar or other piece to be operated upon, so as to bring such section to a working heat irrespective of the other parts not to be forged or otherwise treated, and then bending or straightening by pressing or hammering or the application of force in such a manner as to move the heated particles in the direction required to give the product the intended or desired form or character.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

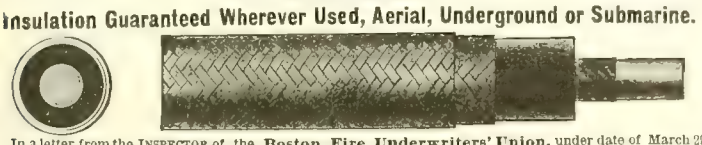
FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used, Aerial, Underground or Submarine.



In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 20, 1886, he says: **"A Thoroughly Reliable and Desirable Wire in Every Respect."**

The rubber used in insulating our wires and cables is specially chemically prepared, and is **guaranteed to be waterproof, and will not deteriorate, oxidize or crack,** and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and to a very great extent, fire-proof. **Our insulation will prove durable when all others fail.** We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS,

4 LaSalle Avenue, Chicago.

Write us for Prices.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. **Telephone, 1718**

JAMES LEFFEL WATER WHEELS

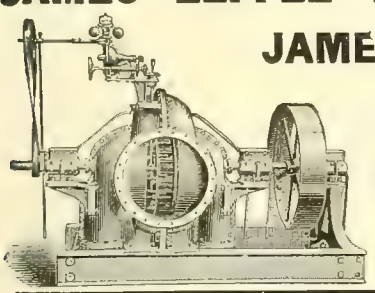
BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

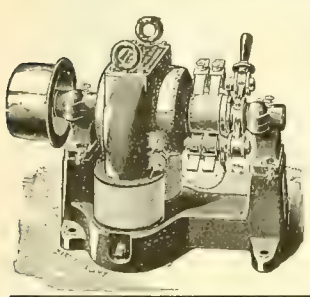


Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE **JAMES LEFFEL & CO.**

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

THE CROCKER-WHEELER PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

WANTED.

An electrician, now in charge of [illegible] ing, electric lights and general electric work, [illegible] equipment Eastern railroad, would like a change. Several years in the employment of present employers, four years in Central States. Thoroughly posted on 3-[illegible] lighting and Edison systems, and can [illegible] work. Address "EASTERN," Care WESTERN ELECTRICIAN.

WANTED.

[illegible] P. O. B[illegible]

Wanted Immediately.

Two Draughtsmen well acquainted with work of designing electrical machinery. Applicants should give reference, wages expected, and an outline in brief of their experience. Address

ELECTRIC LIGHT,

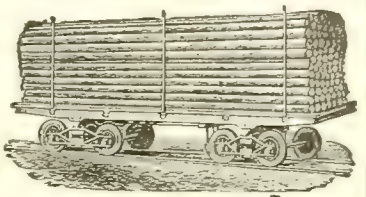
Care WESTERN ELECTRICIAN.

WANTED

A [illegible] Manager [illegible] Lamp [illegible] Must [illegible] [illegible] charge of [illegible] give [illegible]

Address Box 640, CEDAR RAPIDS, IOWA.

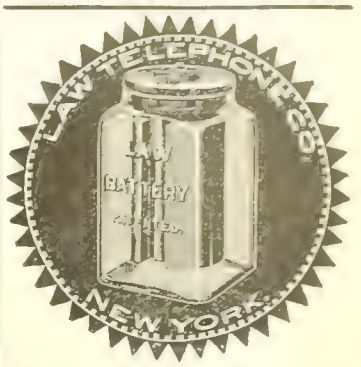
ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.



The Winner of 1890 will win again in 1891. Eleventh year.

SOLE MAKERS

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N.Y.**

REPAIRS

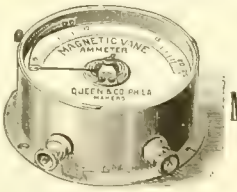
Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

"MAGNETIC VANE"

AMMETERS AND VOLTMETERS



ARE THE BEST INSTRUMENTS FOR

Central Stations, Isolated Plants,

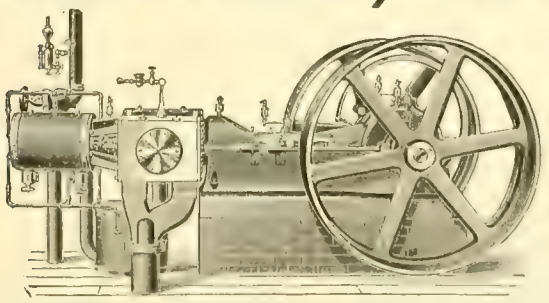
Marine Installations, Electric Railways

Correspondence Solicited.

Send for Illustrated Circular 235.

QUEEN & CO., PHILADELPHIA.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION.
One	12½x12	80	Edison General Electric Co., Groton, N. Y.
Two	18½x17	200	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T.-H. International Electric Co., Rochester, [illegible]
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 19x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Rollins & Co., Chicago, Ill.
One	15 and 23x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric [illegible] Co., Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Lynn, Mass.
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One	11 and 19x15	150	Fritz Wilen, Helsingfors, Finland.
One	16x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 26x17	400	Baltimore Electric Reliance Co., Baltimore, Md.
One	14½ and 23x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, **339 Rookery Bldg., CHICAGO.**

Established in 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN St.

FITCHBURG, MASS., U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the standard grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

SUBSCRIBE

FOR THE

WESTERN ELECTRICIAN

THE ELEMENTS OF

DYNAMIC ELECTRICITY

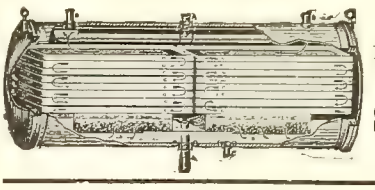
AND MAGNETISM.

A Book For Learners. JUST OUT! Price, $2. Postage Free.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents SCALE in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

To Colorado via

BURLINGTON ROUTE

Only One Night On the Road.

Leave Chicago at 1.00 P. M., or St. Louis at 8:25 A. M., and arrive Denver 6:15 P. M., the next day. Through Sleepers, Chair Cars and Dining Cars. All Railways from the East connect with these trains, and with similar trains *via* Burlington Route to Denver, leaving Chicago at 6:10 P. M., St. Louis at 8:15 P. M., and Peoria at 3:20 P. M. and 8:00 P. M. All trains daily.

Tourists' tickets are now on sale, and can be had of ticket agents of all roads and at Burlington Route depots in Chicago, Peoria and St. Louis.

There is no better place than Colorado for those seeking rest and pleasure.

Manufacturers of

OCTAGONAL AND CEDAR

TELEPHONE & ELECTRICAL

RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA MICH.

ALUMINUM

50 Cents per Pound.

THE COWLES

Electric Smelting & Aluminum Co.,

LOCKPORT, N. Y.,

Offer Aluminum guaranteed to be equal in purity to the best in the market at 50 cents per pound for ton lots in ingots.

Aluminum sheet, wire and castings at lowest market price.

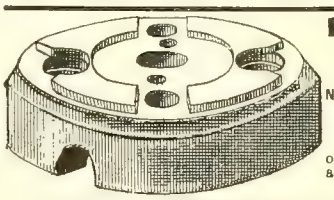
Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence solicited.

Fine Office Furniture and Folding Beds.

Brass and Wire Work. 215 Wabash Av.

A. H. Andrews & Co., Chicago.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

THE MOSHER ARC LAMP

For Direct Incandescent Circuits

BEATS THEM ALL.

Read what a customer says:

Benicia Electric Light and Motor Co.,
Benicia, Cal., June 25, 1891.

MOSHER ARC LAMP CO., CHICAGO.

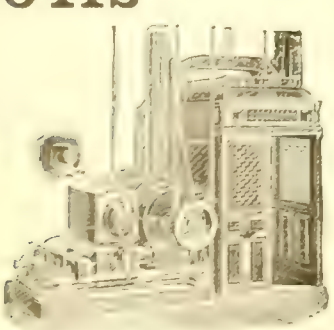
Gentlemen:—Yours of 11th inst. received. In reply we have to say the lamp gives satisfaction, and we are well pleased with it. Our Superintendent says he has tried two other lamps of different makes and this one is the best of them all. He wants you to send another just like it to the Dixon Light & Water Co., Dixon, Cal., of which he is Superintendent. Inclosed please find check, $26.75, to balance account. Yours truly, S. C. GRAY, Pres't.

Write for Circulars, Prices and Sample Lamp to

MOSHER ARC LAMP CO.,

125 ONTARIO ST., CHICAGO, ILL.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

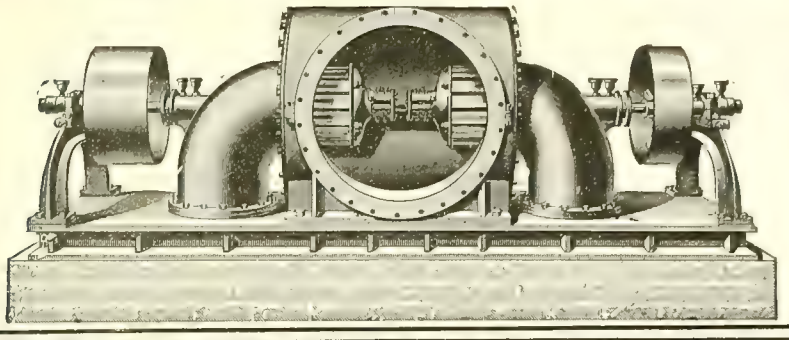
MANUFACTURERS OF

PASSENGER AND FREIGHT

Hydraulic and Electric

ELEVATORS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES [illegible] CELEBRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity.** [illegible] diameter, being **double** the **Power** of [illegible] number of the leading electric [illegible] ical use of water it is without an [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shaft, [illegible] admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

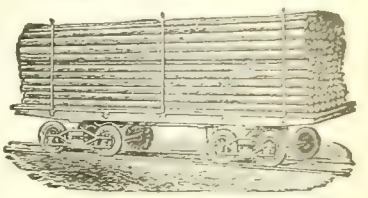
FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing. Will carry two different kinds of material in opposite directions at the same time.

Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

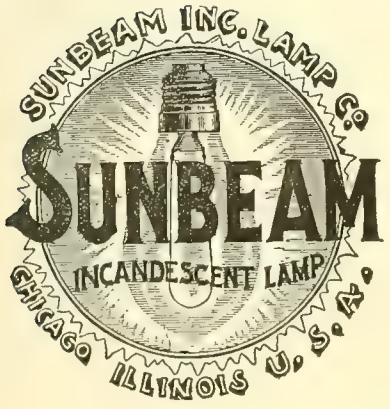
WOODBRIDGE & TURNER ENGINEERING CO.,
Consulting and Constructing
ELECTRICAL AND MECHANICAL ENGINEERS.
Complete Equipment of Electric Railways. Steam and Electric Plants.
47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.



We Feel Able to Make the Positive Statement

That we can satisfy any Central Station if we are given to understand all of the conditions which it is desired to meet.

We cannot give a Lamp that will have the longest life and at the same time be the most efficient of any, nor can we give a Lamp that will be the most efficient and also have the longest life, nor can anyone else supply such a Lamp: there are limitations in all directions. But we can give a Lamp of the same efficiency as others and have it burn longer, or we can furnish a more efficient Lamp of the same length of life as others. In buying Lamps please remember

HIGH EFFICIENCY MUST BE AT THE EXPENSE OF **LONG LIFE.**

The Sunbeam Incandescent Lamp Company,

CHICAGO, ILLINOIS.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

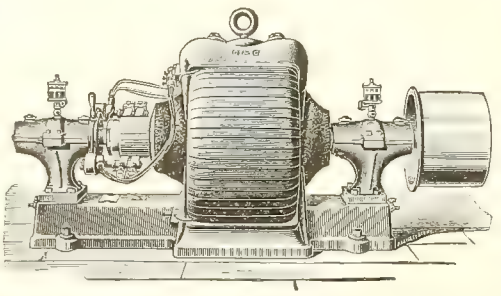
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



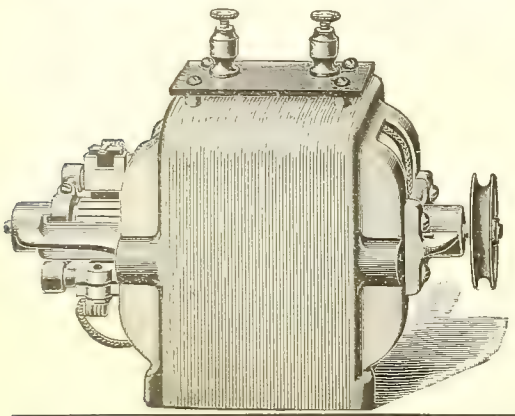
Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

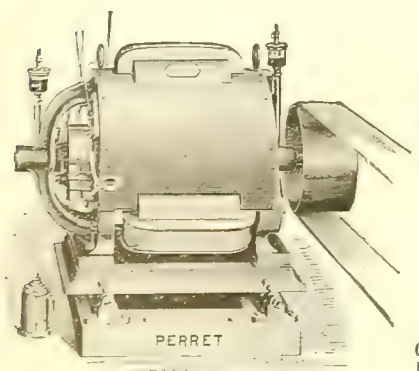
Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

THE ELEKTRON MFG. CO.,

79 and 81 Washington Street, Brooklyn, N. Y.



Perret 25 H. P. Motor, Speed 550, Weight 1,200 lbs.

—MANUFACTURERS OF—

Perret Electric Motors and Dynamos

LAMINATED FIELD MAGNETS, HIGH EFFICIENCY,
LOW SPEED, FULL POWER.

Motors of any size for any purpose. Factories equipped throughout with Electric Power
Isolated Plants for Incandescent Electric Lighting.

—SELLING AGENTS:—

CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 N. 7th St.
WASHINGTON, D. C., J. U. Burkett & Co., 1409 N. Y. Ave.
ST. PAUL, MINN., F. J. Renz, 95 E. Fourth St.
NEW ORLEANS, LA., George Baquie, 140 Gravier St.

JOHN STEPHENSON CO.,

LIMITED,

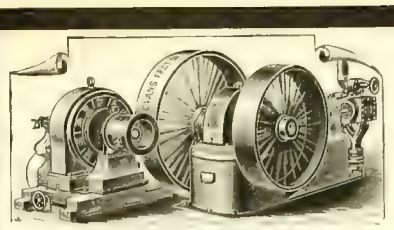
NEW YORK.

STREET CARS

—FOR—

ELECTRIC MOTORS.

CARS ADAPTED TO ALL SYSTEMS.



For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.

Evans' Cones, For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

STANLEY ELECTRIC MFG. CO.

TRANSFORMERS.

Compare these weights with weights of other transformers:

5 light,	48 lbs.
10 light,	65 lbs.
20 light,	85 lbs.
30 light,	101 lbs.
40 light,	130 lbs.
100 light,	300 lbs.

A. C. FAN MOTORS.

SMALL,
NOISELESS,
RELIABLE.

Less than 1½ Amperes required to drive it.

Price, $20.00.

PITTSFIELD, MASS.

Chicago Agents: THE ELECTRICAL SUPPLY CO., 102 Michigan Ave.

ELECTRICIAN PUBLISHING COMPANY'S
HAND-BOOK SERIES.

22,000 Copies published to date. An Astonishing Record.

Dynamo-Tenders' Hand-Book.

By Lieut. F. B. Badt.

Fourth Edition, Eighth Thousand.

94 Pages, 70 Illustrations, Flexible Cloth Binding, Type Page 6x3 inches.

The only PRACTICAL Dynamo-Tenders' Instruction Book in the English language. Just the book for Dynamo-Tenders, Linemen, Stationary and Marine Engineers who wish to learn how to operate and care for electric light or power plants. Moonlight schedule for 1891.

Bell-Hangers' Hand-Book.

By Lieut. F. B. Badt.

Second Edition, Fourth Thousand.

106 Pages, 97 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches.

Designed for those engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat regulating apparatus, etc. The only book of the kind published.

Incandescent Wiring Hand-Book.

By Lieut. F. B. Badt.

Third Edition. Seventh Thousand.

72 Pages, 42 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches. Five Tables, 12x18 Inches.

These tables give *at once* and without any calculation the size of wire required in each case for any percentage of loss.

It is a book for practical wiremen and learners, and does not require any previous knowledge of wiring. It differs in this respect from other wiring tables, or computers.

The book contains full illustrations and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, wiring of fixtures, elevators, buildings, etc. The only book of the kind published.

Electric Transmission Hand-Book.

By Lieut. F. B. Badt.

First Edition, Three Thousand Copies.

97 Pages, 22 Illustrations, and 27 Tables. Flexible Cloth Binding. Type Page 6x3 Inches.

This book contains all practical information for power producers, capitalists, agents of hydraulic and electric companies, engineers, motor inspectors and other persons interested in electric power transmission. By means of the tables anybody can find at once cost of plant for least operating expenses, or for minimum first cost of installation.

The book gives all necessary information concerning motors, and rules for ascertaining horse power of motors, driving various classes of machinery, as hoists, pumps, street or tram cars, fans, etc.

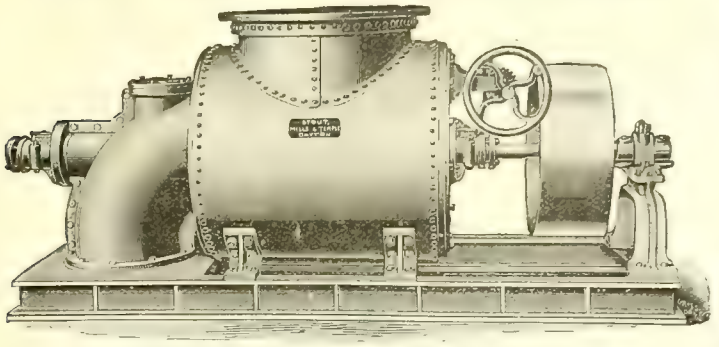
Twenty-seven new and original tables give more information on the subject in a small space than any book heretofore published on the same subject.

Each Work Sent Postpaid on Receipt of One Dollar.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

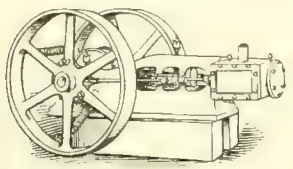
ELECTRIC LIGHT AND POWER STATIONS.

On account of its high efficiency at all [illegible] of gate, [illegible] and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North Street, BALTIMORE, MD.

COMPLETED TO DEADWOOD

The Burlington Route, C., B. & Q. R. R., from Chicago, Peoria and St. Louis, is now completed and daily passenger trains are running through Lincoln, Neb., and Custer, S. D., to Deadwood. Also to Newcastle, Wyoming. Sleeping cars to Deadwood.

Binders FOR THE **Western Electrician** **$1.00.**

STEAM PLANTS

INSTALLED BY

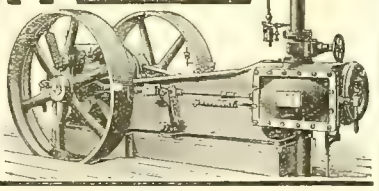
W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application. —
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES: Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



WESTINGHOUSE ENGINES

A FEW RAILROAD USERS:

	Engines.	Horse-powers.
Ashland Coal & Iron Railroad Co	1	60
Baltimore & Ohio Railroad Co	6	190
Boston & Albany Railroad Co	2	130
Camden & Atlantic Railway Co	3	75
Central Railway of New Jersey	4	275
Chicago & Erie Railway Co	2	30
Chicago, Burlington & Quincy Railroad Co	3	175
Chicago, Milwaukee & St. Paul Railroad Co	5	100
Chicago, Rock Island & Pacific Railroad Co	4	170
Colorado Midland Railway Co	1	25
Denver & Rio Grande Western Railroad Co	3	75
East Tennessee, Virginia & Georgia Railroad Co	3	325
George's Creek & Cumberland Railroad Co	2	50
Grand Trunk Railway Co. of Canada	12	500
Gulf, Colorado & Santa Fe Railway Co	3	135
Kansas City, Wyandotte & Northwestern Railway Co	2	55
Newport News & Mississippi Valley Co	2	200
New York Central & Hudson River Railroad Co	4	125
New York, Lake Erie & Western Railroad Co	2	140
New York, West Shore & Buffalo Railroad Co	6	340
Northern Pacific Railroad Co	2	45
Pennsylvania & Northwestern Railroad Co	1	25
Pennsylvania Railroad Co	51	2330
Peoria & Pekin Union Railroad Co	1	55
Philadelphia & Reading Railroad Co	7	615
Pittsburgh, Cincinnati, Chicago & St. Louis Railway Co	2	20
St. Louis & San Francisco Railway Co	3	260
Southern Railway Co	1	10
Wabash, St. Louis & Pacific Railroad Co	4	60
Washington & Georgetown Railway Co	1	15

Many foreign railroads unreported.

THE WESTINGHOUSE MACHINE COMPANY.
BUILDERS AGENT PITTSBURGH, PENNA. U.S. OF A.

FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUS. ETCHING CO. 334 DEARBORN ST. HALF TONE PLATE SPECIALTY CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

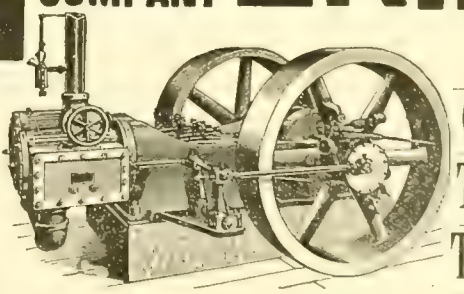
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



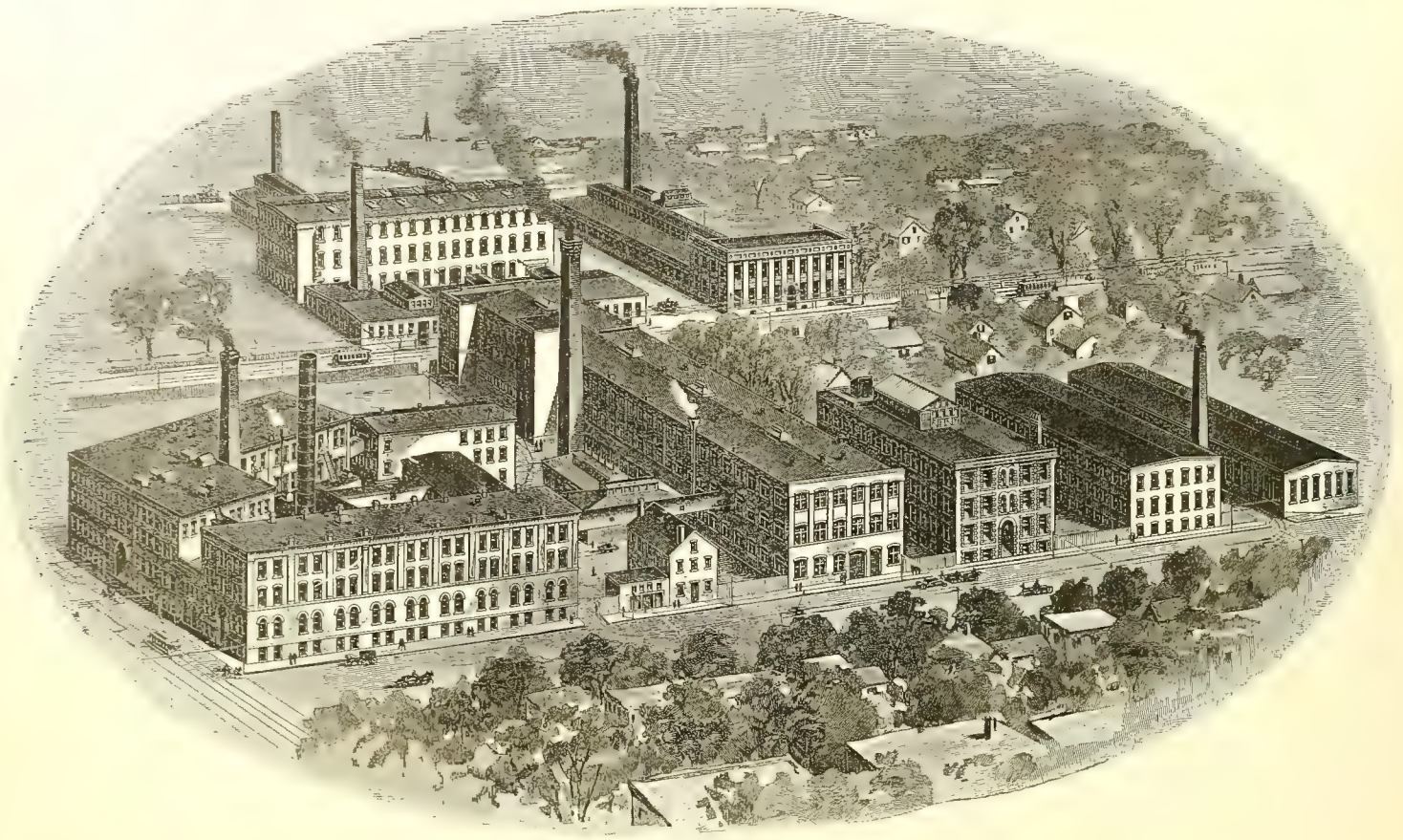
Simple.
Cross Compound.
Triple Expansion.
Tandem Compound

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 106 Liberty St., NEW YORK; J. W. PARKER, 38 South Fourth St., PHILADELPHIA, PA.; COOLEY & VATER, 224 Washington Ave. So., MINNEAPOLIS, MINN.; DRAVO & BLACK, 804 Lewis Block, PITTSBURG, PA.; NORTHWESTERN SUPPLY CO., TACOMA, WASH.

THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.

"MERIT LEADS TO SUCCESS."

HEISLER

LONG DISTANCE SERIES INCANDESCENT LIGHTING

HAS NO EQUAL.

ONLY successful method of distribution covering a large area WITHOUT swamping the plant with INTEREST on Copper Wire instead of FUEL.
Transformers or Converters are a CONSTANT source of TROUBLE and EXPENSE, will cost MORE for repairs in a year than to renew the Lamps by our system.
Our PLANTS can be operated with success ELECTRICALLY and FINANCIALLY where no others can.
Plan of wiring SIMPLE, CHEAP and EFFICIENT.
LAMPS from 16 C. P. up, noted for BRILLIANCY and BEAUTY of the light.
ALSO SERIES LAMPS of any C. P. for Arc Light Circuits.
Gold Medal, Paris Exposition, 1889.
Estimates furnished on application, for erection of plants in any section. Correspondence solicited.

HEISLER ELECTRIC LIGHT CO., Drexel Building, PHILADELPHIA, PA.

Send for Circular.

THOMAS STURGIS, President. WM. C. LANE, Secretary and Treasurer. C. P. MACKIE, General Manager. S. S. BOGART, General Agent.

ELECTRIC SECRET SERVICE CO.,

45 BROADWAY, NEW YORK.

Owning the patents of Mosher, Gill, Hatch, Foote, Kintner and Moore for

INDIVIDUAL TELEGRAPH CALL AND CUT-OUT APPARATUS.

OTHER PATENTS PENDING.

The only practical and reliable system of electric selection invented.

Use either ***Morse Key*** or ***Automatic Transmitter.***

From every station selected an ***Automatic Answer Back*** is received.

Gong rings until shut off by operator.

Any office on line can be selected without disturbing the others and either called up or cut out. No interference with regular telegraph service. No resistance added to main line. Easily applied. Economical. Convenient. Reliable.

Applicable to arc lights, singly or in groups; fire alarm service; police telegraph; electric motor circuits; railroad signals, etc.

The public is warned against infringing companies and devices.

For terms and other particulars, address as above.

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.,

MANUFACTURERS OF

VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES.

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES and CABLES, very pliable. Every variety of INCANDESCENT CORES.

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High Insulation and Long Life, all milage

If you are not acquainted with the merits of Habirshaw Insulation we shall be pleased to send you samples upon application.

W. M. HABIRSHAW, Gen'l Mgr. OFFICE: 315 Madison Ave., Cor. 42d St., New York.

FACTORY: Glenwood, Yonkers, N. Y.

WESTERN AGENTS, The Electrical Supply Co., 171 Randolph Street, Chicago, Illinois.

Buxton's Universal Packing.

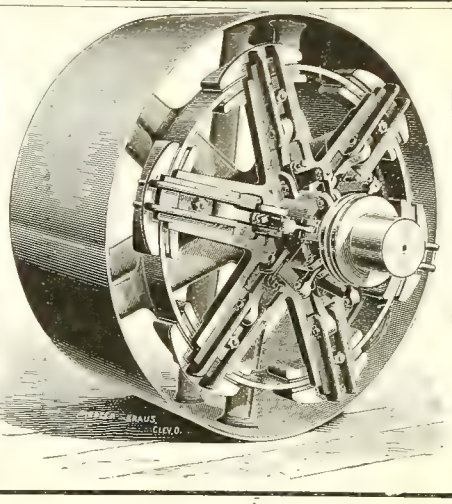
Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps; self-lubricating, steam and water tight. Fifty per cent less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,
17 VIRGINIA ST., EAST SOMERVILLE, MASS.



HILL Clutch Works,
CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

Experimental Work in Anything Electrical.

FREEMAN, COLEMAN & CO.,
53 and 55 South Jefferson Street, - - CHICAGO, ILL.

Subscribe for the Western Electrician.

READ THE FOLLOWING.

EDISON ELECTRIC ILLUMINATING CO. OF BROOKLYN.

BROOKLYN, August 17, 1891.

THE ELECTRIC CONSTRUCTION & SUPPLY CO., New York.

GENTLEMEN: It might perhaps interest you to know the success with which the Ward Arc Lamp is meeting in Brooklyn. We installed, eighteen months ago, two (2) of your lamps and to-day have 740 connected to our low tension circuits. To show you that they give satisfaction it is merely necessary to mention that every day we are replacing high tension lamps and for no apparent reason, except that the light is steadier and more brilliant, and that the consumer has control over each pair of lamps.

I think, from the results we are obtaining here, it would be to the advantage of every station supplying incandescent lights to add this new and profitable source of income to their system.

Yours truly, W. S. BARSTOW, Gen'l Supt.

REMEMBER WE GUARANTEE "WARD" LAMPS TO BE EXACTLY AS REPRESENTED.

THE ELECTRIC CONSTRUCTION & SUPPLY CO., Established 1881.
PHENIX BUILDING, CHICAGO, ILL. TELEPHONE BUILDING, NEW YORK CITY.

The KNAPP ELECTRICAL WORKS,

GENERAL AGENTS FOR

"SAFETY"

WIRES, CABLES AND CORDS

For Inside, Underground and Submarine Use.

"SAFETY" Fire-Proof House Wire. "ATLAS" Line Wire.

R. B. WATSON & CO., Agts., DETROIT, MICH.

J. W. MASON, Agt., 527 Delaware Street, KANSAS CITY, MO

POST & CO., Agts., CINCINNATI, O.

THE PERKINS ELECTRIC LAMP CO.

LAMPS

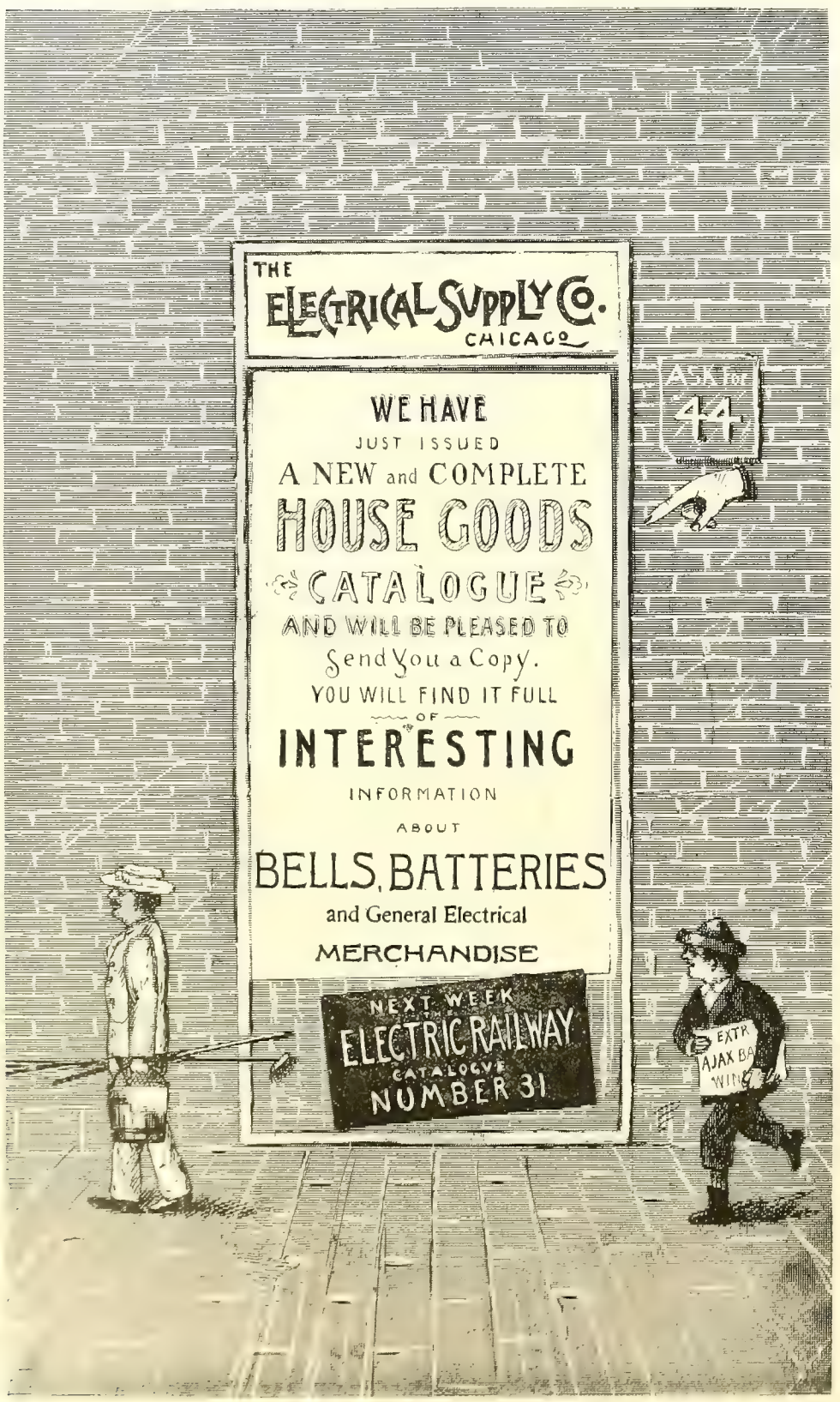
TO FIT ANY SOCKET.
ANY CANDLE POWER.
ANY VOLTAGE.
LONGEST LIFE.
HIGH EFFICIENCY.

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

54 and 56 Franklin Street, CHICAGO.

SEND FOR CATALOGUE.


THE
ELECTRICAL SUPPLY CO.
CHICAGO
ASK for
44
WE HAVE
JUST ISSUED
A NEW and COMPLETE
HOUSE GOODS
CATALOGUE
AND WILL BE PLEASED TO
Send You a Copy.
YOU WILL FIND IT FULL
OF
INTERESTING
INFORMATION
ABOUT
BELLS, BATTERIES
and General Electrical
MERCHANDISE
NEXT WEEK
ELECTRIC RAILWAY
CATALOGUE
NUMBER 31

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE, $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

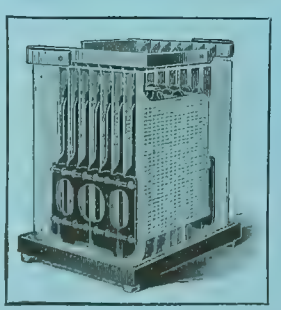
BLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

FACTORIES AND GENERAL OFFICES, BALTIMORE, MD.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



- Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
- Central Station and Isolated Lighting.
- Portable Lighting or Power.
- Portable Electric Lanterns.
- Electric Power for Motors.
- Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF
FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR COMPANY,

224 and 226 Chestnut Street, Philadelphia, Pa.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 and 226 Chestnut St.
NEW YORK:—TRUEX & VAIL, 44 Broadway. CHICAGO:—WM. HOOD, 239 La Salle St.
SAN FRANCISCO:—THE PACIFIC ELECTRICAL STORAGE CO., 118 and 120 Pine St.
BOSTON:—THE HOLTZER-CABOT ELECTRIC CO., 111 Arch St.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

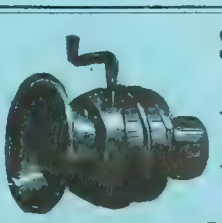
$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, SEPTEMBER 5, 1891. No. 10

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway Installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building, - - CHICAGO.



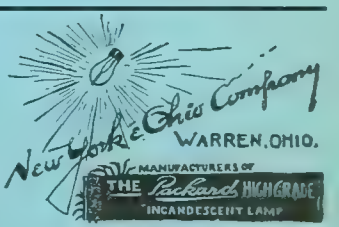
SPEAKING TUBES AND WHISTLES.
Oral, Electric, Pneumatic and Mechanical
ANNUNCIATORS & BELLS.
FULL LINE ALWAYS IN STOCK.
W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE. Out August 1st.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
OF THE
Standard Underground Cable Co.,
New York, Pittsburgh. Chicago.
INVESTIGATION PROVED IT
THE BEST.

WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

DO YOU WANT
A THOROUGH INSULATING PIPE?
AN INDESTRUCTIBLE PIPE?
PIPE TESTED SUCCESSFULLY?
THE PATENT INDURATED FIBRE PIPE
Costs less than iron and does better work in electrical subways and elsewhere.
SOLE AGENTS:
Engineering Equipment Co.,
143 Liberty St., NEW YORK.
126 Pearl St., BOSTON.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.
INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.
OKONITE TRADE MARK
BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.



AGENTS
J. W. PEALE, 1 BROADWAY, NEW YORK
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT ENG AND SUPPLY CO. ST PAUL, MINN.

Insulated Wires and Cables.
DAYS KERITE
The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.
Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.
GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.
THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

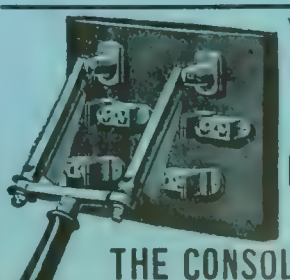
THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.
Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.
STANDARD ELECTRICAL MEASUREMENT APPARATUS.

FOR SALE.
One 3 Horse Power Electric Motor.
One 6 Horse Power Electric Motor.
Both in excellent condition, having been used but little.
ERIE ELECTRICAL SUPPLY CO.,
ERIE, PA.

CLOWER, HARRIS & CO.,
CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.
The largest Electrical Supply House west of the Mississippi River
Everything Electrical
289 ELM STREET, - - DALLAS, TEXAS.



WM. ROTCH, Prest. CHAS G. WINSOR, Treas.
CHAS E. BIBBER, Gen'l Mgr.
DO NOT
Equip your Switch-board with [illegible] Switches
BUY THE
C. E. M. Jack-Knife Switch.
Manufactured Solely By
THE CONSOLIDATED ELECTRIC MFG. CO.,
196 Summer St. and 355 Congress St., BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS.

IS THE THOMSON-HOUSTON ELECTRIC CO.'S SYSTEM OF LIGHTING A SUCCESS?

Cut of Factory, 1882.

TOTAL NUMBER OF LOCAL COMPANIES, OCTOBER 1, 1883, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
22 Companies, 1,653 Lamps.	None.	None.

Cut of Factory, 1886.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1887, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
171 Companies, 21,840 Lamps.	29 Companies, 11,275 Lamps.	None.

Read the Answer on Page XX.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....—
Abendroth & Root Mfg. Co.. xiii
Alexander, Barney & Chapin..... i
American Electrical Works.....xiii
Andrews & Co., A. H..... ...xix
Automatic Switch Co..... x
Baggot, E.....xiv
Bain Electric Mfg. Co.....xvi
Ball Engine Co.....xix
Baxter Electric Motor Co.....xxvi
Bernstein Electric Co.....iv
Blatz, L.....xiii
Borden & Selleck Co.....xv
Braun Illustrating Co.....xix
Brownlee & Co.....xii
Brookfield, Wm.....xii
Brush Electric Co.....xvii
Butler Hard Rubber Co.....iv
Buxton, Geo. B xii
C. B. & Q. R. R.....xiv
C. & C. Electric Motor Co. ...xvi
Card Elec. Motor & DynamoCo viii
Central Electric Co..... ... v
Chicago Electric Mfg. Co.....viii
Chicago Electric Motor Co.....—
Clower, Harris & Co.....i
Chicago Insulated Wire Co....xvii
Colburn Electric Mfg. Co.....xiv
Coolidge, Fuel & Supply Co....xix
Consol. Elec. Mfg. Co., The.....i
Cowles Electric Smelting and Aluminum Co.....xiv
Crocker-Wheeler Electric Motor Co.....xiii
Cutter, Geo..... xxii
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co..xix
Eastern Electric Cable Co.....xiii
Edison General Electric Co.,— Motor Dept.....vi
Edison General Electric Co., Cable and Wire Department.....vii
Electric Construction & Sup.Co. xxii
Electric Merchandise Co.....iv
Electric Secret Service Co.....xviii
Electrician Pub. Co...iv, x, xiv, xvi
Elec. Construction Co., The.....xiii
Electrical Engineering Co,.....xiii
Elec. Eng. & Supply Co., The..xiii
Electrical Supply Co., The.. xxiv
Elektron Mfg. Co.....xvi
Empire China Works.... xiv
Engineering Equipment Co.....i
Erie E ectrical Supply Co.....i
Evans Friction Cone Co..... xvii
For Sale xiv
Foster, O. A.....—
Fort Wayne Electric Co..... xxvi
Freeman, Coleman & Co.....—
Globe Carbon Co xv
Great Western Elec. S. Co. viii, xxv
Greeley & Co., The E. S.....i
Hale Elevator Co..... xiv
Heisler Electric Light Co.....xxvi
Hill Clutch Works.....—
Hine Eliminator Co..... xii
Holmes, C. H.....xiii
Holmes, Booth & Haydens... xvii
Hood, Wm..... x
India Rubber & Gutta Percha Insulating Co.....—
Interior Conduit & Insulation Co.xviii
International Okonite Co.....i
Kartavert Mfg. Co..... xii
Knapp Electrical Works.....xxiii
Law Telephone Co.....xiii
Leonard & Co., H. Ward.....—
Leffel & Co., Jas.....xiii
Loud, H. M. & Sons Lumber Co. xiv
McLaughlin, James xii
Manhatten Elec. Supply Co.... viii
Mason, James H.....xiii
Milliken Bros.....iv
Minneapolis Street Railway Co...xxi
Monitor Electric Co x
Mosher Arc Lamp Co.....
Munsell & Co., Eugene.....xiii
Murphy, T. J.....xiii
National Carbon Co.....iv
National Electric Mfg. Co.....ix
N. Y. Belting & Packing Co.....xii
New York Insulated Wire Co.... x
New York & Ohio Co..... i
N. W. Elec. Specialty Co.. iv
Nuttall Company, R. D..... i
Ostrander & Co., W. R.....i
Paiste, H. T..... xii
Page Belting Co.....—
Partrick & Carter Co..... x
Payne & Co., Geo. W.....xviii
Pearson & Co., W. B.....xix
Phoenix Glass Co.....—
Pond Engineering Co.....xix
Powell Co., The Wm.....xiv
Queen & Co.....xiii
Rochester Railway Co.....xii
Rockford Electric Mfg. Co.... —
Sargent & Lundy.....i
Sawyer-Man Electric Co.....xi
Schieren & Co. Chas. A.....xii
Schoonmaker, A. O.....xii
Schuyler Electric Co..... ...viii
Short Electric Railway Co..... xii
Shultz Belting Co. xviii
Sperry Electric Mining Machine Co.....xiv
Standard Underground Cable Co....i
Standard Paint Co.....xii
Stanley Electric Mfg. Co.... . —
Star Iron Tower Co.....xix
Stearns Mfg. Co.....xix
Stephenson Co., Jno.....
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co xv
Taussig, S..... viii, xiv
Temple, J. C..... xv
Thomson-Houston Electric Co. Lighting Department... ii, xx
Turner Brass Works..... xiii
Union Electric Mfg. Co., The.... x
Union Electric Works.....—
Union Hardware Co.....xii
U. S. Electric Lighting Co...—
Van Nuis C. S.....—
Vulcanized Fibre Co..... xv
Wanted xiii
Wenstrom Consolidated Dynamo & Motor Co., The xviii
Western Electric Co vii
Westinghouse Elec and Mfg Co..xi
Westinghouse Machine Co..... xix
Weston Electrical Instrument Co—
Williams Engine Works..... xix
Windsor Hotel, The..... ..vii
Woodbridge & Turner Engineering Co xv
Woodhouse & Rawson, Ltd.....xiv
Worthington, Henry R.....—

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Electric Smelting & Refining Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Manhatten Elec. Supply Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Manhatten Elec. Supply Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated, **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.
Rochester Railway Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Engineering Equipment Co.
Fort Wayne Electric Co.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Manhatten Elec. Supply Co.
Monitor Electric Co.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hotels.
Windsor Hotel, The.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Cutter, Geo.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cutter, Geo.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus, Electric.
Bain E[illegible]
[illegible]

Motors.
Bain Electric Mfg. Co.
Brush E[illegible]
Baxter [illegible]
Card E[illegible]
Crocker [illegible]
C. & C. Electric Motor Co.
Colburn Electric Motor Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electric [illegible]
Electrical Manufacturing Co.
Erie Electrical Supply Co.
Foster, O. A.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
Rochester Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cutter, Geo.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. THE NATIONAL CARBON CO CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

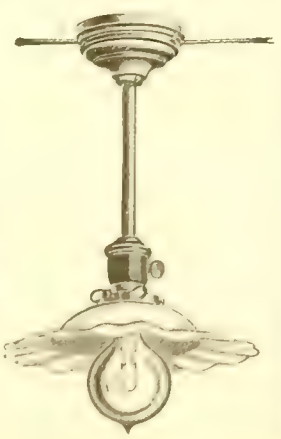
ELECTRICAL BOOKS
OF ALL KINDS.
Send for Complete Catalogue.
ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, CHICAGO, ILL

THE MILLIKEN PATENT POLE
For Electric Street Railways and Electric Light Work.
55 LIBERTY STREET, NEW YORK.
MANUFACTURED BY MILLIKEN BROS.
59 DEARBORN STREET, CHICAGO.
Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.
WRITE FOR CIRCULAR AND CATALOGUE.

THE BUTLER HARD RUBBER CO.,
33 Mercer Street, New York,
POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF
HARD RUBBER GOODS
Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF
SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.
KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES
Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.
HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.
Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.
For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

"BE YE THE JUDGE."
HAVE YOU TRIED THE
ECONOMIC INCANDESCENT LAMP?
If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again.* Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*
NORTHWESTERN ELECTRICAL SPECIALTY CO.,
GENERL WESTERN AGENTS,
CEO. L. KIRKHAM, Manager.
1017 Chamber of Commerce, CHICAGO.

BERNSTEIN ELECTRIC CO.
INCANDESCENT LAMPS
—FOR—
ARC LIGHT CIRCUITS.
SIMPLE. RELIABLE. DURABLE.
620 ATLANTIC AVENUE,
BOSTON, - MASS.



ELECTRIC RAILWAY SUPPLIES
For All Systems.
EXCLUSIVELY.
SEND FOR CATALOGUE.
ELECTRIC MERCHANDISE CO.,
11 ADAMS STREET, CHICAGO.
W. R. MASON, General Manager.

OUR ST. LOUIS BRANCH.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 LOCUST ST., ST. LOUIS, MO.

OUR KANSAS CITY BRANCH.

OKONITE

GATE CITY ELECTRIC COMPANY,
522 DELAWARE ST., KANSAS CITY, MO.

YOU CAN'T AFFORD

TO BUY YOUR

Weather-proof Wire, Underwriters' Wire, Moisture-proof Wire, Insulating Tape, Rubber Tubing, Sockets, Lamp Cords, Switches, Cut-outs, Branch Blocks,

Without getting our prices and letting us show you our samples.

CENTRAL ELECTRIC COMPANY,

116 AND 118 FRANKLIN STREET, CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE COMPANY'S SYSTEM.

OUR DENVER BRANCH.

OKONITE
TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., DENVER, COLO.

OUR OMAHA BRANCH.

OKONITE
TRADE MARK.

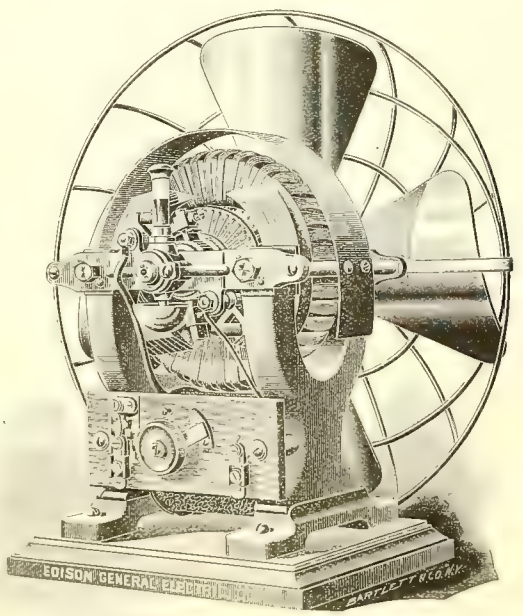
WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., OMAHA, NEB.

EDISON GENERAL ELECTRIC CO.,

Edison Building, Broad St., New York City.

ELECTRIC FANS.

These Fans are operated by new Edison Slow Speed Motors, requiring Minimum amount of attention and lubrication.



They are compact and especially suitable for office desks and similar places.

Will operate on any ordinary Lighting Circuit without Wasteful Resistance.

List Price, Motor and Fan, $42.50, less 45 per cent. to Users. Net, $23.36.

For Particulars Address Nearest District Office.

DISTRICT OFFICES:

Canadian District, Edison Bldg., Toronto, Can.
Central District, 173 and 175 Adams St., Chicago, Ill.
Eastern District, Edison Building, Broad St., New York.
New England District, 25 Otis Street, Boston, Mass.
Pacific Coast Dist., Edison Bldg., 112 Bush St., San Francisco, Cal.
Pacific Northwest District, Fleischner Bldg., Portland, Ore.
Rocky Mountain District, Masonic Building, Denver, Colo.
Southern District, 10 Decatur Street, Atlanta, Ga.

The Windsor Hotel,

HEADQUARTERS OF

The National Electric Light Association.

It is situated on Dominion Square, in the fashionable quarter of Montreal. It is the first hotel in the Dominion, and in constructive substantiality, architectural dignity, thorough equipment and modern appointments compares favorably with any hotel in the world. It is within a few steps of the Canadian Pacific and Grand Trunk Railway stations, from which trains diverge to all points in the Dominion and the United States. Equally convenient are the wholesale and retail business quarters and all objects and places of interest to tourists, including the cathedrals, churches and convents; the great financial institutions, markets and quays, as also the public squares, parks and boulevards. It is the recognized headquarters for tourists, and affords special accommodations to wedding parties, families and commercial and other conventions. The cuisine and wines are of the first quality, and the establishment is maintained up to the best standard.

G. W. SWETT, Manager.

WESTERN ELECTRIC COMPANY,

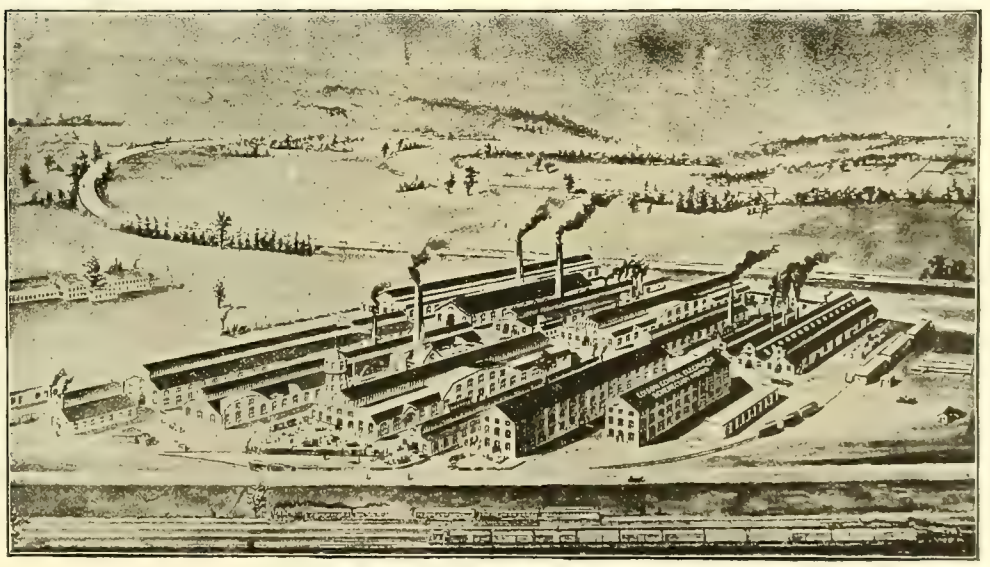
CHICAGO,
NEW YORK,
LONDON,
ANTWERP,
BERLIN,
PARIS.

MANUFACTURERS AND DEALERS IN

Arc and Incandescent Electric Light Apparatus, Patterson Underground and Overhead Cables, I. C. Weather-proof Wire, Washburn & Moen's Hard Drawn Copper Trolley and Galvanized Iron Wires, House Goods, Testing Apparatus, District Telegraph Apparatus, Line Supplies, Tools and all other Electrical Appliances.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

73-75 W. Jackson St. RELIABLE

WE ARE FITTED WITH RELIABLE Machinery and Tools, And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

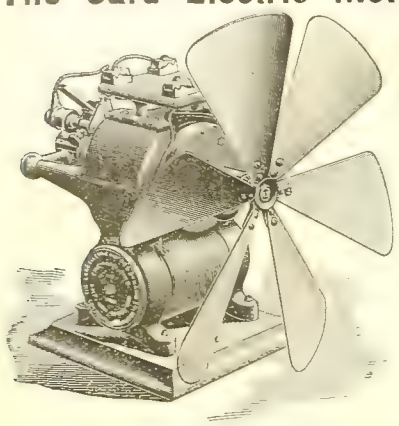
CHICAGO ELECTRIC MFG. CO.

FAN MOTOR,

—MANUFACTURED BY—

The Card Electric Motor and Dynamo Co.,

Cincinnati, Ohio,



MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits, from 1-6 to 50 H. P.

Correspondence Solicited.

AGENTS:

BOSTON—The Eastern Electrical Supply & Construction Co., 65 Oliver St.
CHICAGO—The Thos. L. Johnson Co., 312 Dearborn St.
MILWAUKEE—Henry Ramien, 641 Third St.
WASHINGTON, D. C.—J. Geo. Gardner, 1005 H St.
ST. LOUIS—Stagl Electrical Engineering Co., 1106 Pine St.
MONTGOMERY, ALA.—W. F. Murphy.
DETROIT, MICH.—The Michigan Electric Co., 212 and 214 Griswold St.
MINNEAPOLIS, MINN.—J. M. Lennon, No. 42 Loan and Trust Building.

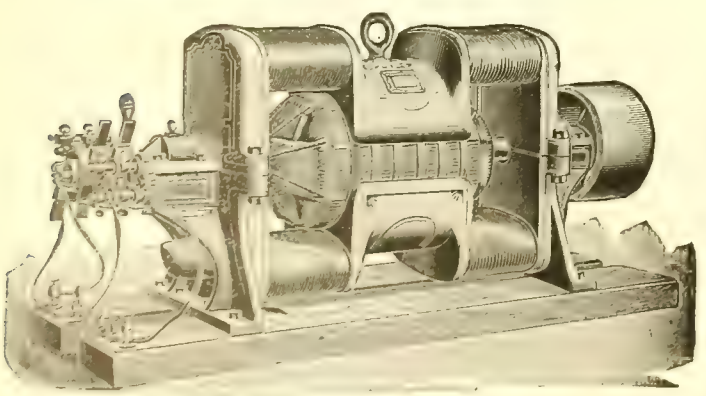
REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

STAR GAUGE GLASS CUTTER.

A necessary tool in every engine room. Sent by mail on receipt of price.

No. 1. Cuts over 5 inches $1 50
" 2. " " 8 " 2 00

S. TAUSSIG, 45 River St., Chicago. WESTERN AGENT.

THE MESCO DRY Battery.

(CUT FULL SIZE.)

PATENT Applied For.

For Call Bells, Annunciators, Burglar Alarms, Telephones, the Laboratory, and all OPEN CIRCUIT USE.

PRICE, 80 CENTS.

Guaranteed equal to any Dry Battery made, in E. M. F., Durability and Recuperative Power. No infringement on any existing patent.

Exhausted Batteries Replaced at a Nominal Price.

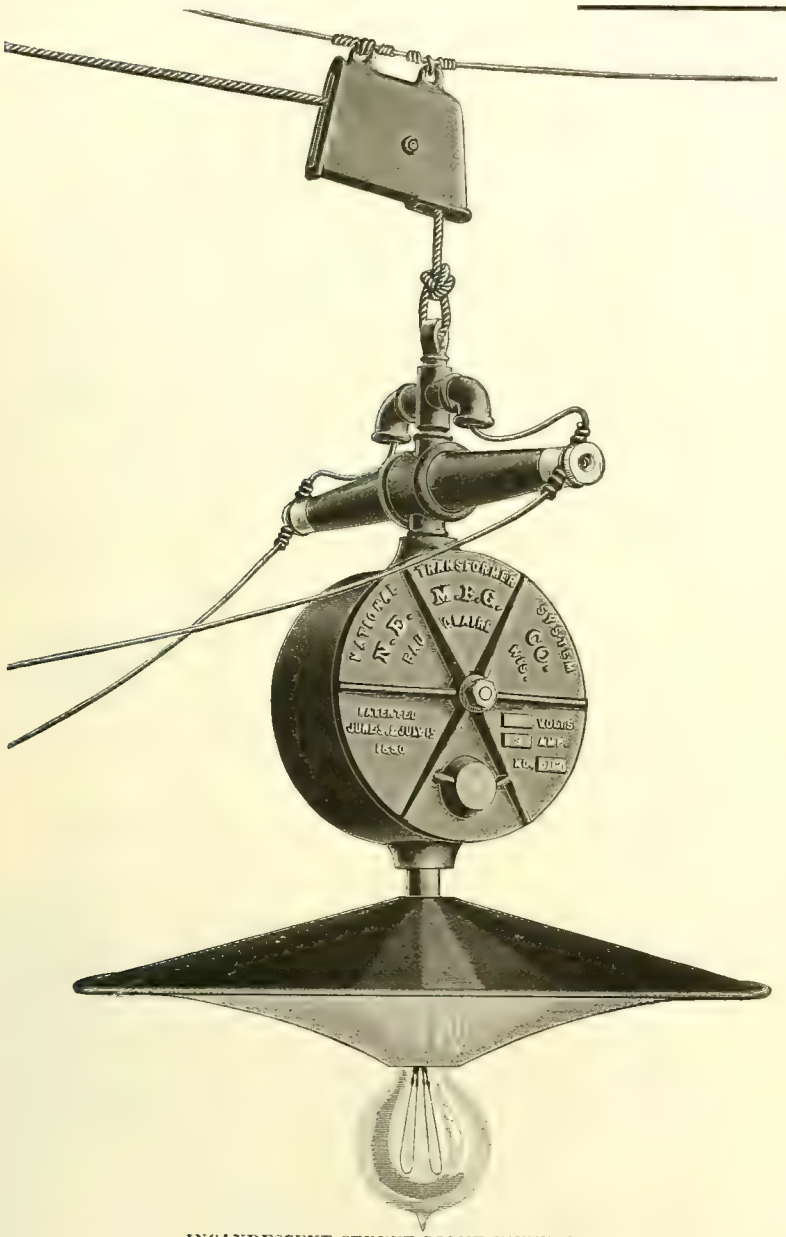
LIBERAL DISCOUNTS TO THE TRADE.

MANHATTAN ELECTRICAL SUPPLY CO.,

36 CORTLANDT ST., NEW YORK.

THE NATIONAL TRANSFORMER SYSTEM

OF INCANDESCENT LIGHTING.



INCANDESCENT STREET LIGHT FIXTURE,
SERIES TRANSFORMER, REFLECTOR CANOPY AND 32 C. P. LAMP.

WHY

USE ARC LAMPS

WHEN THE

NATIONAL

SERIES TRANSFORMER

ENABLES YOU TO DO

STREET LIGHTING

ECONOMICALLY
EFFICIENTLY
SATISFACTORILY ???

Send for Circulars and Prices.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

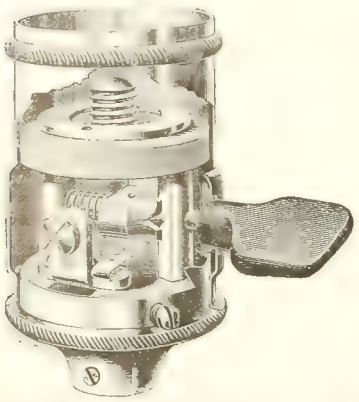
COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED
LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

AGENTS

NEW YORK, N. Y., National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.
BUFFALO, N. Y., Little, McDonald & Co., 141 East Seneca St.
CINCINNATI, O., W. N. Gray, 12 Chamber of Commerce.
WASHINGTON, D. C., L. N. Cox, 16 Fifth St., S. E.
PHILADELPHIA, PA., C. M. Blanchard, Girard Building.
LINCOLN, NEB., Lincoln Electrical Mfg & Supply Co.
SEATTLE, WASH., Chas. H. Baker & Co.
ST. PAUL, MINN., The Electrical Engineering & Supply Co.
DETROIT, MICH., Commercial Electric Co.
DENVER, COLO., The Mountain Electric Co.
WINNIPEG, MAN., Simpson-Davis Electrical Construction Co.
SAN FRANCISCO, CAL., National Electric Development Co.
KANSAS CITY, MO., Thomas Wolfe, 515 Main St.
DULUTH, MINN., The Electrical Eng. & Supply Co.



THE FACT that COMPETITORS are IMITATING our SOCKET is PROOF ENOUGH for ANYONE that it is the

BEST SOCKET ON THE MARKET.

THE UNION ELECTRIC MFG. CO., BRIDGEPORT, CONN.

NEW YORK: Alexander Barney & Chapin. BOSTON: The Eastern Electrical Supply Co.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

WM HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES!

16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

THE NATION'S CHOICE.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

Grimshaw White Core Wire.

B. D. WIRE, TAPES AND COMPOUNDS.

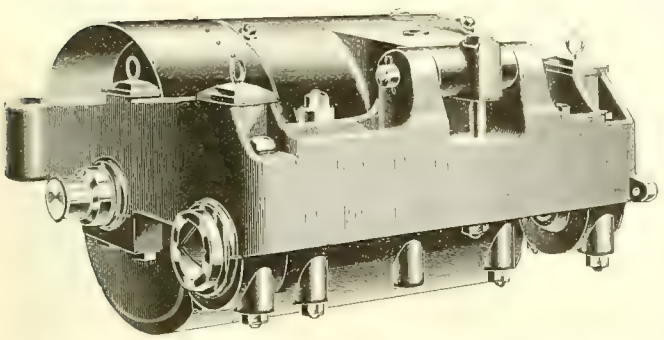
ALL SUPPLY STORES KEEP THEM.

NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street, CHICAGO,

MAIN OFFICE; 649-651 Broadway, New York. GEO. H. MEEKER, Western Manager.

THE WESTINGHOUSE
"Single Reduction" or "Slow Speed"
STREET RAILWAY MOTOR.



☞ Write for descriptive catalogue. ☜

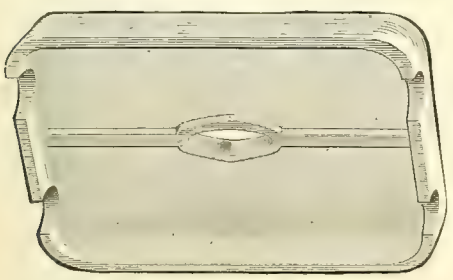
"Slow speed" means small number of revolutions of Armature per minute, NOT SLOW CAR SPEED.

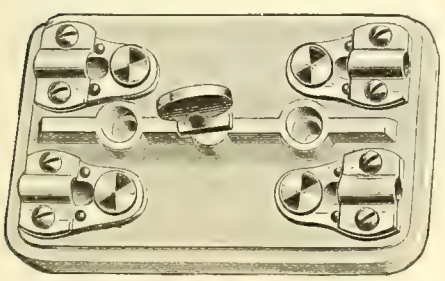
"Single reduction" means elimination of High Speed Gearing and Bearings.

The Westinghouse Single Reduction Motor is **Efficient, Economical** and **Durable,** and is giving ENTIRE SATISFACTION after long usage.

RAILWAY DEPARTMENT,
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,
PITTSBURGH, PA.

Branch Offices: 120 Broadway, NEW YORK. Pullman Building, CHICAGO.

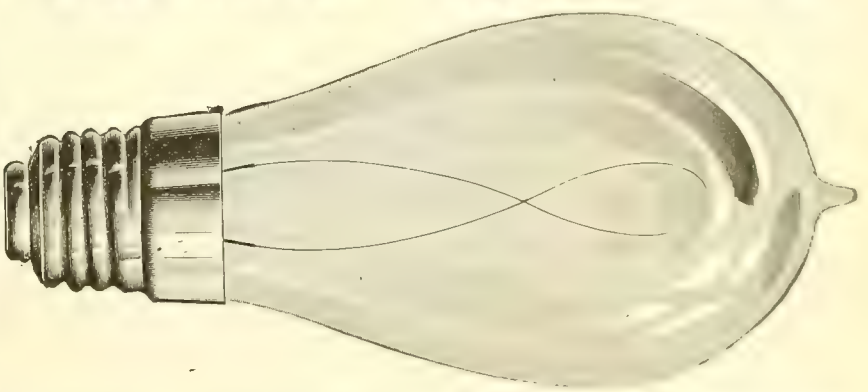




CUT-OUTS,
Single Light, Main and Branch,
OF SUPERIOR PORCELAIN,
With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.
510-534 W. 23d Street, NEW YORK.
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

FOR SALE.

STREET CARS.

ONE HUNDRED 12-FOOT CARS,

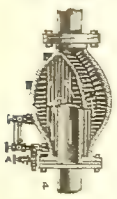
Built by the John Stephenson Co. and Jones, one end type, with fare box, in good order; gauge, 4 ft. 8½ in.

Six Hundred Tons 38-lb. Tram Steel Rails and One Hundred 30 ft. Steel Poles.

ROCHESTER RAILWAY CO.,

ROCHESTER, N. Y.

KNOW WHAT YOU'RE GETTING!



HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

A test of six of the best known "Separators" has recently been made at Cornell University. **Hine's Eliminator stands at the head.** The full report with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street. NEW YORK.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

ATTENTION,
STREET RAILWAY MANAGERS.

The Jamestown (N. Y.) Street Railway Co. report that the total time lost by 10 cars from June 10th to August 29th (11 weeks) was two (2) car days.

Short System.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, O.

H. T. PAISTE,

MANUFACTURER OF

Paiste Electrical Specialties.

Western Office and Storeroom:
341 THE ROOKERY,
CHICAGO, ILL.

Eastern Office and Factory:
1201 MARKET ST.,
PHILADELPHIA, PA.

PAISTE SWITCH SOCKETS.

Price, 40 Cents.

Porcelain Insulation used.

Made to fit all Standard Lamps.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

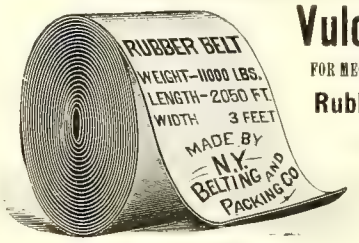
Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.

SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street
CHARLESTON, 161 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

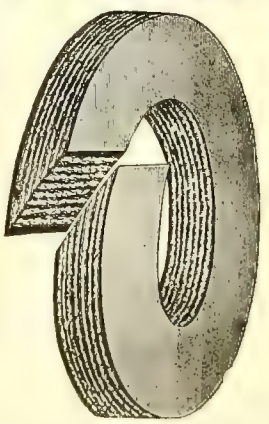
SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 1624 Woodward Ave.
BALTIMORE, 12 North Charles Street
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.



Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

P AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, SEPTEMBER 5, 1891. No. 10

Montreal as the Electric Light Convention Will See It.

What sort of a place is Montreal? This is a question often asked by those who have traveled only in "the States." From the fact that it is on the other side of an imaginary line and in a country called Canada, there are some who believe a visit would reveal sights familiar to those in countries across the sea. From an æsthetic standpoint it is, indeed, quaintly picturesque, and to the historically inclined Montreal is a city possessing many features intensely interesting. But, as a rule, delegates to electrical conventions—unfortunately, perhaps—are not æsthetic. Neither will they read historical sketches.

Since the last convention of the National Electric Light association, when Montreal was selected as the place for the summer meeting, the electrical fraternity has been curiously watching to see how the Canadians would handle their big undertaking. Reports coming to the States from time to time showed that Montreal fully appreciated the compliment which had been paid her. Now, as September 7th approaches, a visit to the meeting place reveals that reciprocity will be the order of the day, and the delegates will have a reception unrivaled in the history of similar proceedings.

The writer was informed a few days ago—by an officer of the National Electric Light association, too—that "there wasn't much of interest to electricians to see in Montreal."

The reader is left to judge for himself whether some one has not made a mistake.

This sketch and the accompanying views, then, are presented with the object of placing the readers of the WESTERN ELECTRICIAN in a position to be in touch with the convention and visit the points of greatest interest.

Delegates arriving via the Grand Trunk railway or at the Windsor station of the Canadian Pacific railway will find themselves within three blocks of their hotel, the Windsor. On the accompanying map, Fig. 1, may be located the points of greatest interest, electrically speaking. The general view of the city shown in the cut was taken from the mountain, looking east over the river. The city, it may be mentioned, is built at the base and on the east side of the mountain. It extends to the northeast and southwest.

The McGill University is on the side of the mountain facing east, and overlooking the Windsor Hotel, Fig. 2. It is at the university that the Thomson-Houston and Edison generating plants which furnish current for these companies' exhibits in the Victoria Rink will be located. The dynamo and engine to supply electrical power to the Fort Wayne company's exhibit in the rink has been set up in the basement of the Windsor Hotel. The Victoria Rink, as will be seen from the map, is only a block from the hotel, being, in fact, just behind it to the southwest.

Leaving the hotel, the rink and McGill University, the reader may now take a look about the city.

First, by reason of its being the most important electrical enterprise in Montreal, comes the lighting stations and the factory of the Royal Electric company. This concern operates two separate and distinct plants, shown in Figs. 3 and 4. The works on Wellington street comprise a station and the factory. The Water street establishment or the eastern plant is used exclusively as a lighting station.

Figures 4 and 5 will give the reader glimpses of one of the two dynamo rooms in the Wellington street station. One of the cuts shows the alternators, which do not appear in the other view.

When it is remembered that the Royal Electric company was organized in 1[illegible] and started [illegible] Thomson Houston arc dynamo [illegible] cated on Dowd street, one is not apt to be impressed with the fact that Canada does not appreciate the multitudinous applications of electricity. When the Royal company started it was under the name of the Thomson-Houston Electric company, which was changed to the American Electric & Illuminating company, and again in 1884 to its present name. The headquarter premises occupied at present are located on Wellington street from Queen to Prince street. The main building is four stories high. In 1890 the large new station was erected at the corner of St. Ignace and Water streets. The factory on Wellington street is equipped in conjunction with the lighting station. The Royal Electric company [illegible]

VIEW OF MONTREAL FROM THE MOUNTAIN.

The factory manufactures all descriptions of electrical supplies from the most minute article required in an electric light station up to the largest sized dynamos and power generators.

The Wellington street station has two batteries of boilers, 300 horse power each, Babcock & Wilcox, also seven return tubular boilers, 125 horse power each. These supply steam for the commercial lighting plant, the city lights being run from the eastern station. Five of the above mentioned boilers are equipped with Leadbeater's draft devices, and the whole battery is equipped with Locke's automatic damper regulators. The engines are run coupled in pairs with cranks quartered. Four of them are of 200 horse power each, and two are of 125 horse power each. These engines are of the Brown type and are manufactured by the Polson Iron Works company, [illegible] Ont. They run at a speed of from [illegible] revolutions per minute driving countershafts, which are equipped with Hill & Waterous clutches. The company is running twenty arc light Thomson-Houston arc machines from this station

and two 1500 light alternating dynamos of the Thomson make, as well as two 50 horse power Thomson generators of 250 volts each, operated on the three wire system. These generators are used to supply power in different parts of the city, running printing presses, elevators, hoists, sewing machines, etc. Most of these motors are of the Thomson type, manufactured by the Royal Electric company. The smallest motor on the power circuit is 1 horse power and the largest 25 horse power. There is about 75 actual horse power now in operation and about 6,000 incandescent lights installed in stores, dwellings, etc. The factory is run from a 15 horse power Thomson motor manufactured by the Royal Electric company.

At the East End station, there are two batteries of Bab[illegible]

FIG. 2. WINDSOR HOTEL, MONTREAL, HEADQUARTERS N. E. L. ASSOCIATION.

FIG. 6. OPERATING ROOM, MAIN OFFICE, BELL TELEPHONE CO. OF CANADA.

FIG. 8. DYNAMO ROOM IMPERIAL INSURANCE BUILDING, MONTREAL.

[illegible]

and 200 incandescents. There are twenty five 50 light Thomson-Houston arc dynamos in this station.

A novel way of gettting the water for this station is employed. A well was sunk 65 feet deep and a tunnel constructed from the bottom of the well under the Canadian Pacific Railway company's tracks and wharves for a distance of 560 feet to obtain the water from the St. Lawrence River. The air pump and condensers were placed in the well, 35 feet below the floors, and the discharge water from the condensers in the well supplies the water for the condensers of the tandem compound engine on the floor.

In the several departments of the factory about 250 hands are constantly at work, besides which the company employs a large staff to carry on its various contracts, not only in Montreal, but all over the Dominion. It is stated that over [illegible] arc lights and [illegible],000 incandescent lights with the necessary dynamos to operate them, as well as wire and all kinds of supplies have been manufactured by the company and are in use in the various cities and towns of Canada. The incandescent system has been worked up to [illegible] magnitude during the last two years, as previous to 1889 the company devoted its entire time to the manufacture of arc apparatus. The stock of this company is held entirely by Canadians. Senator J. R. Thibaudeau is president and W. J. Withall the vice-president, the other members of the board being Messrs. G. R. Robertson, L. A. Small, Wm. Cassils, J. A. L. Strathy, F. L. Béique and Allan Macdonell, all of Montreal, and John T. Ross, of Quebec. Chas. W. Hagar holds the position of general manager and secretary, being assisted by H. H. Henshaw as treasurer, David A. Starr as general agent, and Fred. Thomson as chief electrician. In the light and power department he is assisted by D. Thomson as superintendent, and F. H. Badger, Jr., as electrician. Geo. Hunt is the chief engineer in charge of the company's extensive steam plant. The Royal Electric company has a capital stock of $375,000 and the company is proprietor of the Thomson and Thomson-Houston systems of electric lighting for the Dominion.

The Bell Telephone company of Canada, which practically does all the telephone business of the country, has its head office at Montreal, C. F. Sise being the president and C. P. Sclater the secretary and treasurer. The headquarters of the eastern department are also in that city, L. B. McFarlane being the manager.

FIG. 1. MAP OF MONTREAL, SHOWING POINTS OF INTEREST TO DELEGATES.

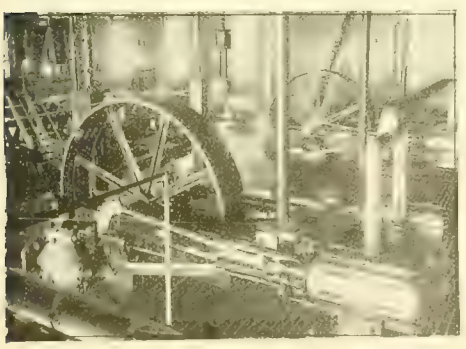
The company has 5,700 subscribers in Montreal, connected with four exchanges. The main office, of which the accompanying cut, Fig. 6, is an illustration, has a Western Electric multiple switch-board for 3,000 subscribers, and an annex in the same building fitted with similar apparatus

FIG. 3. ROYAL ELECTRIC COMPANY'S PRINCIPAL PLANT, MONTREAL.

for a further thousand subscribers. In this exchange eighty-two operators are engaged attending to the 2,600 subscribers.

Its west end branch is in a very fine building belonging to the company, at the corner of Mountain and St. Catharine streets. Here also is the Western Electric company's system of multiple switch-boards, wired for 2,000 subscribers but with an ultimate capacity of 3,000, about 1,500 subscribers being connected. Thirty-two operators are engaged here.

In the east end of the city there is an exchange fitted with standard switch-boards, with which are connected 1,200 subscribers, who are attended to by 26 operators; and in the southwest portion of the city there is yet another branch, also fitted with standard boards, with



ENGINE ROOM, ROYAL ELECTRIC CO.'S PLANT, MONTREAL

which 400 subscribers are connected and 10 operators are engaged.

Another company, known as the Federal Telephone company, is also in operation in Montreal. Its exchange is worked on the Law system of New York.

The Holmes Electric Protection company, whose headquarters are illustrated, Fig. 7, is one of the institutions of the city, which though not long established, has made rapid advances. It depends largely upon the banks and large commercial houses of the city for support, and these concerns depend upon it to guard their property against fire as well as burglars. To give an idea of the working of the system, let it be supposed that work for the day is over in one of the banks with which it is connected. The cashier, before leaving, calls up the office of the Holmes company, giving a private signal, by simply pressing an

or opens an electric current and gives the alarm. Should he know that the bank was protected by the company's system, and, having traced the wire, sever the connection, he would by that act give the alarm. Even should he be able to gain admission, the opening of a safe door, either in the usual way or by being forced, or a panel or lock cut out, the alarm is sounded. The company also has an automatic fire alarm, which not only gives warning of a fire, but be-

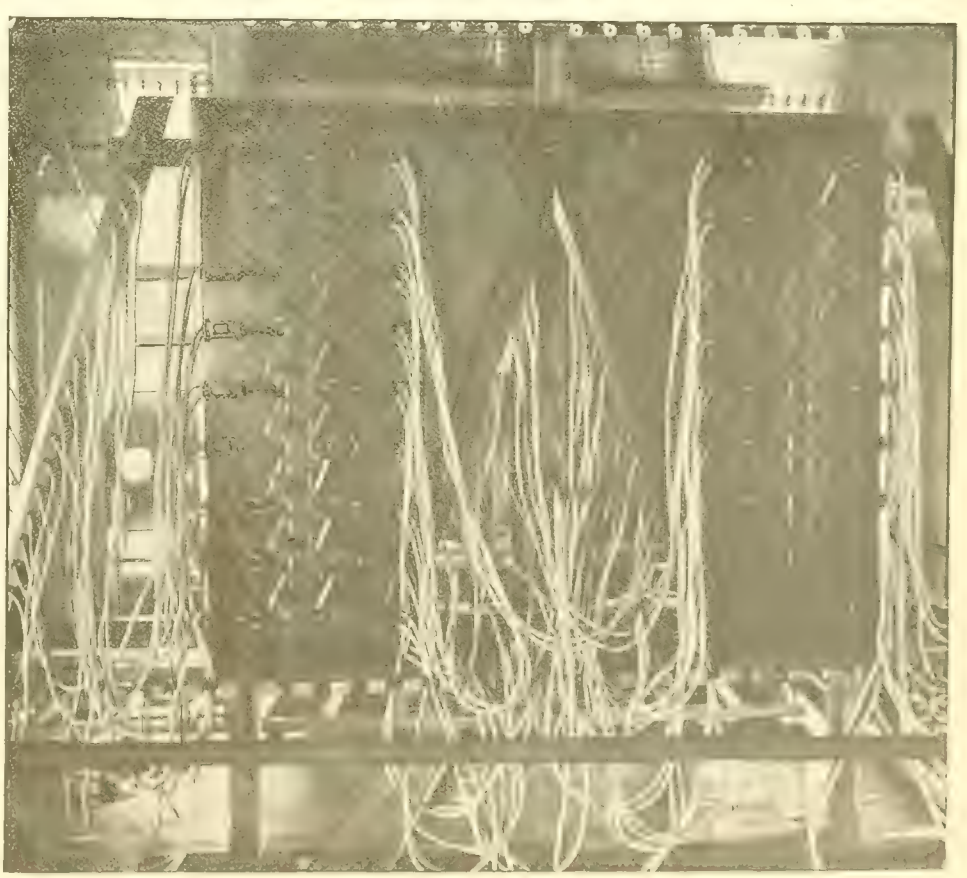
tion of private residences. A force of patrolmen, em-

dicates exactly where the break has occurred. The hand-

[illegible] MONTREAL

street. The officers of the company are H. C. Roome, president; W. J. Turpin, vice-president; W. Alex. McKay, secretary and treasurer; F. E. Brouwer-Ancher, manager. The president and manager are American gentlemen.

The plant of the Imperial Insurance company, shown in, Fig. 8, is in the basement of the company's building at St. James street and Place d'Armes. There are two 270 light Edison machines, driven by a Leonard Ball engine of 50 horse power, operated at 300 revolutions. The dynamos are driven direct. Steam is received from two boilers of 40 and 60 horse power each. The offices in the building are all supplied with electric lights. The plant was installed by the Edison General Electric company



[illegible]

street service.

The Montreal Convention.

The preparations for the Montreal meeting of the National Electric Light association have been completed, and everything is now in readiness for the reception of the American visitors. The programme arranged by the citizens' committee for the entertainment of delegates and visitors has already been published. Following is the official programme of the convention proper. It has been decided to hold only one session each day extending from 10 A. M. until 2 P. M.

September 7th. Three P. M., convention called to order; addresses of welcome and reception; response; address of president; report of secretary; report of treasurer; reading invitations received; adjournment to meet in evening at exhibition rink at 8 P. M., when the formal opening of the exhibition will take place.

September 8th. Reports of committees on relations, etc., data, World's Fair, legislation, underground, safe wiring.

September 9th. Discussion of T. C. Smith's paper; paper, W. C. Warner, "Various Forms of Carbon for Use in Arc Lamps;" paper, Capt. Eugene Griffin, "Three Years' Development of Electric Railways;" paper, H. Ward Leonard, "A Central Station Combining the Advantages of both Continuous and Alternating Systems."

September 10th. Paper, J. I. Ayer, "Some Details of the Care and Management of an Arc Lighting Station, as Practiced in the 'Municipal' of St. Louis;" paper, C. J. Field; paper, George A. Redman, "Central Station by Water Power;" paper, J. J. Burleigh, "Uniformity of Method in Keeping Central Station Accounts;" Executive session to elect members of Executive committee and to name place of next meeting.

Entertainments will be arranged for each day and announced by bulletin.

[illegible] Barney, manager of the exhibition, has issued a circular letter in which he announces that the rink is ready for the installation of exhibits.

All exhibits must be in place and ready for exhibition by Monday, September 7th, at [illegible] M.; after that hour, no [illegible] except clearing up and preparing for the opening of the exhibition, which will take place at 8 P. M. [illegible] The exhibition will close on Wednesday, September [illegible], at 10 [illegible], and all goods must be removed from the rink within three days thereafter. All goods intended for exhibition should be plainly marked with the name of the exhibitor, for example: John [illegible], [illegible] Exhibition, Victoria Skating Rink, Montreal, Canada."

If [illegible] from points in the United States, they should [illegible] "For Exhibition in Bond." They [illegible] removed [illegible] Victoria Skating Rink [illegible] for the [illegible] of the exhibition.

[illegible] one of which should be marked "Certified Correct," and signed by the firm, or by an officer of the corporation making the shipment, must be mailed direct to "C. H. Barney, Manager Electrical Exhibition, Victoria Skating Rink, Montreal, Canada." The prices on the invoices should be those which would be charged for the goods if sold in Canada.

EDISON GENERAL ELECTRIC COMPANY'S TRANSMISSION SYSTEM AT THE MONTREAL EXHIBITION.

Crystal Palace Exhibition Postponed.

The opening of the Crystal Palace exhibition has been postponed, according to the English papers, until January 1st. The prospects are not very flattering, but, according to a contemporary, "with the view of promoting the success of the exhibition, the Chamber of Commerce has agreed to appoint a committee to act with the directors of the Crystal Palace company. Over 60 well-known gentlemen have consented to act as an honorary council of advice, and judging from the names there should be no lack of sound common sense on every question which may arise."

Romances of the Telegraph.

A pretty little romance of the telegraph comes from a little station away out in the desert from Yuma, Arizona, on the line of the Southern Pacific. The hero of the story is J. J. Stansbury, who, since the incident about to be described, has located at Jackson Springs, Cal., a far more congenial place. Nearly two years ago Mr. Stansbury was operator at the little station named. A more uninviting place of abode could scarcely be found. The station consists merely of a big water tank, a rough shed called the telegraph office, and another shed in which half a dozen trackmen live. During the summer months life at the little desert station was almost unbearable. The temperature was generally playing between 120 and 135 degrees—sometimes reaching 150 degrees—and at night if the mercury dropped to 90 degrees it was a signal to pull up the blankets. The tortures of existence in such terrific heat can hardly be imagined and if it were left to his choice, the telegraph operator ordered to a station out on the desert would prefer a berth on the devil's gridiron. Recreation of any sort was, like sleep, out of the question, and the only means of passing away the time was found in talking over the wire with other operators at distant stations. It was in this manner an acquaintance sprang up between Mr. Stansbury and the operator at Banning, Cal., whom Stansbury described as a "jolly, cheerful sort of a fellow." Their telegraphic acquaintance ripened into a warm friendship and finally the two operators arranged to have their vacation together and to pass two or three weeks together in the mountains hunting and fishing. All details were carefully arranged. The Banning operator wanted every convenience in the camping expedition, even refusing to part with rubber boots for trout fishing, despite Stansbury's insisting that he saw nothing the matter with "taking off their shoes and stockings, rolling up their trousers and wading." Finally, after all arrangements had been perfected, the Banning operator backed squarely out of the expedition, greatly to Stansbury's disgust. He had changed his plans, he said, and he was going to spend his vacation in New Mexico and would be glad to see Stansbury as the train passed the latter's station, but on that day Stansbury had succumbed to the torrid temperature and lay with a burning fever, unconscious and delirious.

The rest of the story is best told in Stansbury's own words.

"Into the fever tortured brain there sometimes creeps a semi-consciousness of the life about it, and so during the days of my agony I was vaguely aware of gentle, womanly hands and a kindly feminine presence in my sick-room, and when I returned to the conscious world I was not surprised to find a fair and pleasant face beside me. Its owner said that she had been upon the train when I was found stricken down, and had staid to minister to my

FORT WAYNE COMPANY'S POWER TRANSMISSION SYSTEM AT THE MONTREAL EXHIBITION.

sore need. The idea may seem preposterous, but I believe the foundation of my affection for my kind attendant had been laid while the unconsciousness of fever was still upon me, and the affection grew into the deepest love as she cared for me during the days of my convalescence.

"After a time I ventured to tell her of my love, and to ask her if she would be mine; but I was not prepared for her answer.

" 'John,' she said, 'do you really mean that you wish to marry a girl that insists upon wearing rubber boots and will not—roll—'

" 'Mat!' I said, for I was completely beaten. Then it flashed upon me. She was the operator at Banning, and I, like a fool, had always taken it for granted that she was a man.

"Well, I am not going to tell how I convinced her that

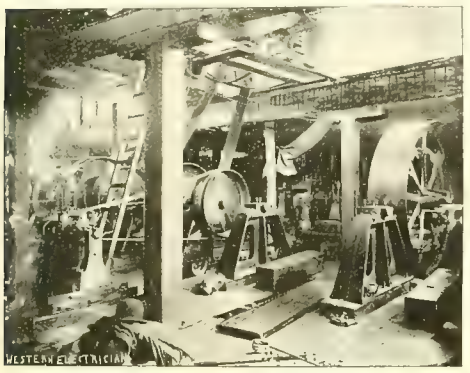


FIG. 4. ROYAL ELECTRIC COMPANY'S FACTORY PLANT, WELLINGTON STREET, MONTREAL.

I wanted to marry her, boots and all, but I did it, and, like Barkis, she was willin', and here we are on our wedding journey. The Southern Pacific has lost an operator, but I calculate that I am ahead on the deal."

This recalls the account of another no less interesting romance of the telegraph, as related to the writer by W. H. Storey, who afterward in response to continued entreaties, produced a clipping from the San Diego, Cal., *Daily Union* of April 25, 1876, containing an account of his marriage to Miss Clara E. Choate of San Diego, by telegraph. At that time Mr. Storey was the United States Signal Service operator at Camp Grant, Arizona, and as he could not obtain leave of abseece to make the journey by wagon to San Diego for his wedding, and as there was no minister or other person qualified to perform the marriage ceremony within hundreds of miles of Camp Grant, it appeared as though the wedding would have to be indefinitely postponed. But Mr. Storey did not propose to let things go that way if they could be possibly averted. "A contract by telegraph is binding, then why," he thought, "can we not be married by telegraph?" This logic proved sound, Miss Choate made the pilgrimage to Camp Grant, and the couple were married by Rev. Jonathan L. Mann, pastor of the Methodist Episcopal church of San Diego, by telegraph from that city.

The incidents of the wedding were unique and interesting. At that time Lieut. Philip Reade, U. S. A., was the officer in charge of the government telegraph lines of the department of California and Arizona, with headquarters at San Diego. Upon being asked permission to use the telegraph lines from San Diego to Camp Grant, after regular hours for the purpose of performing a marriage ceremony, Lieut. Reade readily consented, and issued the following general order:

To all Managers of Stations along the Entire Division.

You are hereby informed that the wires of this division after 8 P. M. April 24th will be used for the purpose of conducting a marriage ceremony by telegraph between San Diego and Camp Grant, and you and your friends are specially invited to be present on the occasion, to assist if necessary and to see that good order is maintained.

(Signed) PHILIP READE,
Lieut. and Officer in Charge.

Each operator on the line accepted this novel invitation and, with invited friends, was present at his station as wedding guests. At 8:30 P. M. the father of the bride sent this message from San Diego to the wedding party at Camp Grant:

Greeting to our friends at Camp Grant. We are ready to proceed with the ceremony.

D. CHOATE AND PARTY.

The answer at once came back:

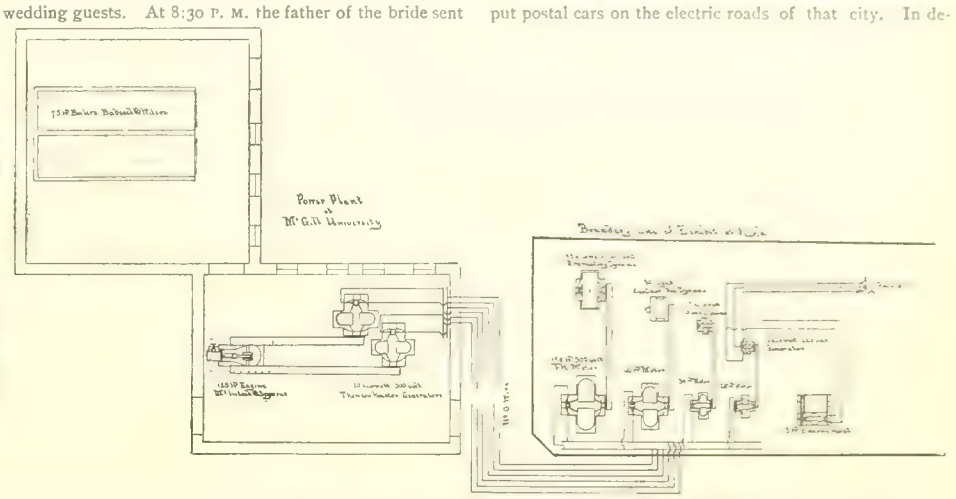
We are ready. W. H. STOREY.
CLARA E. CHOATE.

Then the Rev. Mr. Mann read the marriage service, which was repeated to Camp Grant as uttered, word for word, by Mr. Blythe, chief operator at the San Diego office. At the proper moment, the solemn "I do" came back over the wires signed first by "William H. Storey," then by "Clara E. Choate." Then, following the words of the minister, the instruments clicked.

"As a token of your sincerity you will please join your right hands."

The answer came promptly: "It is done."

The service was then concluded in regular form, after which congratulatory messages were sent the bride and groom from all stations. Suddenly Chief Operator Blythe of San Diego broke in and telegraphed Mr. Storey that "the Silver Cornet band of San Diego is just outside the office, gving you and your bride a serenade," a welcome that was warmly appreciated even though it was not heard at Camp Grant, 650 miles away. Mr. and Mrs. Storey are still living in San Diego and have a happy family of five [illegible] story of their parents' romantic wedding. Mr. Storey, [illegible] yet it is not an uncommon experience of his, upon being [illegible] wedding. I heard the whole ceremony at the telegraph office at ——, Arizona."



THOMSON-HOUSTON COMPANY'S SYSTEM OF POWER TRANSMISSION AT THE MONTREAL EXHIBITION.

Postal Cars on Electric Roads in St. Louis.

Postmaster [illegible] put postal cars on the electric roads of that city. In describing his plan he says: "At first we will make the experiment with some ordinary car temporarily fixed up for the service, and then will come regular postal cars especially adapted for the work. The route I had chosen to make the trial over was the Lindell railway from Third street and Washington avenue out Washington avenue, Lucas and Grand avenues to Vandeventer, and thence to Rock Springs, and back east on Chouteau avenue, Eighteenth street and Fourteenth street to the point of departure. This would give a circuit of ten miles, reach important residence and business parts of the city, and would fully demonstrate the practicability and usefulness of the scheme. It was my intention to have put [illegible] route, going in opposite directions [illegible] They would have greatly expedited the delivery of letters to the outlying sections of the city, and [illegible] the reception of mails at the general postoffice. At present this route cannot be used, as there is a gap of four blocks between Manchester road and Chouteau avenue. The street railway company is seeking to build over the gap, and an ordinance to that effect is now hung up in the council. The experiment, however, will be undertaken in a few days, as soon as the details are arranged [illegible] and two cars will be put in service. One car [illegible] Chouteau avenue to Forest Park and return, the other over the Washington ave. route [illegible]

EXTERIOR AND INTERIOR VIEWS OF CUPOLA OF THE ROYAL ELECTRIC COMPANY'S STATION, MONTREAL.

Electricity at the World's Fair.

Colonel Clowry's committee on electricity, after the recognition it secured at the hands of the executive committee, as detailed last week, is getting ready to settle down to business. [illegible] meet regularly twice a week—on Mondays and Thursdays—at Chief Burnham's office, where the plans of the electricity and other buildings are conveniently at hand. At last week's meeting of this committee the chairman read a report from Chief Barrett, of the department of electricity, showing succinctly what progress had been made by that department. This report was prepared at Colonel Clowry's request. It is dated August 22d, and reads as follows:

I have up to the present time specific applications for space, including particulars as to power required, square feet, etc., from electrical firms and individuals, aggregating a demand for 55,377 square feet of space. I have, in addition to these, preliminary applications from 41 concerns, aggregating a demand for 62,300 square feet, the applicants having failed as yet to particularize as to power required and other necessary details, and having also failed to return the properly filled out application. In addition to this I have letters from 59 concerns, notifying the department of their intention to exhibit, and asking for certain information required to allow them to make the proper applications. These 59 firms or individuals have intimated in their letters that they will require an aggregate of something over 75,000 square feet of space. This does not include any space for foreign exhibitors, and up to the present time the department has received no applications from this class of exhibitors. As these foreign applications must come through the commissioners of the states in which the exhibitors live, however, we have given little or no attention to this part of the work.

The work of the department is behind. It is behind through no fault of our own. Those who intend to exhibit, but as yet have made no formal application for space, are desirous before doing so to have the question of the supply of power for the service of the exposition settled. None of the larger concerns have applied for space, and they have informed the department that they do not intend doing so until the question of the supply of power is settled. They urge that they cannot settle the question of space until they know whether, and on what terms they are to be allowed to participate in the service of the exposition. The firms spoken of as having required certain information before they can submit applications for space are waiting upon this department. They have asked for ground and gallery plans of the electrical building. I made application to the chief of construction for these plans on the 25th of March last, and have made specific requests for them repeatedly since that time. Yesterday (Aug. 21) the department received through the director-general a complete set of working plans of the electrical building, the first that we have been able to secure, yesterday being the first time that we have been able to survey these plans with a view to understanding our possibilities under them. The department of construction has been for three months or thereabouts working upon another set of plans which we have required, including sectional drawings of the buildings of a character that will aid us in the allotment of space. I intend to at once have prints made of the ground floor and gallery plans for the use of exhibitors. As soon as this is done, [illegible] giving a prospectus of our work, including all information that can be required [illegible] for the government [illegible] foreign exhibitors, [illegible] a brief summary [illegible]

[illegible]

[illegible] living electrician. After its presentation the chief of con- [illegible]

The suggestions of the chief of construction were deemed [illegible]

templated in this list, we will have to permit the possible injustice of allowing honor to most distinguished men of to-day to come from future generations. And while upon this subject the department begs leave to suggest that any list of electricians comprised of 69 names, will be much weakened, in the matter of distinction, because of the fact that there have not been 69 electricians who deserve this title, and whose names would sustain the dignity contemplated. The department would suggest therefore, that not more than thirty names be applied to this purpose, and as a part of this report we submit for your consideration a list for such honor. The department asks that your committee upon approval or readjustment of these names, give instructions to the department of construction along these lines.

In the matter of foreign exhibitors: It is yet too early to hope to hear definitely from the electrical people of foreign countries, but this department is fully enough advised as to their sentiments upon the subject of the World's Columbian Exposition to be able to report that considerable effort will be required to induce these people to make creditable displays. In some fifty letters which the department has had the opportunity to consider from electrical firms or individuals in all European countries, we find a disposition on the part of these people to excuse their want of enthusiasm in the matter because of unfavorable conditions of our laws, and because of the possible superiority—at least in some directions—of our electrical work. Later on, therefore, at perhaps some early date, it will be advisable to send an emissary to Europe and Canada, to place the matter properly before the large electrical concerns of these countries. It is of course contemplated by the exposition management to give foreigners an equal opportunity in all electrical matters with our own people. As soon as they can be convinced of this fact the department believes they will be much more agreeably disposed.

FIG. 7. HOLMES ELECTRIC SIGNAL SYSTEM AT MONTREAL.

This report was afterward brought to the attention of the executive committee by Colonel Clowry, and the suggestion that a representative of the department be sent abroad was duly considered. The subject was discussed at some length. The representatives of the exposition who have so far gone to Europe have met with great success, and it was thought that, in order to secure a representative foreign exhibit in the department of electricity, an agent should be sent abroad at once. Accordingly a resolution was adopted by the committee requesting Director-General Davis to send Prof. Barrett, chief of the department of electricity, abroad, to the end that he might interest the foreign electrical companies in the World's Fair. It is not unlikely that Chief Barrett will sail in time to meet the electricians at the Frankfort electrical exhibition before that exposition is brought to a close. There are many points in relation to customs duties, foreign employes, transportation rates and the relation of the electrical exhibits to the plant for furnishing light and power that are not [illegible] foreign manufacturers [illegible] will be Prof. [illegible] enlighten them.

[illegible] to Chicago on August [illegible]th. He [illegible] eastern trip. In [illegible] to Europe he [illegible] of [illegible] necessary, and that he [illegible]

[illegible] of director [illegible] has received [illegible] from Mr. Butterworth one of the [illegible] in Europe containing many [illegible] derived from his visit to the Frankfort exhibition. It is right in line with the executive committee's action in recommending that Prof. Barrett be sent to Europe. Following in an extract:

We reached Frankfort on the night before last. The largest electrical exhibition ever held is in progress here now. We visited this exposition yesterday and looked until we were tired out. I submit that it would be of great advantage if Mr. Barrett could visit this exposition immediately; not only with reference to the arrangement of the exhibits, that is, the installation, but with a further view of availing himself of what they have accomplished here in the matter of requiring those who make electrical exhibits of dynamos and batteries and devices for lighting, to light certain halls and buildings. I was informed by the president, or rather the vice president, of the exposition, that they had arranged with those who installed plants to exhibit various electrical devices, and that they had secured the lighting of the grounds and buildings free of cost; and, from my investigation, I think the same thing can be done, though possibly in a smaller measure, at Chicago. There would seem to be no good reason for the directory to supply power to develop electricity unless that electricity in turn is made available for lighting the grounds and supplying power in certain contingencies. They not only light the grounds here, but also make displays, free of charge, so that the lighting and the displays do not cost the management one farthing. There is much of interest here, in the field of electrical art, which it would be well for Prof. Barrett to see. It would aid him very greatly in the matter of installation of exhibits and the utilization of electricity. They have dynamos here developing 600 horse power, and every appliance known to electrical science; and they seem to have studied with great care the matter of installation.

The president is Mr. Sonnemann, an eminent journalist and statesman, who has often had tilts with Bismarck in the Reichstag. He is very friendly to our exposition and is aiding us in every possible way, as are his assistants, Vice-president Muller and other officials. We have done what we could to assure exhibitors (and they are here from all sections) that the most elaborate preparation is being made for them at Chicago, and the tariff system offers no stumbling block to their reaping a rich harvest in America, if perchance they can show improvements on what we have accomplished in the United States. One matter of interest was called to my attention. The Germans seem to have demonstrated the practicability of conducting electricity long distances with comparatively little loss. Within the next eight days a system will be completed for generating electric force 120 miles from Frankfort and utilizing it here. They assure me that they can do this with a loss of only 30 per cent., distributed thus: 10 per cent. in resistance, 10 per cent. in dynamo and 10 per cent. in motor, leaving 70 per cent. for actual use. They say also that if they meet with the measure of success contemplated, it in a large measure solves the problem of cheapness in the matter of electric force for industrial uses. We shall certainly know within thirty days whether they are over-sanguine. Of course they use water power to generate the current, which is comparatively inexpensive. If they shall be successful in this we shall be able to utilize the waterfalls within some hundred miles of Chicago for our exposition.

Last evening we were entertained at dinner by the managers of the exposition, and the president read a paper warmly welcoming us, and to that Judge Lindsay and myself responded. It is proper to say that the consul-general here, Mr. Mason, is working earnestly for the exposition, and very effectively, as he is a man of great ability and energy. To-night we have a reception for the American exhibitors, who make quite a respectable showing here, and the other exhibitors are invited, when we hope to offer some considerations why the whole exhibit here should be transferred to Chicago in 1893.

It has been decided that Secretary Hornbsy shall represent the Department of Electricity, World's Fair, at the Montreal convention. He will undoubtedly read a paper showing the progress so far made in the work of the exposition.

The press and printing committee has adopted a resolution asking the grounds and buildings committee to reserve a space of 80,000 square feet for a newspaper building on the exposition grounds. This building is intended for the use of editors who may visit the exposition, and for the accommodation of the newspapers of Chicago. It is to be fitted up with reading rooms, apartments for writing and all the conveniences of a modern newspaper office. The project is a commendable one, and will undoubtedly receive the support of the technical press.

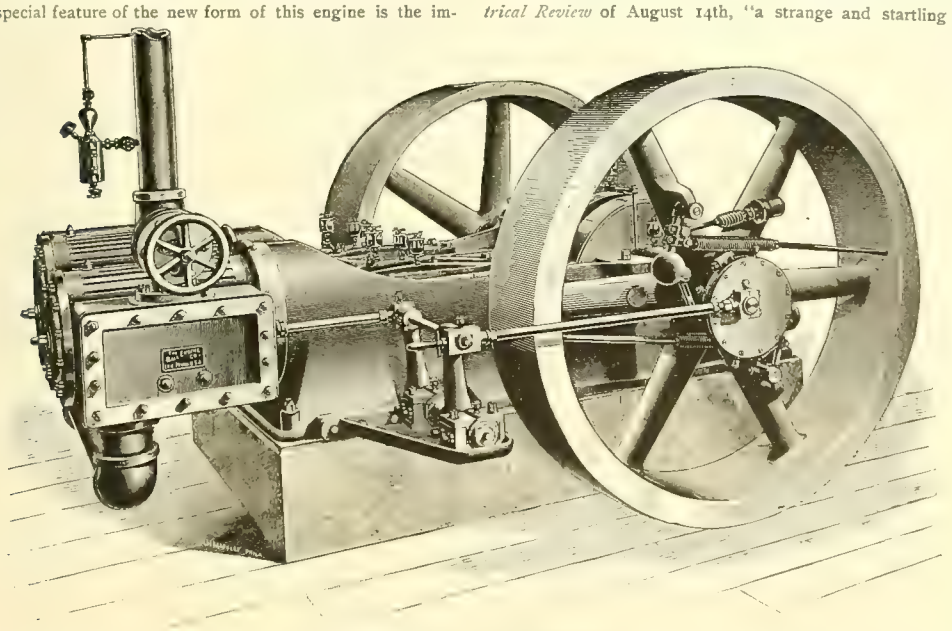
The list of names proposed for the friezes of the electrical building is as follows:

Aepinus, Rus.	Jacobi, Rus.
*Ampere, Fr.	Jenkin, Eng.
*Arago, Fr.	*Joule, Eng.
Armstrong, Eng.	*La Place, Fr.
Bain, Eng.	Le Sage, Fr.
Barlow, Eng.	*Maxwell, Eng.
Bennet, Eng.	Mattencci, It.
Biot, Fr.	*Morse, Am.
*Cavendish, Eng.	Mattheissen, Eng.
Channing, Am.	Muschenbroek, Ger.
Christie, Eng.	Nicholson, Eng.
*Coulomb, Fr.	*Ohm, Ger.
Cooke, Eng.	Oersted, Dan.
Coxe, Am.	*Page, Am.
Cuneus, Ger.	Poisson, Fr.
Cuthbertson, Eng.	*Priestley, Eng.
*Daniell, Eng.	Pouillet, Fr.
*Davenport, Am.	*Reymond-Dubois, Ger.
*Davy, Sir H., Eng.	Ronald, Ger.
Davy, Marie, Fr.	Saussare, Fr.
Dufaye, Fr.	Seebeck, Ger.
*De la Rive, Fr.	Sommering, Ger.
De la Rue, Eng.	*Steinheil, Ger.
*Don Silva, Sp.	Sturgeon, Eng.
*Faraday, Eng.	Symner, Fr.
*Foucault, Fr.	*Siemens, Ger.
*Franklin, Am.	Thales.
*Galvani, It.	Theophrastus.
Ganzain, Fr.	Vail, Am.
*Gauss, Ger.	*Varley, C. F., Eng.
Gilbert, Eng.	*Volta, It.
Green, Eng.	*Weber, Ger.
*Guericke, Otto, Ger.	*Wheatstone, Eng.
Gray, Stephen, Eng.	Wollaston, Eng.
*Henry, Am.	
Haris, Sir Wm. Snow, Eng.	

This is the full list, those marked by a star being the thirty names it is proposed to select. The nationality follows the name in each case. There are more than sixty-nine names given, but one or two are those of living men. It should be understood that the list is merely under advisement, and has not been officially adopted. Both the committee and department of electricity will be glad to receive any suggestions that will improve it.

Cross Compound Ball Engine.

In the accompanying illustration is shown the latest form of the Cross compound engine of the Ball Engine company of Erie, Pa. These engines are especially adapted for heavy electric light and power service. The special feature of the new form of this engine is the improved governor. Instead of using the eccentric and strap on the low pressure side, an adjustable wrist pin plate is bolted directly to the hub of the wheel. On this plate is the valve driving crank pin.



CROSS COMPOUND BALL ENGINE.

The crank shaft is made of the best open hearth steel, with the cranks opposite each other; one counteracting the effect of the other, so that the engine is perfectly balanced and capable of being run noiselessly at a high speed and without heating.

The valve provides for quick admission of steam, and insures against all possible leakage. The pistons are as readily accessible as in a single cylinder engine.

An electric light plant is to be erected at Lake Charles, La.

Solenoid Coal Cutter.

In some grades of coal it is found desirable to make the under cut with a machine concentrating its power upon a single reciprocating shaft, carrying a chisel at its extremity. This type of cutter or drill is compact and may be controlled by one man, the direction of the blow being varied as occasion demands.

The accompanying illustration shows the Van Depoele solenoid coal cutter, manufactured by the Thomson Van Depoele Electric Mining company of Boston. The type shown is the present standard form, though modifications can be made to suit special requirements. The operation of the cutter may be easily understood from an inspection of the illustration. The direction of the blow is determined by the operator, who sits on the floor facing the breast, his feet resting against the wheels, and his hands grasping the handles at the rear of the cylinder, thus obtaining a double leverage, by which the machine, being almost exactly balanced, is easily turned on its points of support.

SOLENOID COAL CUTTER.

A simple switching device turns the current on or off, as desired, while lights, pumping apparatus, electric ventilators, etc., may be run on the same system of wires which supply power to the coal cutter, if desired.

The weight of the apparatus is a little over 700 pounds, the number of strokes usually from 300 to 350 per minute, although the rapidity of the blow can be varied at pleasure. The stroke is from five to six and one-half inches. The tension guide can be furnished in different lengths, according to the depth of under cut desired.

How About Ferranti?

"At the time of going to press," says the London *Electrical Review* of August 14th, "a strange and startling rumor is in the air, to the effect that Mr. Ferranti has severed his connection with the London Electric Supply corporation and left the country. We cannot, however, vouch for the truth of this." This is indeed a strange rumor. Mr. Ferranti's brilliant achievements have made for him many admirers in this country, who will await the sequel of this statement with much interest.

Later English papers confirm the statement that Mr. Ferranti has left the London Electric Supply corporation, his contract with that company having expired. He has not left the country, however.

Work was begun this week on the Love Electric Traction company's street car line, which will encompass the blocks bounded by Webster, Racine and Fullerton avenues and Halsted street, Chicago.

Enterprise in Forwarding War News.

[illegible] scribes the situation: "The statement that the cable had [illegible] which is an American corporation, has managed its business [illegible] laid in February last between Lima and Valparaiso, it would have been impossible to send messages at all from this city showing the progress of the war, and the public would not have been informed of recent events for weeks to come, and then only through slow mail connections. The lines to Europe via Buenos Ayres have been interrupted in consequence of military operations, and the Central and South American cable, therefore, was the only means of communication with the outside world. Much praise is due its officers and managers for their energy and just management during this critical period. They have just arranged to extend the free use of the cable to the authorities of Valparaiso and Iquique for official messages and to acquaint friends and relatives respecting the killed and wounded. People here appreciate this act of the company very highly."

Project for Ventilating Chicago's Electrical Conduits.

As has been frequently pointed out in this paper, the presence of gas in subways containing electrical wires has many times caused explosions and subsequent fires, for which electricity alone was held to blame. To prevent this the Chicago Sectional Electric Underground Conduit company has applied to Commissioner Aldrich for a permit to put in ventilating manholes in its subway for the purpose of creating perfect circulation in the conduits, and preventing gas explosions. Ventilating pipes will be erected in the manholes. The commissioner thinks the idea a good one, and will probably issue the permit.

Death of the British Postmaster-General.

On August 24th occurred the death of Rt Hon. Henry Cecil Raikes, M. P., the head of British postal and telegraphic service. Mr. Raikes had been ill but had recovered sufficiently to go out walking. He was caught in a thunderstorm, however, and received an electric shock which led to his death. Mr. Raikes was not a popular official, but his ability was unquestioned. Sir John Gorst, John Henniker, M. P., Mr. Heaton and the Duke of Rutland are mentioned as the men from whom the selection of a successor will probably be made.

Taunton Electrical Exhibition.

The electrical exhibition at Taunton, Eng., is pronounced a most interesting display of the most approved methods of applying electrical apparatus.

A number of machines for the electrical utilization of water power are on exhibition. It is mentioned that a gentleman living a short distance from Taunton is deriving sufficient motive power from a stream passing near his residence to light his house by electricity. Another feature of the exhibition is a complete and compact installation for the illumination of a dwelling house or factory. Sewing machines, lathes, and ventilating fans can be seen at work, driven by electric motors. At other stalls electrical appliances of a varied description are on view. The general public, however, will be more interested in the show of electrical fittings, which constitutes the charm of the exhibition. In one corner of the main building a miniature drawing-room is fitted up, and lighted entirely by electricity, the effect surpassing anything which could be obtained from any other illuminant. The light bursts forth from the most unexpected nooks, or is half hidden beneath shades of rare design and beauty. [illegible] attractive, and some of the stands supporting the incandescent lamps are remarkably pretty. In an opposite corner there is a large collection of these fittings, which are far more [illegible] most expensive of [illegible] brightly in any position. The exhibition will remain open till the end of October.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, ... Editor and Publisher.
J. B. O'HARA, ... }
F. L. PERRY, ... } Associate Editors.
W. E. KEILY, ... }
J. L. BAKER, ... Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK

W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application

CONTENTS OF THIS NUMBER.

PAGE.

Montreal as the Electric Light Convention Will See It. Illustrated 127, 128, 129, 130, 131, 132
International Exhibition at Buda Pesth 129
The Montreal Convention 130
Crystal Palace Exhibition Postponed 130
Romances of the Telegraph 130, 131
Postal Cars on Electric Roads in St. Louis 131
Electricity at the World's Fair 132, 133
Cross Compound Ball Engine. Illustrated 133
Solenoid Coal Cutter. Illustrated 133
How [illegible] Ferranti 133
Enterprise in Forwarding War News 133
Project for Ventilating Chicago's Electrical Conduits 133
Death of the British Postmaster-General 133
Ta[illegible] Electrical Exhibition 133
Editorial 134
New Street Railway Generator. Illustrated 135
Minimum First Cost of Plant and Maximum Economy of Operation in the Electrical Transmission of Power, by H. Ward Leonard. Illustrated 135, 136, 137, 138
The Future of the Electric Railway, by Frank J. Sprague 138, 139

DEPARTMENTS.

Correspondence 140
New Incorporations 141
Electric Light 141
Electric Railways 141
[illegible] 141
[illegible] 141
[illegible] 141
[illegible] .... 14[illegible], 142
[illegible] 142
Business 142
[illegible] 142

The [illegible] of the WESTERN ELECTRICIAN during the convention at Montreal will be parlor 101, Windsor Hotel.

[illegible] presented an article by [illegible] power transmission, in which [illegible] F. B. Badt and Frank J. Sprague. Mr. [illegible] upon the manner in which Mr. Badt treated the subject of minimum total initial [illegible] "Electric Transmission Hand-Book." The subject is still new. [illegible] bearing upon [illegible]

[illegible] Montreal [illegible] find not only elaborate entertainment but much that will interest them from an electrical view. Those who have [illegible]

as well as a large number of standard installations. A perusal of the columns of the WESTERN ELECTRICIAN this week will suffice to give an excellent idea of the advancement made in the electrical industries in the Canadian Metropolis.

OF international expositions there seems to be no end. It is now announced that one will be held in Buda Pesth in 1895 to celebrate the thousandth anniversary of the creation of Hungary as an independent state. It is to be hoped that this exhibition will not prevent any prospective exhibitors at the Chicago World's Fair from making a display here in 1893. It is hardly probable, however, that the electrical department, at least, will be unfavorably affected by this later attraction. The announcement that the Crystal Palace electrical exhibition has been postponed until next year, will also be received with interest in this connection.

ANNOUNCEMENT is made in the English electrical papers that Mr. Ferranti has left the employment of the London Electric Supply corporation, his contract having expired. We have always viewed with admiration this young engineer's daring feats with enormous currents at the Deptford station, and hear with gratification that the large dynamos and mains are all working satisfactorily at the present time, *Industries* of London being authority for the latter statement. In this country the transmission of currents of high potential for considerable distances is regarded as one of the most important problems now confronting electricians. We hope that Mr. Ferranti will see his way clear, now that his work at Deptford is finished, to pay a visit to the United States, where there are many electrical engineers who would be glad to benefit themselves by his experience.

INTERESTING news comes from Frankfort to the effect that the plant for the electrical transmission of 300 horse power between Lauffen and Frankfort has been completed. The installation has been handed over to the exhibition authorities, and will soon be in operation, if, indeed, it is not at this writing. It is said that 60 tons of copper wire were used, and that 1,600 pounds of oil were needed for the insulators. The German imperial chancellor, it is asserted, takes great interest in this exhibit, and he has ordered special reports to be made upon the tests with this method of power transmission. In all probability a special commission will be appointed by the chancellor under the presidency of Mr. von Helmholtz, who has requested Dr. Lowenherz, Dr. Lumbart and Dr. Brodhun to assist him. Prof. Dietrich of Stuttgart and Prof. Weber of Zurich are already busy with preparations for tests on behalf of the scientific committee appointed by the exhibition authorities.

IT will undoubtedly be some time before the question of the availability of electricity as against steam in long distance transportation is settled, and travelers by rail will probably have to make the best of smoke and cinders for years. But while the realization is far in the future the discussion waxes warm about us at the present day. H. S. Wynkoop presented one phase of the subject in the WESTERN ELECTRICIAN last week, and now Frank J. Sprague is out in an article in *The Forum* on "The Future of the Electric Railway." Mr. Sprague is nothing if not optimistic, and he takes a hopeful view of the situation. He calculates that, with the three-wire system, trains could be propelled by electricity by power furnished from stations 45½ miles apart, the electromotive force being 900 volts. Mr. Sprague thinks that the commercial question is now the sole arbiter of the problem and that the service he outlines will soon be practicable. Undoubtedly much remains to be accomplished before this end is attained, but Mr. Sprague is nevertheless entitled to thanks for his untiring efforts in behalf of electricity as a motive power on long distance railways.

THERE is a possibility that the subject of holding an electrical Congress during the World's Fair may be brought before the convention of the National Electric Light association at Montreal. It has been suggested that the association or the American Institute of Electrical Engineers assume direction of the Congress, but a moment's reflection will enable any one to realize that such action would be ill-advised. The suggestion comes with poor grace to say the least, inasmuch as the electrical department of the Exposition under whose auspices the Congress should be held, has been engaged in making arrangements for this event ever since the formation of the department. The work now well in hand and correspondence has been opened with representative electricians in Europe as well as this country, with a view of securing a representative gathering. The Electric Light association and the American Institute should, in common with all other electrical organizations, do everything in their power to make the Congress one of the great features of the programme of the electrical department, but should either of these organizations attempt to assume control of the affair, it would rightly be considered in the light of an intruder. If the electrical congress is to be successful, it must be held under the auspices of the electrical department, and must receive the united support of the electrical fraternity.

THE question of lighting the streets of Chicago was brought before the council last week but was temporarily dismissed on the statement from the office of the comptroller that there was no money at the disposal of the department for the purpose of extending the electric system. The question will have to be settled soon, however, and the city fathers may as well face the music at once. There has been some talk of having the boulevards leading to the Exposition grounds lighted at the expense of the World's Fair company, but such a proposition is preposterous. The city of Chicago can well afford to light her streets and place them in creditable condition, and the boulevards must be brilliantly illuminated before the Fair opens. Little has been done toward extending the city lighting system during the last year, though the municipality never needed lights more than at the present time. When the power stations were constructed it was hoped that they would soon be loaded to their full capacity. It is to be regretted that the work has been allowed to lag. All the time at the disposal of the city is now needed for perfecting public improvements, and further delay will mean that the time for opening the Exposition will find the city unprepared for the event.

THE budget of the World's Fair news presented this week is of more than usual interest. The report of Chief Barrett to the committee on electricity is an important statement of the condition of affairs in the department of electricity, showing exactly the progress that has thus far been made. Prof. Barrett frankly states that the department is behind in its work, but adds that this delay is occasioned by no fault of the department of electricity. He then explains how necessary it was to have detail plans of the building and how he was obliged to wait nearly five months after his application to the chief of construction for these drawings before he received them. In the absence of a satisfactory explanation of this delay, it is natural to assume that it was unnecessary, and that the backward condition of affairs in the electrical department is directly attributable to the construction department. The drawings furnished the department of electricity were copied from the originals in May and the contracts for the building were awarded about the first of June. This seems to strengthen the conclusion that the plans might have been furnished to the electrical department sooner than they were with but little effort.

One important suggestion in the report, subsequently indorsed by the executive committee of the directors, is that some representative of the department be sent abroad to interest European electrical manufacturers in the exhibition. So far there has been but little enthusiasm for the World's Fair on the part of foreign electricians. It is evident that these gentlemen have not yet made a satisfactory computation of the benefit to accrue to them by making a display at Chicago. Prof. Barrett, should he be sent to Europe, would be able to point out the advantages of exhibiting here, and could also disabuse the minds of the members of the electrical fraternity over the water of bugbears that have arisen through misconstructions of our laws. The idea is a good one, and we hope that the director-general and national commission will carry it into effect.

Mr. Butterworth's letter from Frankfort is interesting and entertaining, although, of course, it contains little that is new to electricians. The accomplished secretary is evidently mistaken, however, in assuming that the electrical installation at the World's Columbian Exposition may be smaller than that at Frankfort. We are quite sure that the electrical plant for Jackson Park, as now planned, will be of much greater capacity than the one that Mr. Butterworth has lately visited. This, however, is undoubtedly due to the fact that it is intended to make use of electrically transmitted power throughout the whole exposition, and not merely in the department of electricity. But the actual floor space for exhibition purposes is greater at the Frankfort electrical exhibition than in the corresponding department of the World's Fair. Prof. Barrett, as Mr. Butterworth suggests, could doubtless get many valuable hints from the management of the German exhibition.

New Short Railway Generator.

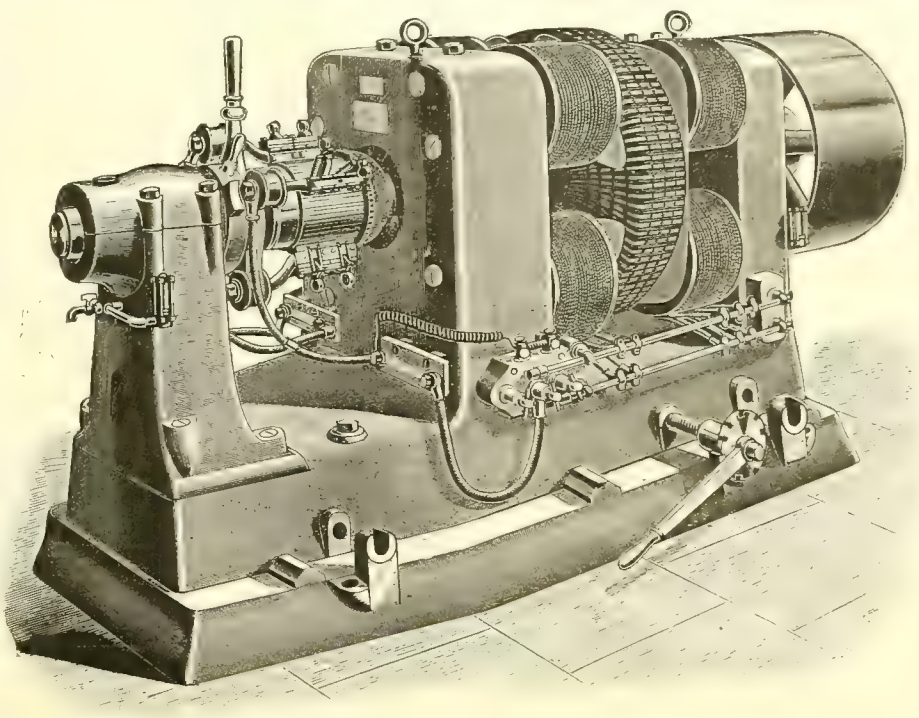
The Short Electric Railway company has just brought out the first of a series of railway dynamos. It is massive in form, simple in construetion, and marked by mechanical perfection and finish.

The illustration gives an excellent idea of the 150 horse power generator, capable of delivering 225 amperes at a pressure of 500 volts.

The field magnet frame is one of the largest single castings ever made for electric work. It weighs over 8,000 pounds, and nothing but the softest and purest iron is used in the melting pots.

To this heavy frame are bolted eight field magnets carrying the shunt and series coils and provided with pole pieces of peculiar shape arranged for side presentation to the armature, and so disposed as to make a powerful and almost perfectly uniform field of force within a magnetic gap of large diameter. Within this space revolves the armature, which is a distinctive feature of the machine.

Upon a shaft nine feet long by six inches in diameter is keyed a massive spider carrying the foundation ring upon which the armature is built. The armature core is formed of thin sheet iron wound spirally on the foundation ring and riveted firmly together. The outside circumference of the ring is somewhat wider than the remainder, and this portion is milled out into notches forming a modified Paccinotti ring. The coils are then wound on the core around the hollow ring, the method being such that each of the 200 coils is entirely exposed to the air on all sides, thus securing perfect ventilation. The projecting coils are, in fact, a sort of fan, and the current of air set in motion by the armature can be detected ten or fifteen feet away. As a consequence both armature and field run cool. The destruction of a single coil will not affect adjacent coils, and it is even possible, in cases of necessity, to run the machine for several days without rewinding a burned out coil. A burned out coil can be wound by any good mechanic at a cost of two or three dollars and a half day's labor. One of the most noteworthy features of the armature is its large diameter, 36 inches, which is also, by the way, the diameter of the pulley usually employed with high speed engines. The center of gravity is low and the machine runs smoothly and quietly.



NEW SHORT RAILWAY GENERATOR.

The armature shaft runs in a large self-centering and self oiling bearing, the lubrication being accomplished by rings carried by the shaft and drawing oil from a reservoir in the usual way. The height of the oil is indicated by the little sight glass on each box. At the commutator box is also found an adjustable ball bearing thrust collar containing several hundred balls, and so arranged as to carry the armature thrust in either direction without the slightest heating.

The commutator is 20 inches in diametor. It has 200 bars, so that the pressure between two adjacent bars is very small, avoiding sparking. There are four brushes, carried by two independent collars and sets of brush holders. In order to secure perfect adjustment at the neutral points multiple carbon brushes are used. The terminals of the field coils are carried to two heavy bars held securely in place on each side of the base of the machine. The plan of connection is simple and in plain sight, and the machines are so exactly duplicates of each other, that there is no necessity for complicated shunt spools or other adjusting devices, beyond the ordinary field rheostat box. The dynamo is placed on a heavy foundation plate and moves on V-shaped rails by means of an ordinary ratchet and screw. The electrical properties of the machine are quite as noteworthy as the mechanical. The magnets always work far below the saturation points, even at heavy overloads. The compounding has been so carefully calculated that the "pressure curve" is a straight line, passing from 500 volts at no load to 525 volts at full load, with speed maintained constant at 500 revolutions.

The Short company is building this type of generator in five sizes, 75, 100, 150, 300 and 500 horse power. The last named size will run about 100 revolutions and will be connected directly to a vertical compound engine, thus doing away with all belts and shafting. It is probable that even larger sizes will be built later on, to accommodate the heavy railway work which is immediately in prospect.

Minimum First Cost of Plant and Maximum Economy of Operation in the Electrical Transmission of Power.

By H. Ward Leonard.

A great deal has been and is being written and said about the condition governing the minimum first cost of a plant for the transmission of power by electricity, and also about the conditions governing the maximum economy of operation of such a plant, and some radical errors and false deductions have been made by those who are considered authorities upon this subject, so that it is not surprising that a somewhat erroneous idea at present exists in the mind of the electrical public upon this question.

As a rule, the theories and deductions developed by the various papers on this subject have given as a conclusion certain formulæ and laws, the application of which is practically impossible because of the necessity of using factors, the determination of the value of which is fully as great, if not greater, a problem than that, the solution of which is attempted. The result of this has been that vital errors in some of the most noteworthy papers on the subject have remained unnoticed by most readers, and even if others besides the writer have been familiar with these errors, they have probably felt, as he did, that no good purpose would be served by calling attention to them, as no practical application seemed to have been attempted of these formulæ or laws.

The recent publication, however, of a compilation entitled "Electric Transmission Hand-Book," by F. B Badt, makes it appear of importance to call attention to the serious errors contained therein, for Mr. Badt not only publishes all the original errors of the authorities he quotes, but he proceeds to carry the erroneous deductions further, and to give and solve practical problems in a manner such that the reader cannot but receive a clear and definite, although entirely incorrect, understanding of the subject. Furtherfore, some of the formulæ published by Mr. Badt, and for which the present writer is responsible, have been interpreted by means of erroneous laws laid down by F. J. Sprague, and consequently an entirely false meaning has been given to formulæ which, when properly interpreted, are entirely correct. In order to point out the errors mentioned in as clear a manner as possible, I shall first treat the subject generally and deduce the correct laws, and then point out the inconsistencies and inaccuracies of the conclusions, formulæ and laws given by Mr. Sprague and Mr. Badt.

Under date of August 16, 1886, the writer published a general formula for the determination of the size of conductors which should supply devices arranged in multiple arc, the form of which was as follows:

$$M = \frac{\text{K. W.} \times D \times 21{,}400}{V(E - V)} \qquad (1)$$

in which M = Circular millage of conductor.
K. W. = Kilo-watts at terminals of translating device.
D = Distance of transmission in feet.
E = E. M. F. at generator brushes.
V = Volts lost in transmission.

of the formula

$M =$ Now $K =$

Weight of

ing 3 per cent. for sag, etc.

Calling

copper at L cents per lb.

∴ The cost of the conductor per kilowatt at motor brushes is

Calling G the cost of dynamo electric machinery per

at brushes, and

at motor brushes, we have

where P = the percentage of loss in the conductor; this may also be expressed as follows:

Cost of generator

at motor brushes,

The cost of the generator and the bare copper for the conductor are the only two elements of the cost of a power transmission plant which it is necessary to consider in the determination of the condition of minimum first cost of plant, for the other factors of the cost of the plant, such as the development of the motive power, the labor of erecting the line, etc., are not proportionate to the power delivered, and hence should not be considered in the determination of the minimum conditions.

With any given initial electromotive force and distance, it is evident that the more volts we lose in the transmission, the less will be the cost of the conductor; but at the same time the cost of the generator per unit of power transmitted will be increased because of the additional generator capacity required to take care of the increased amount of energy lost in the conductors.

Hence it is evident that for any given initial electromotive force and distance there must be some particular loss in the conductor which will make the combined cost of the generator and conductor a minimum. We can determine the minimum value by placing the first differential of the expression indicating the sum of the costs of the generator and the conductor, equal to zero.

From 4 and 6 we have cost of generator

conductor =

Placing the first differential = 0 we have:

From which we get

This last equation expresses the relation existing under the conditions of minimum first cost of generator and conductor, and consequently of the entire plant.

Since

$$\frac{P}{(E - 2V)^2} = \frac{100}{(100 - 2P)^2}, \qquad (10)$$

we have from 9 and 10

Calling the cost of conductor in dollars per kilowatt

at motor brushes under condition of minimum first cost of plant, we have from 4 and 11

and

——the cost of generator in dollars per kilowatt at motor brushes under conditions of minimum first cost of plant, we have from (7) and (9)

$$\frac{K}{K.W.} = \frac{D^2 I (E - 2I)}{750 V^2 (E - I)} \quad \text{and} \quad (14)$$

$$\frac{L}{K.W.} = \frac{I^2 (100 - 2I)}{750 V^2 (100 - I)} \quad (15)$$

When the cost of dynamo is $33 per kilowatt at brushes ($G = 33$), per is 20 cents per lb., that is, when $L = 20$ we have, from 11,

$$\frac{123{,}750\ I}{100 - 2I} = \frac{5m}{K.W.} \quad (16)$$

From 3 we have

$$I = \frac{K.W.}{750\ V^2 L - W} \quad (17)$$

Thus if we have an initial electromotive force of 3,000 volts and a distance of 50,000 feet we must, in order to secure the minimum first cost of plant, operate with a loss of 30 per cent., and in such case the cost of generator = $47.15, and cost of conductor = $35.35 per kilowatt at motor brushesr so that, adding the cost of motor, $33 per kilowatt, we have total cost of generator, conductor and motor = $115.50. (*Example* 1.)

Similarly if we have a distance of 30,000 feet and 3,300 volts initial electromotive force we must operate at 20 per cent loss, and the total cost of generator, conductor and motor will be $88. (*Example* 2.)

Now, it by no means follows, because we are working with the minimum first cost of plant for a certain voltage and distance, that we are working at the highest economy, for, evidently, it is possible that if we work with a less percentage of loss in the case cited in Example 1, although our investment be increased thereby, the interest and depreciation on this increase of investment may be much less than the saving we would effect, due to the reduction of the loss of energy in the conductors. In other words, we must consider the variation in the interest and depreciation upon the investment, as well as the variation in the first cost is a question almost entirely for the investor to decide. We should be able to tell him not only the minimum first cost and its corresponding percentage of loss, but also the cost corresponding to any other loss than that demanded for the minimum cost.

In order to accomplish this I have designed Chart 2, which gives not only the cost of plant and necessary percentage of loss for any case of initial electromotive force, and distance under the conditions of minimum first cost, but it also gives the cost of plant for the given initial electromotive force and distance with any other percentage of loss.

Thus if, as in Example 1, the distance is 50,000 feet and the initial electromotive force 3,000 volts, we find, by examining the curve in which the initial electromotive force equals 60 volts per 1,000 feet, that the minimum first cost of plant will be realized when we operate at 30 per cent. loss, and that the corresponding cost of generator and conductor is $82.50, making the total cost of generator, conductor and motor $115.50.

We also learn that if, with the same initial electromotive force and distance, we operate at various losses, the cost of generator and canductor varies as follows:

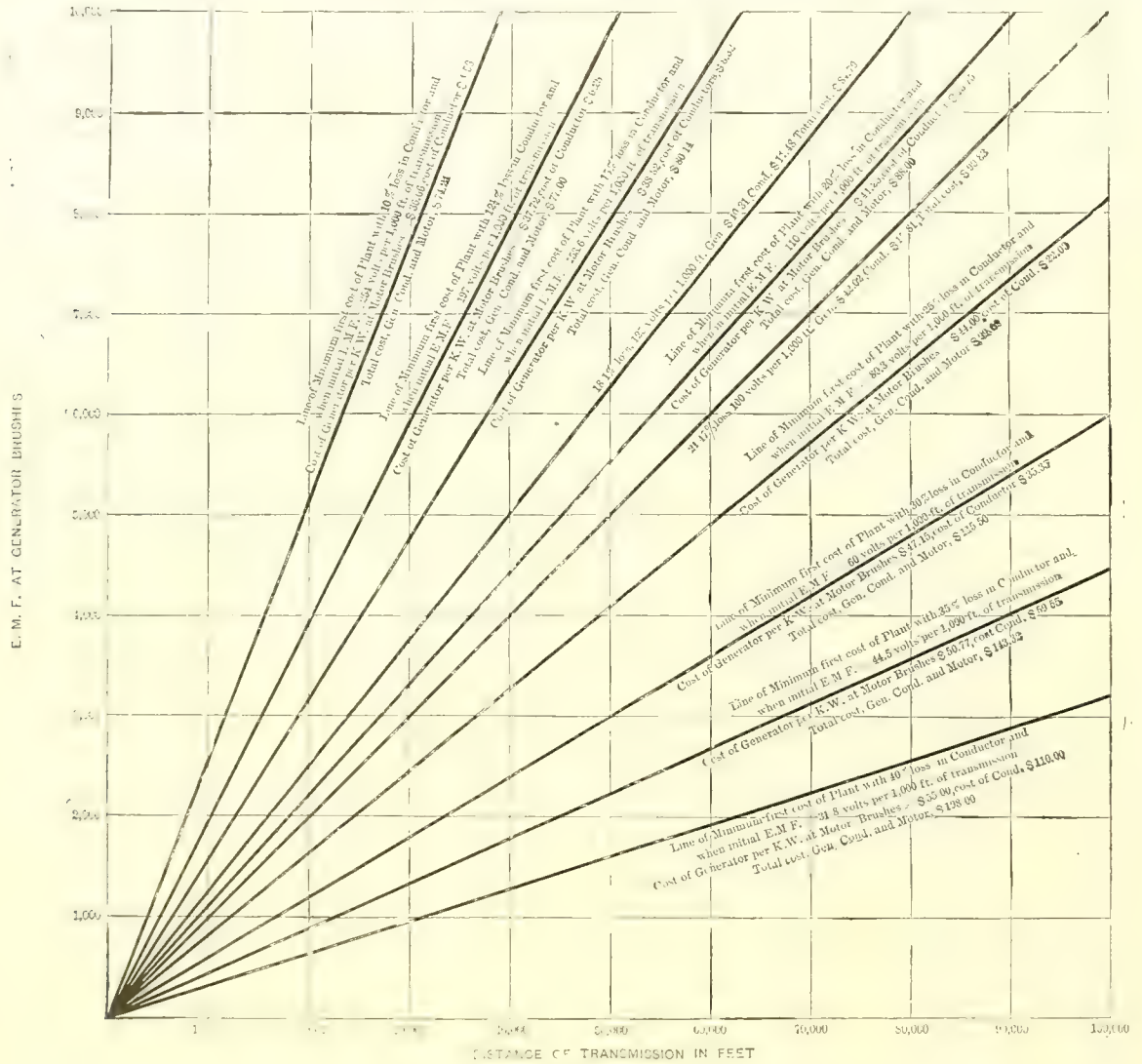


CHART NO. 1.

Showing Least Cost of Plant, and Varying Distance and Initial E. M. F.'s.

L = Distance of transmission in feet.
E = Initial E. M. F.
I = Per cent lost in transmission.
G = Cost of dynamos per K. W. at brushes
L = Cost of bare copper in cents, per lb.
K = Cost of generator per K. W. at motor brushes under condition of minimum first cost.
$\frac{K}{K.W.}$ = Cost of conductor per K. W. at motor brushes under conditions of minimum first cost.

Under conditions of minimum first cost of plant and when G = $33.00 and L = 20 cents,

$$I = \frac{123{,}750\ I^2}{100 - 2I}$$

$$\frac{K}{K.W.} = \frac{D^2 I (E - 2I)}{750 V^2 (E - I)} = \frac{D^2 I (100 - 2I)}{750 V^2 (100 - I)}$$

$$I = \frac{G E V}{100\ G I}$$

$$\frac{K}{K.W.} = \frac{E - I}{(E - 2I)} \cdot \frac{(100 - I)}{(100 - 2I)}$$

value of the energy wasted in the conductors, and must make the sum of the interest and depreciation on investment plus the value of the energy wasted in the conductor, a minimum, in order to operate at the maximum economy.

The interest on the investment can be definitely determined, but the value of the energy wasted it is very difficult to determine before the installation is made, for the reason that it is usually impossible to ascertain exactly how much of our total power will be transmitted in the future, [illegible] upon an unknown demand. In [illegible] of the power wasted [illegible] nothing in the beginning, when [illegible] at [illegible] per cent per [illegible] the energy wasted would probably be much greater.

[illegible] the question of the most economical

30 per cent. loss	$ 82 50
25 " "	83 20
20 " "	87 20
15 " "	95 60
10 " "	119 00

If, now, we have a superabundance of water power and are transmitting but a small fraction of it and the value of the energy wasted is consequently negligible, we would do better to operate at 30 per cent. loss and reduce our investment to a minimum. But if our power be limited and valuable so that the value of the energy wasted becomes an important consideration, we must then, for the highest economy, operate at such a loss in conductors that, although the cost of plant may not be a minimum, the sum of the interest and depreciation on such cost, plus the value of the energy wasted, will be a minimum.

It will be evident that when such sum is a minimum we will be operating at the highest economy. To determine

this minimum let us call I the rate of interest and depreciation on the investment, expressing I in per cent. Let U be the value of 1 kilowatt at the brushes of the motor, used as it will be used in practice. Then from 7 we have

Interest and depreciation on capital invested in generator and conductor per kilowatt at motor brushes. $\frac{I}{100}\left(\frac{I}{I-V}\right)\frac{D^2 L}{750\,V(E-V)}$ (18)

The value per kilowatt at motor brushes of the energy wasted in the conductor per annum will be $\frac{V\,I}{I-V}$ (19)

The sum of 18+19 is that portion of the cost of operating subject to variation by a variation in the loss in the line, and to learn when this is a minimum we will place the first differential of

18+19 = 0.

and calling A_E the cost of generator under conditions of maximum economy, we find,

$$A_E = \frac{[illegible]}{[illegible]} \quad (22)$$

From this relation we can plot curves which will enable us to quickly determine the conditions of maximum economy in practice. A set of such curves is shown in Chart 3.

Chart 3 is designed for transmissions in which 100 volts are allowed per 1 000 feet of transmission. Two sets of curves are plotted, one, marked X, assuming the combined interest and depreciation to be 10 per cent. per annum, and the other set assuming 15 per cent. for these items.

The value of the energy wasted is also plotted when the value of the energy is \$5, \$10, and \$20 respectively, per kilowatt at motor brushes; and then each of these latter curves is combined with each of the former, giving as a result the operating cost under six different conditions and indicating the maximum economy in each case, and also the variation in the expense due to any deviation from the loss corresponding to the maximum economy.

[illegible] can be readily and accurately determined. The value of [illegible] the fact that there is in use in this country a plant put in [illegible] of the following conditions prevails: Initial electro motive force, 2,200 volts; distance, 50,000 feet; loss in conductor, 50 per cent. The company which installed this plant even [illegible] exactly the same cost of generator and conductor they could have operated at 22 per cent. loss instead of 50 per cent. [illegible] cent., or they might have made a saving in their investment of \$10 per kilowatt delivered by conductor with an increase in power of 30 per cent., had they worked at 35 per cent. loss in conductor, which is that required for minimum first cost.

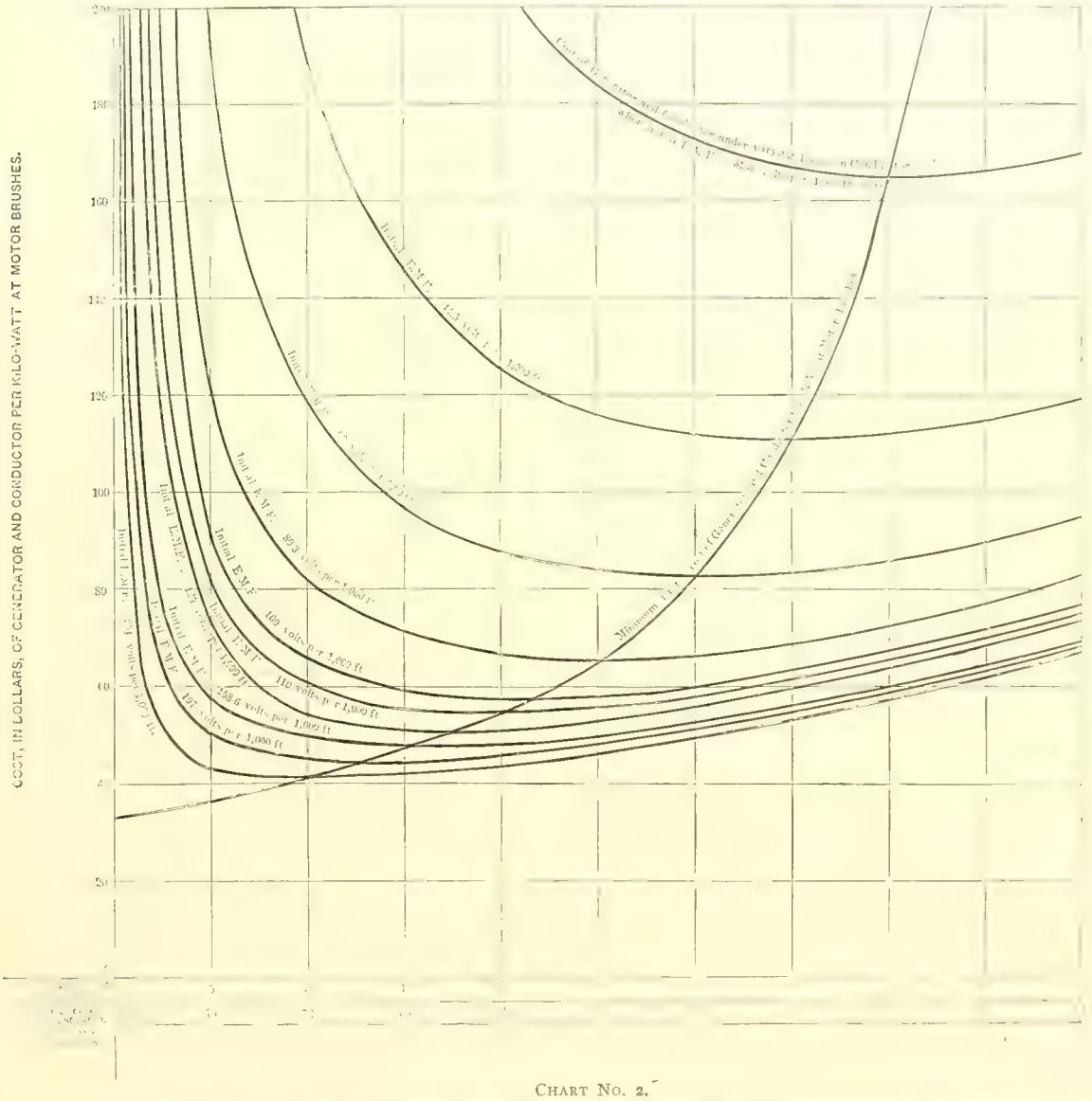


CHART No. 2.

Showing Minimum First Cost of Plant for any Distance and Initial E. M. F., with [illegible] in Conductor, and also Showing Variation in Such Cost [illegible] Necessary for Minimum First Cost.

D = Distance of transmission in feet.
E = Initial E. M. F.
V = Volts lost in transmission.
G = Cost of dynamos per $K.\ W.$ at brushes.
L = Cost of bare copper in cents, per lb.

$\frac{A_M}{K.\ W.}$ = Cost of generater per $K.\ W.$ at motor brushes under conditions of minimum first cost.

$\frac{B_M}{K.\ W.}$ = Cost of conductor per $K.\ W.$ at motor brushes under conditions of minimum first cost.

Cost (in dollars) of bare copper conductor per $K.\ W.$ at motor brushes [illegible] general case). $\frac{[illegible]}{750\,V(E-V)}$

Under conditions of minimum first cost of plant and when G = \$33.00 and L = 20 cents.

$$D = \frac{123{,}750\,V}{100-2\,V}$$

$$\frac{A_M}{K.\ W.} = \frac{D^2\,L\,(E-2\,V)}{750\,V\,(E-V)} = \frac{D^2\,L\,(100-2\,V)}{750\,V\,(100-V)}$$

$$\frac{B_M}{K.\ W.} = \frac{G\,E\,V}{(E-V)(E-2\,V)} = \frac{100\,V\,(100-2\,V)}{100\,V\,(100-2\,V)}$$

Doing this, we find that the equation expressing the condition of minimum operating expenses, or, in other words, maximum economy of operation, is

$$D = \frac{750\,L\,V^2\,(I\,G + 100\,U)}{I\,L\,(E-2\,V)} \quad (20)$$

From this calling B_E that the cost of conductor under conditions of maximum economy, we find

$$B_E = \frac{E\,V\,(I\,G + 100\,U)}{I\,(E-V)\,(E-2\,V)} \quad (21)$$

Example 3 For instance, suppose a transmission of 30 000 feet with 3,000 volts initial electromotive force, and suppose we value interest and depreciation at 15 per cent. per annum. Also, suppose our power to have a value at first of \$5 per kilowatt at generator brushes. By Charts 2 and 3 we find that the maximum economy will be realized when we operate at 17 per cent. loss, athough the minimum first cost of plant alone would be realized when we operate at 21.47 per cent.

If later on in this same plant the increasing scarcity of power makes its value \$20, instead of \$5 per kilowatt, we

The following examples will serve to give [illegible] the use of these curves:

[illegible] Suppose a proposed [illegible] feet, and that [illegible] volts is the [illegible] dynamos for, that is, [illegible] per [illegible] we learn that for minimum [illegible] per cent. in conductor. That the cost of bare copper conductor will be \$[illegible] per [illegible] \$37.72 total cost of generator [illegible] \$[illegible]

[illegible] If we have [illegible] initial electromotive force, we must [illegible]

cost lose 21½ per cent. The cost of conductor will be $15.81, that of generator, $42.02; and that of generator, conductor and motor $90.83.

Example 6. If, instead of 12½ per cent. loss, we wish to lose less, we find from Chart 2 that the cost of such generator and conductor will be as follows: 6,000 volts and 5 per cent., $50. 1,200 volts and 10 per cent., $43.25. Knowing the value of the power and the rate of interest and depreciation, we can determine which loss to operate at. It will be noticed that with 6,000 volts, we should, under no circumstances, lose more than 12½ per cent. in the conductor, as with greater losses not only the waste of energy increases, but also the cost of plant.

There are four factors in a transmission plant—the distance, the initial electromotive force, the percentage of loss, and the cost of plant, and knowing any three we can by chart 2 get the fourth. We have already considered the case of fixed distance initial electromotive force and per cent. of loss.

Suppose now, distance, loss, and cost be fixed and we want to determine the initial electromotive force necessary.

Example 7. Suppose distance as before 30,000 feet, and that the loss must not exceed 20 per cent. and that the cost

Example 8. Suppose distance 30,000 feet; initial electromotive force, 1,800 volts; capital to be invested, $100 per kilowatt for generator and conductor. Having 60 volts per 1 000 feet available, we find that we must operate at 14 per cent. loss Now, suppose investment, initial volts and permissible loss to be fixed, and we want to find the maximum possible distance of transmission.

Example 9. Suppose investment in generator and conductor fixed at $60; initial volts, 2,400; percentage of loss, 15 per cent. We find that the maximum distance corresponding is 24,000 feet.

Let us now briefly examine the formulæ and laws which have been referred to by Mr. Badt in his "Electric Transmission Hand Book." Mr. Badt quotes freely from a paper by F. J. Sprague, read before the Franklin Institute, which is printed in the *Journal of the Franklin Institute* for April, 1889 By careful examination of the paper it will be found that, after having assumed the value of the electromotive force at the motor brushes and the distance also being fixed, the error is made afterward of considering the results obtained as applicable to cases in which these values are variable. Hence it is not surprisnig that we find Mr. Sprague saying: "That is with fixed conditions

fore. Now, according to Mr. Sprague, the "minimum cost of plant is a function of the distance alone and is independent of the electromotive force used at the motor;" yet it will be evident that in "Example 10" the cost of the conductor is only one-quarter of that in Example 1 and the cost of the generator is the same; hence the total cost is much reduced. In other words, while, if we fix the initial electromotive force and distance, there is a definite loss in conductor at which we must operate in order to have a minimum first cost of plant, it by no means follows that if we fix the distance and percentage of loss there is a definite initial electromotive force which corresponds to a minimum first cost of plant; for, evidently, the higher we make the initial electro motive force meanwhile keeping the percentage of loss constant, the more we reduce the cost of plant, and there is no minimum value under these conditions.

Following out the same error, Mr. Sprague also lays down the following incorrect law: "With any fixed couple and commercial efficiency the cost of the wire should bear a definite and fixed ratio to the cost of the generating plant." It will be evident from what we have just seen regarding the preceding law, that this one is equally as incorrect and

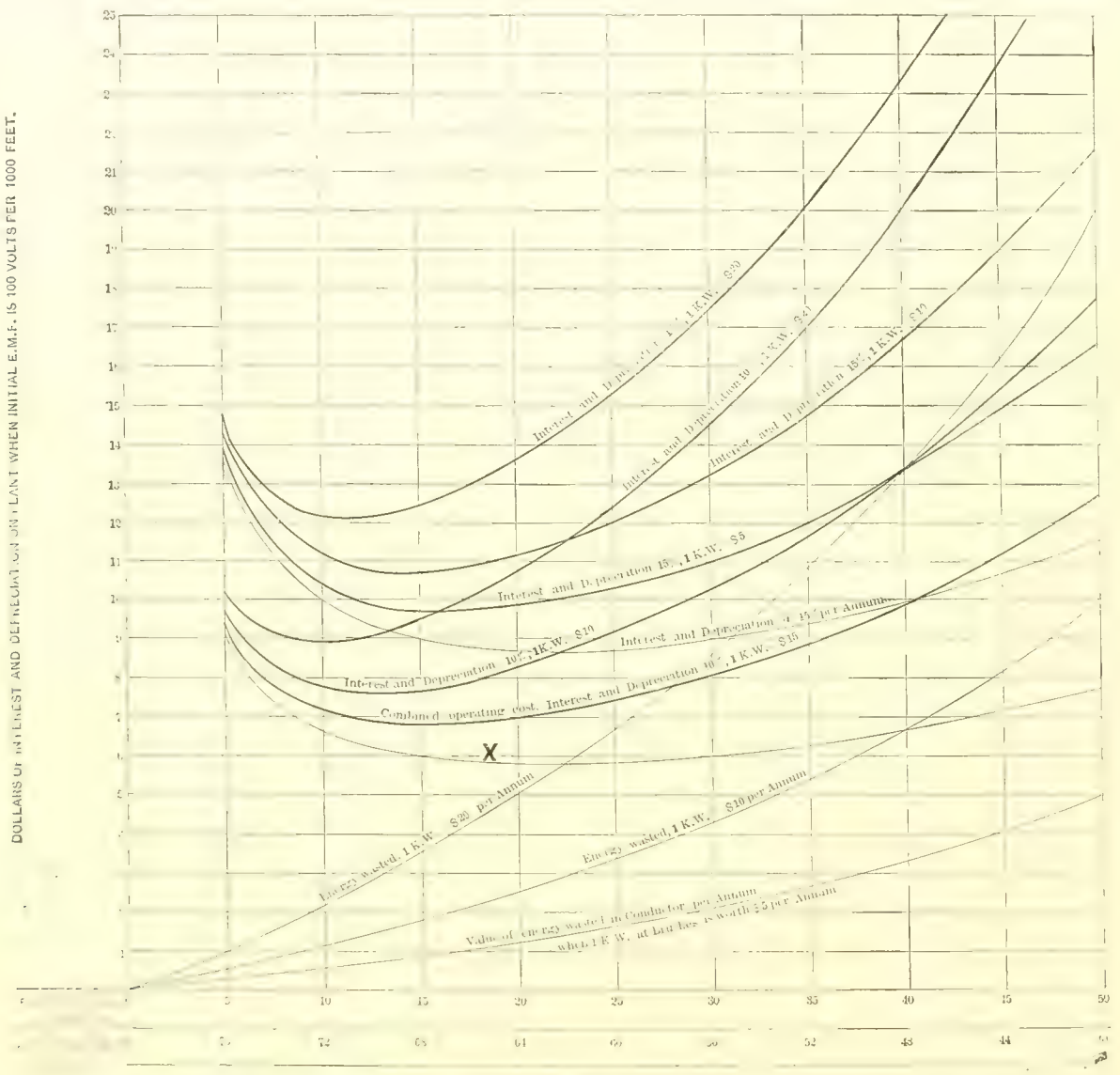


CHART NO. 3.

Showing Maximum Economy of Operation when 100 *Volts per* 1,000 *Feet are Used, and when Interest and Depreciation on Plant are* 10 *per cent. and* 15 *per cent., and when value of Power at Generator Brushes is* $5.00 $10.00, *and* $20.00 *per K. W. respectively.*

A = Cost of generator per $K.$ $W.$ at motor brushes under conditions of maximum economy of operation.
B = Cost of conductor per $K.$ $W.$ at motor brushes under conditions of maximum economy of operation
C = Cost of one pound of bare copper in cents per lb.
D = Distance of transmission in feet.
E = Initial E. M. F.
F = Per cent. of interest and depreciation.
G = Per cent. of loss.
H = Value per $K.$ $W.$ at brushes.
I = Per cent. of interest and depreciation on cost of generator and conductor.
K = Per cent. of loss at motor brushes.
U = Value of 1 $K.$ $W.$ per annum at brushes of motor as used.

$$D^2 = \frac{750\,I\,U\,(I\,G + 100\,U)}{I\,H\,(K - 2\,I)}$$

$$E = \frac{K\,U\,(I\,G + 100\,U)}{I\,(K - I)\,(K - 2\,I)}$$

$$A_V = \frac{D\,I\,(K - 2\,I)}{750\,I\,(K - I)} - \frac{100\,E\,I}{I\,(K - I)}$$

of cost and efficiency of apparatus the number of volts fall to get the minimum cost is a function of the distance alone and is independent of the electromotive force at the motor, a somewhat startling conclusion."

In the light of what we have already seen it will be evident that this statement is entirely incorrect. To make [illegible] suppose that with the same distance as in Example 1, that is, 50,000 feet, and the same efficiency of apparatus, that is, 30 per cent. loss in conductor, we use the initial electromotive force of 6,000 volts instead of 600, and consequently have an electromotive force at the end of 5,000 instead of 2 100 volts as before. Now, according to Mr. Sprague, the minimum cost of plant is a function of the distance alone and is independent of the electromotive force used at the motor;" yet it will be evident that in "Example 10" the cost of the conductor is only one-quarter of that in Example 1 and the cost of the generator is the same; hence the total cost is much reduced. In other words, while, if we fix the initial electromotive force and distance, there is a definite loss in conductor at which we must operate in order to have a minimum first cost of plant, it by no means follows that if we fix the distance and percentage of loss there is a definite initial electromotive force which corresponds to a minimum first cost of plant; for, evidently, the higher we make the initial electro motive force meanwhile keeping the percentage of loss constant, the more we reduce the cost of plant, and there is no minimum value under these conditions.

Following out the same error, Mr. Sprague also lays down the following incorrect law: "With any fixed couple and commercial efficiency the cost of the wire should bear a definite and fixed ratio to the cost of the generating plant." It will be evident from what we have just seen regarding the preceding law, that this one is equally as incorrect and formulæ 13 and 15 clearly indicate the impossibility of either of them being correct. In his paper Mr. Sprague gives several tables based upon these laws, and since this same error is maintained throughout, his results are entirely incorrect.

Mr. Badt has not only followed Mr. Sprague blindly, but has gone much further and has finally brought up with such remarkable results, that we find him, after stating some of these surprising conclusions, saying: "At the same time it seems somewhat startling that for the minimum cost of the installation under given conditions as mentioned before (i. e., fixed cost and efficiency of apparatus), the

volts lost in the conductor are dependent upon the distance alone."

It seems almost impossible that such a statement as this could be seriously made by an electrical engineer of practical experience, yet we find Mr. Badt giving examples and tables in which it is surprising that he did not see the absurdity of this statement. For instanee on page 28 he gives "*Example* 1. Distance, including 5 per cent. for sag, 7,000 feet; electromotive force at motor terminals, 500 volts. What must be the loss in the wire and electromotive force of generator for minimum cost of plant?"

Mr. Badt, by the aid of Mr. Sprague's laws, with his own additions, concludes that he must have 20 per cent. loss in conductor; hence 625 volts at the generator. Since the electromotive force at the motor is fixed, is it not evident that the higher the initial electromotive force and the less the percentage of loss in the line, the less will be cost of p ant? In other words, if the cost be a certain amount at 20 per cent loss in conductor with 625 volts initial, would it not be less with 10,000 volts initial and 1,000 volts loss in conductor or 10 per cent.

Similarly, "*Example* 2. Distance (including 5 per cent. for sag), 50,000 feet; we want to obtain at least 55 per cent. (efficiency from generator pulley to motor shaft). What is the voltage to be employed at motor and generator for minimum cost of plant?"

Mr. Badt finds that the electromotive force generator must be 2 711 and that of the motor 1,850, with a loss in conductor of 32.5 per cent. Is it not evident by using 5,482 volts at generator and 3,700 at motor the cost of generator is the same and the cost of condnctor only one-quarter what it was, and that there is no limit to the possible reduction in cost of the conductor, and hence no minimum value?

Mr. Badt, following the law that "the number of volts to get the minimum cost of plant is a function of the distance alone," finds that for every 1,000 feet we must lose 17.5 volts, and with fixed cost and efficiency of apparatus no other factors need be considered. This, certainly has the beauty of simplicity, and the tables built upon this conclusion leave little to be desired in this direction; but the transmitter of power who follows these tables will pay heavily for his faith in them.

Another law which Mr. Badt deduces, after making the assumption that $\frac{''/)}{V}$, the relation of distance to volts drop for minimum cost of plant, is a constant," appears on page 37, and is as follows: "For minimum cost of plant the total weight of the conductor per horse power delivered by the motor shaft remains the same at a certain percentage of loss in the conductor, regardless of the voltage of motor and the distance." This involves the same erroneous assumptions and is evidently absurd, as is another law on page 39: "For minimum cost of plant the weight of the conductor depends only on the percentage of loss in the conductor and the number of mechanical horse power delivered by the motor."

Mr. Badt, on page 42, quotes from Mr. Sprague another equally misleading rule, viz: "For minimum initial cost of plant, and assuming certain prices per horse power of motors, generators and power plants (all erected and ready for operation), and assuming a certain price per pound of copper (delivered at the poles), the total cost of plant, excluding line construction, is a constant for a certain efficiency of the electric system, no matter what the electromotive force of the motor and the distance may be." The absurdity of this is evident from what we have seen and is clearly shown by chart 2.

We now come to a consideration of the conditions governing the maximum economy of operation.

Sir William Thomson, in a paper entitled "The Economy of Metal Conductors of Electricity," read before the British Association in 1881, stated the following law: "The most economical area of conductor will be that for which the annual interest on capital equals the annual cost of energy wasted."

This law has been accepted ever since that date with slight modifications, but upon close and practical investigation it proves to be entirely incorrect as applied to maximum economy of operation of a plant, for the very surprising reason that no account whatever is taken of the fact that the cost of the generator per horse power transmitted will vary as the loss in the line varies.

Since the variation in the cost of the generator is the principal factor, it is not surprising that the correct minimum and that obtained from Thomson's law are widely different. In fact, it will frequently be impossible to apply Thomson's law, as it will frequently occur that the interest on the plant, even when at its minimum cost, will far exceed the value of the energy wasted; and, evidently, if we depart from the condition of minimum first cost with an endeavor to increase the loss and thereby to make the value of the increasing loss in the line finally equal the interest on the increased cost of plant, since we are increasing both items, we evidently are not approaching a minimum value. Chart 3 clearly shows that, frequently, the curve of interest and depreciation and the curve of value of energy wasted will never cross, and hence will never be equal under any conditions of loss.

Formulæ 21 and 22 clearly show that no such relation can exist, and chart 3 makes it evident graphically. *Example* 11: We find that by Sir William Thomson's law if the power is worth $20 per kilowatt at generator brushes, and the interest and depreciation are 10 per cent., we should work at 22½ per cent. loss; whereas, in reality, for the maximum economy we should work at 10 per cent.

We also find that in all the seven other cases indicated by the curves it is impossible to apply Thomson's law, as we cannot, by any means, make the interest on capital outlay and the value of energy wasted equal.

Both Kapp and Ayrton and Perry have discussed Thomson's law and made certain limitations and modifications, but have only complicated, and not corrected it. In Mr. Badt's present work he refers to Kapp's latest formulæ contained in a lecture of March 2, 1891, a copy of which lecture I have not as yet seen; hence the formulæ quoted by Mr. Badt cannot be commented on by me further than that Mr. Kapp's formulæ as given by Mr. Badt point to one fact which is very evident from formulæ 13 and 21, Chart 1, namely, that under no circumstances will it be economical to lose more than 50 per cent. in the conductor, for when $E = 2\ V$, we have $E - 2\ V = 0$, and an infinite cost of conductor as a resulting condition.

The Future of the Electric Railway.[1]

By Frank J. Sprague.

There are five kinds of railway service, each having its peculiarities and requiring special consideration. That which is of everyday importance is the street-surface system, operated by horses, cable, steam dummies, or electricity. Then there is local rapid transit, such as is given by the New York elevated railroads, the underground railway of London, and the viaduct road in Berlin. Next is surburban traffic, generally attempted on the same rails as through traffic, but now often confined to routes of its own, as on the suburban section of the Illinois Central at Chicago. There is also the through trunk-line express and way passenger service, and, finally, freight transportation. Given a medium capable of transmitting energy over great distances without time limitation, independent of the laws of gravity, sensible to neither heat nor cold, which while, like all other forces, subject to vagaries when improperly applied, is still capable of the most positive and instantaneous control, what are its possibilities in replacing the existing means of train propulsion? Its application to one class—the first mentioned—is now simply a matter of history, and displays an almost unprecedented development. That history is instructive.

Only twelve years have elapsed since the first crude suggestions of the practical workings of an electric railway were made, and four years ago a list of a dozen would comprise every such road in the world in even passably successful operation, whatever the method of application. The first large commercial electric railway was, after many difficulties and discouragements, opened in the early part of 1888 at Richmond, Va., and since that demonstration was made the industry has grown until there are now in operation or under contract, on the general lines laid down at Richmond, not less than 350 roads in the United States, Europe, Australia and Japan, requiring more than 4,000 cars and 7,000 motors, with about 2 600 miles of track, a daily mileage of nearly 500,000 miles, carrying nearly a billion passengers annually. Fully 10,000 people are employed on these roads, and there has never been an authenticated report of death on account of the electrical pressure used. Over $50,000,000 is invested in this industry in this country alone.

Of the three methods of application—the storage battery, the conduit, and the overhead wire—the last mentioned alone is an admitted success, and must, for many practical reasons, hold, for a long time at least, the supremacy. Without discussing the more or less sentimental objections against overhead wires, many of which utterly fail when a system is properly constructed, it is well briefly to note what the introduction of electric railways has accomplished.

While the horse, with extra help, has slowly and painfully pulled his car up a five per cent. grade, the electric motor has propelled a car of double the weight up grades of from 10 per cent. to 13 per cent., and at nearly double the speed. It has conquered combined curves and grades impossible for even the cable, and has increased the schedule speed with perfect safety from 50 per cent. to 100 per cent. Larger and more luxurious cars have been made possible, and the available carrying capacity for a given street space occupied has been increased by one-half. The loose jointed, light-weight, badly-laid tram center-bearing rail is giving way to a substantial, smooth, perfectly-built, and rigid road bed. Paving is no longer dependent upon the necessities of the car horse, and whatever is best outside of the rails can now be used between them. Malodorous stables have disappeared, and streets been made cleaner. Types of neat, strong iron poles, unknown to constructors of telegraph and telephone lines, have been developed.

The action of the motor as a dynamo is utilized to make the descent of the heaviest grades absolutely safe, even if the whole system exterior to the car should fail. This consideration alone was one of the most powerful in influencing the Italian government to allow the re-opening of the Fiesole line at Florence after an accident caused by a car jumping the track at a badly-laid curve prior to the adoption of this system of breaking.

The abolishment of the car stove is now possible, and on heavy grades the falling energy of the car is used through the motors not only to put a brake upon its own speed, but also to heat the car without taking energy from the central station, as on the Pleasant Valley road in Pittsburg.

The electric motor has halved the motor power expenses per car-mile, and has effected even greater reduction in the cost per ton-mile. It has reduced the charge per car-mile for conductors and drivers, by increasing the number of miles operated in a given time. Roads hitherto unproductive have become dividend earners, and the earnings of those already successful have been increased Roads are now possible where horse, steam, or cable service was impossible. Years have, in the aggregate, been saved to men for rest and recreation.

Such have been the results of the use of electricity on street railways. There is no room for doubt as to the permanence, in some form or other, of this application. Its future will solve the problem of intermural rapid transit. Until recently, three methods have existed for handling this character of traffic: the underground shallow brick tunnel of the Metropolitan District Railway of London, the masonry viaduct of the Berlin railway, and the elevated iron bridge of the Manhattan company of New York. Each has been operated by steam very much as

1. Abstract from an article in *The Forum*.

[redacted] very important limiting conditions in determining a solu- [redacted] motive power, route, and construction, and in considering the further ones of legal interference with construction [redacted] view.

[redacted] road, to be successful, must satisfy the demands of both the public and the capitalists, and it hardly need be said that the demands of the two are rarely entirely the same. Both want the road to follow as nearly as possible existing arteries of travel so as to be most easily accessible to the greatest number, because most convenient, and also to afford an already established patronage. To facilitate general travel, the road should make easy connections with crossing or intersecting lines of travel. It should require the least condemnation of property, avoid interference with the public right to the free occupation and use of the streets, should cause the least damage to existing systems of other corporations, and inflict the least loss upon private property during its construction or operation. It should, furthermore, provide high express and way speeds, to do which, independent way and express tracks are necessary.

The capitatist will demand quick construction, and, as nearly as may be, a reliable estimate of cost, which is made up of a number of elements, such as preparation of way, actual construction, temporary or permanent damage to property or business, building space occupied, rolling-stock equipment, and legal expenses.

There are five general plans to which the constructors can turn. They are, an elevated steel structure; a masonry viaduct; a shallow tunnel made by excavating the streets; a closed iron tunnel, tubular or square, containing one or more tracks; and a deep rock tunnel. In order that there may be the utmost latitude for consideration of these methods of construction, it is vital that a system of motive power be adopted which is unlimited in its application and can be as freely used in a closed tunnel as on an open viaduct. Such an agent, and the only one possessing the necessary flexibility, is electricity. Hence, if it be once proven that its use is capable of such development as to be able effectively to move traffic of a large system, there is at once opened to the promoter of rapid-transit schemes possibilities not dreamed of a short time ago.

Let us turn now to the needs of the suburban travelers, who are slaves to time tables because necessity compels steam service to be conducted on present lines. Long trains hauled by high-power engines are dispatched at irregular intervals. They stand in the station, after being made up, from ten to twenty minutes. The passengers crowd the waiting rooms long before the time of departure, and often elbow and hustle each other in the strife for seats. This condition of affairs is a necessity in steam traction, because no other method of operation would be economical, but this is not the kind of service best suited for suburban travel, which ought more nearly to approach that of street-car service, of course at much higher speed; that is, the time interval of train dispatching should approximate to, or be a portion of, the average time of transit, instead of being several times that period, as in a large proportion of the present steam suburban services, especially such as is given the people of New York. While this time interval must be necessarily influenced by the time of day, that is, by the aggregate travel, this latter element should be principally important in determining the size of the train unit. I now speak, of course, of such suburban transit as would exist where the city and suburban interests are intimately connected.

To illustrate, suppose the suburban line be 20 miles long and to have a number of stations. The average distance of travel would be, say, 10 miles, and at 30 miles an hour the average time of transit for each passenger would be 20 minutes, with a maximum of 40 minutes. Suppose single cars to be run every 20 minutes instead of trains of four cars every 80 minutes. The former service would be far more satisfactory, even if the latter should run at a rate of 40 miles an hour, which would require, of course, more power. It is a well-known fact that the actual wear and tear in making a stop on an ordinary train often exceeds in value the tariff paid by the passengers for whom the stop is made.

Another consideration favors this method of train-dispatching. In the electric system the load would be much more evenly distributed, and the economy of power supply materially increased; that is, the coal expenditure per car-mile would be smallest. Such a system of small unit operation is impossible in steam practice, because there, necessarily, the motor is a self-contained unit, and must be large enough to haul the largest combination made up behind it, so that the operation of a number of locomotives in this way offers no economical possibilities. The flexibility, however, of electric application at once removes this objection, because the electric motor may be mounted as an independent unit to haul [redacted] may have its own motor equipment. This is, in fact, practically the method of operation in street-car service, except that the cars are generally equipped with motors which can easily haul an additional car.

There is another matter to be thought of in suburban traffic. Few people are such ardent travelers as to find pleasure in suburban transit as at present conducted. The smoke, cinders, noise, and dust all combine to make such travel anything but agreeable. Smoke and cinders affect all cars, but dust caused by the movement of a train affects the rear cars more than the forward ones. With the

electric motor the troubles due to coal consumption would disappear, and with small units that due to road dust would vanish also. These considerations make traveling by a high-speed electric car exhilarating rather than fatiguing, and hence suburban life and travel will become [illegible] more acceptable. This class of traffic should be conducted on exclusive rails, not on those used for through trunk passenger or freight traffic. Such an independent line is illustrated by the suburban service of the Illinois Central Railroad at Chicago, where about 74 trains are operated each way in 18 hours.

We next come to an inquiry as to whether electricity will ever be used on trunk lines for heavy passenger or freight traffic. My answer is: Probably not according to our present notions of trunk-line transportation, and not by the present method of train dispatching; but, with these qualifications, I expect to see rapid transit over long distances for certain classes of service. Railway engineers are constantly meeting with a demand for more rapid and luxurious methods of transportation and greater frequency of train dispatching. It is but fair to say that every effort which executive ability and reasonable financial expenditure warrant, is made to meet this demand, and the spirit of competition is an active factor.

But the most experienced railroad men feel that the possibilities of steam practice are nearly reached—much greater speed is not practicable. A maximum of 90 miles an hour, with a running speed of 60 to 70, is all that can be hoped for under the very best conditions which can be provided.

With respect to electric motors, the question is not whether a motor of sufficient capacity to pull a heavy train can be built, but rather how economically electricity can be supplied to such a motor; and this involves a question of electrical pressure. While every electrical engineer hopes to see the time when electricity will be produced directly from coal without the intervention of engines and dynamos, we are now limited to existing methods of creating the supply, and generally we have to depend upon the steam engine. It is, then, necessary for us to consider the possibilities of the amplification and development of present practice, and for this purpose I will consider the possibility of an express service between New Jersey and Philadelphia.

We will assume that a through express track is constructed, by the most direct route possible between the principal localities, with the fewest grades and easiest curves. The method of supply for such a road would be by a rod carried above the car, the return circuit being made by the rails and the earth. This system would be supplied from one or more central stations equipped with high-class triple-expansion engines, driving multipolar dynamos directly coupled. Such a station could be operated, with a fairly-uniform load, with about 1.6 pounds of coal per horse-power hour. What concerns the electrical engineer is whether the cost of copper, the electromotive force required on the line, and the number of stations necessary, would be prohibitory.

As regards the electric potential, I think it fair to say that whatever pressure is demanded in the interest of economy will be used. Means will be found, consisting mainly in care of construction, which will make such use for the purposes intended entirely safe and proper. We have in this manner to face the same difficulties that are met in the use of high steam pressure in the locomotive or on board steamships. To accomplish the larger engineering feats necessary to meet the demands of commerce, we should be governed more by belief in our power to subordinate a good servant to our will than by fear of its vagaries in case it should be allowed to become a master.

During a period of about 13 hours, 21 regular trains leave the Jersey City station on the Pennsylvania road to run through to Philadelphia 12 of these making but one or two stops. In addition to the above, there are a number of local trains stopping at way stations. Taking the through trains only, and allowing an average of say five cars to a train, there would be, in the 13 hours, about 105 through cars dispatched from Jersey City, or at the rate of two cars every quarter of an hour.

For the practical purpose of this paper we will consider that the road is level—as it is—and we will increase the number of cars dispatched by one-half, so that two car units are sent out every ten minutes on a perfect block system, for which the electric application offers special advantages. Let the run be made to Philadelphia, a distance of 90 miles at an average rate of 60 miles an hour. Slight grades would make little difference in the operation. For the overhead conductor let us take a solid copper rod, one inch in diameter, over each track, or a smaller rod if desired (the main conductors making up [illegible] of equivalent capacity. This arbitrary size is taken for convenience in the present calcu- [illegible]

[illegible] company has a line of long distance wires running from New York to Boston, a [illegible] aggregate area, technically speaking of 500,000 circular mils, and the total [illegible] larger engineering problem which we have now under con- [illegible]

center of the system, would be about 3,600 volts at the points farthest from the station, and at the station itself about one ninth higher. This is a high electrical pressure. Can we handle it on work of this character? In time, I think so, but perhaps not yet, nor is there any necessity of doing so, because by a simple process founded on known electrical laws, the electrical pressure with which we have to deal can be materially lessened. The laws which I refer to may be expressed more fully as follows:

The weight of copper necessary to transmit a given amount of power with a fixed loss will vary inversely as the square of the electrical pressure used.

The distance over which it can be transmitted with a given weight of conductor, will vary directly as this pressure.

The distance over which it can be transmitted with a conductor of a given cross section will vary directly as the square of the pressure.

The weight of copper necessary where the supplying station is in the center of the system is only one quarter that required if the station is at one end.

The weight of copper will also vary inversely as the square of the number of supplying stations properly spaced.

From the above we see that the electrical pressure required will vary inversely as the number of stations. By arranging our machinery so that, instead of making both overhead conductors of like potential (that is, forming one side of the circuit, while the track furnishes the other) we arrange them so as to form a three-wire circuit (that is, make the two overhead conductors the positive and negative terminals of dynamos coupled in series of two, with the track a compensating conductor, negative to one overhead line and positive to the other) we halve the potential which exists between the overhead conductor and track, and by applying the laws which I have enunciated, we would get a table as follows:

Stations		Motor Potential	
Number	Miles Apart.	2-Wire	3-Wire.
1		3516	1808
2	45	1808	904
3	30	1205	603
4	22½	904	452

It will be noticed that in the last example given there are four stations, 22½ miles apart, and the three-wire system with compensating rail is used. The electrical pressure is that which at present distinguishes our street service, but this is far lower than it is necessary for work of this kind to go, and we could easily assume the second instance given—that of two stations 45 miles apart—requiring under the three-wire system about 900 volts. It will be noticed that I have made conditions of this operation, distributed work and the dispatching of units at short intervals. These conditions are absolutely necessary if we are to consider long distance transportation by electricity. They are such as characterize in some degree elevated railroad operation, and should hold also in suburban traffic.

The operation, from a fixed station, of large units over long distances, at irregular and long intervals, is not feasible, although possible; and after all, the commercial question is the arbiter.

Such a service as I have outlined is not only possible, but will soon be practicable, and it would revolutionize travel.

CORRESPONDENCE.

New York Notes.

NEW YORK, Aug. 29—During the past week the public has been startled by the Park place fire, which occurred last Saturday, and at which so many lives were lost. Thousands have visted the scene of the disaster daily, and public indignation has been raised to such a high pitch that no pains will be spared by the district attorney and assistants in discovering who is really to be blamed for the awful catastrophe. The official report of "sixty-one lives lost" will no doubt cause the adoption of measures to prevent similar calamities in the future and also be the means of forcing immediate investigation in regard to many over-weighted buildings.

The work of fitting the navy yard with an electric lighting plant is being pushed rapidly. The wiring is well under way, and the boilers to be used for the steam plant are being put into position. It is expected that the plant will be ready for use by the middle of October.

Young Henry Frank, nineteen years old, has just taken his first lesson in electricity with experience as his principal teacher. One night last week he gained an entrance to the house of Mrs. J. W. Wright on Nineteenth street by letting himself down into the cellar through the coal-hole. But before going away to the country Mrs. Wright had had the house connected with the American District Telegraph company's office, and the young burglar came in contact with the wires while moving about the cellar. The night operator at the office responded immediately to the alarm, and placed the culprit in charge of the police.

The attention of the Society for the Prevention of Cruelty to Animals has been attracted by the treatment to [illegible] on the Orange line of horse cars are subjected. After the cars turn from Broad street into Orange a long hill is encountered, and the open cars, loaded with passengers, are often drawn up the incline by single teams. [illegible] cheaper and better, it seems strange that any corporation should use horseflesh so mercilessly.

At Sandy Hook last Thursday afternoon the second severe test of the new 12 inch steel rifle was made. The trial was the first public one, and a large party of army officers from Fort Wadsworth, Fort Hamilton and Governor's Island were in attendance. The object was to test the quality of American made powder, but the experiments, as far as velocity is concerned, were unsatisfactory. This is a fault, however, which can be remedied. Firing was begun at two o'clock, and the big gun, mounted on a steel carriage which stands on a concrete foundation, received a 1,000 pounds projectile. The powder is compressed in prisms with a hole in the center, and 3,269 of these constituted the first charge. When the breech plug had been screwed in, wires were attached to two smaller wires, which were connected with a small fire spitting cap in the breech of the gun and which protruded through the breech plate. When everything was ready the sergeant in charge pressed a button and made an electric contact. In its flight the projectile passed through two wire frames 150 feet apart. These frames were connected by electricity with the office, where, by means of the Boulanger chronograph, the velocity was measured. In passing through the wire screens the projectile broke the circuits and two iron rods dropped from the magnets supporting them. These rods were marked in their fall, and from these marks the velocity of the projectile on the first round was computed to be 1,473 feet per second. The highest velocity obtained was 1,865 feet per second, the point desired being 1,975. Various trials will be had until the maximum speed is attained.

A representative of the WESTERN ELECTRICIAN called at the offices of the Rapid Transit Commission the other afternoon, but was unable to find out anything further in regard to the doings of the commission. The attendants in charge, when asked whether there had been a meeting of the commission or not, laughed at the idea. It seems about time that the rapid transit question in New York city should come to an issue. The *New York Times*, in a recent editorial, says: "Considering the possibilities of the deep tunnel plan, its absolute immunity from all these objections and drawbacks, the prospect that it would meet with no serious opposition, the absolute demonstration of its success elsewhere, and certain incidental advantages of its own which commend it, we can only wonder at the commission's change of purpose, and await with no little anxiety the promised details and arguments that are to justify it. At present it looks as though the success of the whole scheme of rapid transit, for which we have waited so long, might be at stake in the decision of this question."

F. T.

Pittsburg, Pa.

PITTSBURG, August 29.—H. McL. Harding, general manager of the railroad department of the Westinghouse Electric & Manufacturing company, has gone on a vacation.

No meeting of the Westinghouse Electric & Manufacturing company was considered necessary last week. An official of the company said: "The work of reorganizing the company is going along smoothly. The directors can do and are doing all that is necessary to complete the plans, and there is nothing for the stockholders' meeting to do."

Preparations for the next convention of the National Street Railway association are rapidly progressing and the arrangements for entertaining the guests in this city are gradually assuming a more definite shape. The local committee at the head of this part of the convention is determined to entertain the guests as pleasantly as possible, and to make this convention one of the most memorable ones in the history of the organization.

B. L. W.

PERSONAL.

F. E. Degenhardt has returned to Chicago after a pleasant vacation at Lake Minnetonka, Minn.

D. B. Dean of the Electric Merchandise company, Chicago, retured from an eastern trip last week.

Albert Fisher has been appointed agent for the Ball Engine company of Erie, Pa., with headquarters at room 506, The Rookery, Chicago.

Geo. H. Meeker, General western manager for the New York Insulated Wire company, has recently returned from a trip through the Northwest. He reports business flourishing.

W. R. Mason, general manager of the Electric Merchandise company, has returned from an enjoyable vacation spent at Kankakee, Ill. Like many other Chicagoans, Mr. Mason is greatly pleased with this pleasant resort.

George P. Nichols, manager of the stationary motor department of the Chicago office of the Thomson-Houston company, has returned from an eastern trip that included Boston and other cities. He reports signs of an increased activity in electrical circles in the East.

NEW INCORPORATIONS.

Paxton Electric company, Paxton, Ill.; capital stock, $24,000; furnishing electric light and power. Cook & White, Paxton, Ill.

East Side Land company, Goshen, Va., capital stock, $25,000, real estate, mine and quarry building, laying out streets, etc., gas, electric and waterworks, street railways, etc.

Jenney Star Electric company, Portland, Maine, capital stock, $50,000, to manufacture and deal in electric motors, dynamos, batteries and machinery; W. M. Rayson, Portland, Maine.

People's Electric Street Railway company, Erie, Pa.; capital stock, $50,000; constructing and operating a street railway from Bridgewater to Economy township, Beaver Co., Daniel H. Stone, Beaver, Pa.

Circleville Light & Power company, Circleville Ohio; capital stock, $ 00,000; manufacturing gas, coal tar, ammoniacal liquor, coke, producing electricity, manufacturing ice, etc.; C. J. Delaplane, Circleville, Ohio.

Electrical Engineering company, Chicago, Ill.; capital stock, $50,000; steam and electrical construction and dealing in steam and electrical machinery, appliances, material, and supplies; Page & Pearson, 85 Dearborn street, Chicago, Ill.

Red Oak Electric company, Red Oak, Iowa; capital stock, $20 000; to construct, operate and maintain the necessary structures, fixtures and apparatus to supply electricity for light and other use; F. H. Hutchinson, Red Oak, Iowa.

Piedmont Spring Water & Power company, Oakland, Cal.; capital stock, $1,000,000; to operate a complete system of waterworks within the county of Alameda, and to construct and operate machinery for generating electricity and the operating of electric motors; W. J. Dingee, Oakland, Cal.

Northwestern Street Railway company, Chicago, Ill.; capital stock, $25,000; to construct, maintain and operate street railways in the town of Leyden, Proviso, Cicero and Main, and the city of Chicago, to be operated by any motive power except steam locomotives; Pearson & Stookey, 75 Metropolitan block, Chicago, Ill.

West & South Town's Horse Railway company, Chicago, Ill.; capital stock, $100,000; the construction and operation of horse, electric, cable or dummy railroads on any or all such streets and alleys of Chicago as may be granted by the city council and particularly on Twenty-second street from Lawndale to Lake Michigan; Bonney Bros., 511 Tacoma Building, Chicago, Ill.

ELECTRIC LIGHT.

The capacity of the Cordele, Ga., electric light plant is to be doubled.

The Del Rio, Tex., Electric Light company's plant is completed and in operation.

The contract for the new electric light plant at Rockdale, Tex., has been let to M. P. Kelley.

It is reported that a stock company will be organized in Jonesboro, Ark., to operate an electric light plant.

An electric light plant at Huntsville, Tex., is among the possibilities. W. S. Gibbs and C. G. Barrett are contemplating such an investment.

The Wagniere Electric & Manufacturing company, of Los Angeles, Cal., has been incorporated with a capital stock of $250,000 to manufacture the Wagniere arc lamp and electrical appliances.

The preparations for the grand autumnal festivities at St Louis include brilliant illumination, numerous arches lighted by thousands of incandescent lamps in colored globes, and other electrical effects.

Specifications for an electric lighting plant for Christiania, Norway, have been issued in several languages by the city authorities. The station is to have 24,000 lamps on the low pressure, direct current three-wire system.

Alexander Mitchell and others have incorporated the Edison Electric Power, Light & Heat company at Wheeling, W. Va., with a capital stock of $100,000. Its purposes are to furnish light, heat and power for commercial use in Wheeling.

The dynamo room of the electric light plant of the Pawtucket, R. I., Gas company will be 60 feet by 150 feet, the engine room 58 feet by 78 feet and the boiler room 60 feet by 60 feet. The side walls will be of brick, with iron roof covered with corrugated iron.

At present the electric street lighting of Chicago extends no farther south than Twenty-second street. Alderman Madden wants to see the entire boulevard system, from the heart of the city to Jackson Park, lighted by electricity, and not only that, but all the parallel traffic streets for many blocks in either direction illuminated in the same way.

Attention was attracted in Rochester, N. Y., a few days ago by the little steamer Cygnet, which was lying in the Erie canal. Although only 17 feet long, the little vessel has an electric light plant of its own. The engine is a high pressure, direct acting machine mounted on top of the boat engine, and belted to an Edison dynamo which is fixed to brackets over the boiler.

A writer in the London *Times* discusses the disadvantages of using search lights on war vessels. He suggests that steady beams of light from points on shore or small craft be directed continually across the mouth of anchorage so that any craft entering must cross the beams and so reveal herself. He adds: "The only time [illegible] opinion, when a threatened battleship should use her light is when she has already clearly discovered an approaching enemy. Then let her flash it full into his eyes. It will blind and puzzle him, and, facing on [illegible] paintwork, it will give her a capital target for gun fire. Splendid, when thus used, was the effect of the light upon torpedo boat No. 25, in Lucy Bay, on the morning of July 27th. From the moment when the beam struck the boat she was as good as destroyed, [illegible] clearly that only very bad gunners could have missed her. The light ought not to be worked from any point very near the guns which are to be fired. The ideal position is as far as possible below them. It is, all things considered, a mistake to mount lights on bridges and chart-houses; they cannot be too close to the surface of the water." The same writer calls attention to the fact that when an ironclad, believing that torpedo boats are near her, but seeing none of them, begins flashing her search lights in order to discover the enemy, she greatly helps her foe, who thenceforward knows exactly where and how she lies, and to what quarter her uneasy suspicions are directed.

ELECTRIC RAILWAYS.

C. W. Batsell, owner of the Sherman City, Tex., railway, contemplates changing to the electric system.

The electric street railway system of Spokane, Wash., has been completed at the cost of over a million dollars.

The Edison people have offered to build the proposed electric road at Warrentown, O., and equip three cars for $10,000.

The Cincinnati Street Railway company will extend its electric road to Havendale as soon as possible. It will soon be completed as far as Shillito.

The street car company of Lancaster, O., has decided to try electricity. For this purpose $5 000 has been subscribed toward the $30,000 necessary.

The G street electric line of Portland, Ore., is being extended from Fifth street east to the city limits. An extension will also be made to Woodlawn, contracts having been let.

A charter has been issued to the Gettysburg Electric Railway company, its purpose being to render that historical battlefield more easy of access by visitors. The company has $100,000 capital.

When the Columbus and Orinoco, Ohio, electric lines were started, W. M. Graves, a prominent capitalist, paid the first fare by depositing $250 in gold in the box, as a voluntary bonus to the road.

It is stated that a suburban railroad extending through part of West Knoxville, Tenn., to the property of the New England Investment company will be built. The motive power is to be either electricity or dummies.

The London Electrical Tramway company, capitalized at £150,000, has been formed with the object of buying up the tramways of the North London Tramway company, and to operate, extend and develop the same electrically.

The Granite City Land & Improvement company contemplates building a railroad from Mt. Airy, N. C., to the Mt. Airy White Sulphur Spring, a distance of about four miles. The line is to be operated by either electricity or dummy engines.

Electric cars are now bowling along the classic highways of Old Rome, a short line between the Place del Popolo and the Ponte Mollo having just been completed and put in operation. There are now three cars, each carrying a 15 horse power motor.

Dr. John Law, Col. R. E. Goodall and a syndicate of New York capitalists will build an electric railway seven miles long between Leadville and Evergreen Lakes, Colo. Water power conveyed through eight miles of flumes will be used to run the power station.

The Jersey City & Bergen Railroad company has been operating a portion of its lines by electricity for some time but owing to the refusal of local authorities to grant a franchise for the entire system, the residents of the town will probably be obliged to forego rapid transit.

A movement is on foot to build an electric road to connect the Massachusetts town of Whitinsville with Manchauga, East Douglas, Glenwoods, Uxbridge and perhaps Mellville. The road between Manchauga and East Douglas is practically assured, $50,000 having already been subscribed.

The newly incorporated Roland Avenue Electric Railway company of Baltimore will build an electric railroad from the property of the Roland Park company to a connection with a railway reaching the center of the city. The company has applied to the Baltimore county commissioners for a franchise.

The directors of the Liverpool Overhead Railway company have entered into contract with the Electric Construction corporation of London, for the equipment and working of the line by electricity. Two miles of the line have been completed within the last six months, and the railway will probably be opened next spring.

A press dispatch from New York states that R. C. Crawford, "assistant general manager of the West Division Street Railway company, the largest surface line in Chicago, and probably the biggest system under one management in the United States," was in New York last week examining the Broadway cable plant. The dispatch concludes: "Mr. Crawford goes from here to [illegible] from the heart of the manufacturing center of Reading [illegible]

ELECTRIC MINING.

The Pleasant [illegible] Utah has for [illegible] Utah, used [illegible] The drum was made by the Lidgerwood Manufacturing company of New York, and the electric motor and the electrical equipment furnished by the Thomson-Van Depoele Electric Mining company, together with all the [illegible] teen large pit cars run out of the mine by gravity, dragging the tail rope after them. The empty trains are hauled back into the mine by the haulage drum located nearly 2,000 feet feet from the chute in the interior of the mine. The operation of this apparatus has proved so satisfactory and so economical that [illegible] ordered two more electric hoists of more powerful type.

TELEGRAPH.

The new telegraph cable between England and Germany has been completed. It is 273 miles long, and the cost is estimated at $475,000.

The German government has decided to establish telegraph lines along the whole of the German East African coast. Three officials have left Berlin for Bagamoya, where they will, immediately after their arrival, commence the preliminary work in connection with the new lines. Bagamoya and Saadani will be first connected by wire.

Telegraphic communication has now been extended to Jelebu, one of the "protected states" in the Malay Peninsula, and telegraph offices have been opened in the towns of Jelebu and Kwala Kwalang. It is stated that the service in the Malay native states is very uncertain, the operators being mostly half-breeds, with very elementary ideas as to good work. As a rule it is safer to telegraph to Singapore or Penang, and have the message sent on thence by mail.

Rear-Admiral Belknap's survey of parts of the Pacific, preparatory to the laying of the proposed trans-Pacific telegraph cable, indicates that great difficulties will be encountered. His soundings show the existence of a trough or basin of extraordinary depth and extent along the east coast of Japan and the Kurile Islands, and under the Kuro Siwo, or Japan or Black Stream. The basin exceeds any similar depression yet found in any other region of the great oceans. In a run of 30 miles after leaving the coast of Japan the waters deepened more than 1,800 fathoms, and upon the next cast of the lead the wire broke after 4,643 fathoms had been run out without bottom having been reached. Thermometers specially constructed for deep-sea sounding were wrecked by the unprecedented pressures.

TELEPHONE.

A recent report of the Winnipeg telephone exchange shows that there are now 750 subscribers in that city. This is one instrument to every 36 persons, figuring the population at 27,000.

Mayor Somers of Milwaukee recently sent an ordinance to the common council declaring all overhead telegraph and telephone wires in the greater part of the East side business portion a nuisance. The ordinance provides for a fine of from $100 to $500 a day for [illegible] wires, and a like fine for any owner or agent who refuses to take down the wires at once. The ordinance was passed to a third reading.

MISCELLANEOUS.

A. J. Painter of Pasadena, Cal., has invented [illegible] motor in which the gas is exploded in cylinders by an electric spark from a battery. He thinks the motor can be used in street railway traction.

The object of the newly organized Flint Creek, Mont., Electric Power company is to utilize the power of the Flint creek falls, and to carry on a general [illegible] ing power by the use of water motors [illegible] to electric energy by the use of dynamos. The power will be conveyed over electric conductors to Philipsburg, Granite, Rumsey, Black Pine, Georgetown, Pyrenees, Cable and Anaconda. The power will doubtless be conveyed to other points, and can be modified for distribution and use in electric lighting, for the electric ap[illegible] of metals, or for any other purpose for which electricity may be desired.

A piano upon which several selections were played automatically by means of electricity was [illegible] Richelieu, Chicago, last week. The instrument was fitted with a drawer beneath the keyboard in which [illegible] strip of thin cardboard, perforated with holes and slots representing the notes of the selection. This was [illegible] to pass over a series of metallic points with springs under them. These points were firmly pressed down as the strip passed along until reached by one of the slots.

holes, when the spring forced the iron point upward so that it struck one of the hammers of the instrument. A small electric motor, worked by a little storage battery just behind the piano, turned the rollers and moved the [illegible]

The much talked of ball game between the Okonite base ball club, composed of employes of the Central Electric company, and the Kerite club, made up of the pick of the Western Electric company of Chicago, was played at Lin[illegible] Chicago, on the 15th inst., and resulted in a [illegible] the Okonites by a score of 11 to 7. The fea[illegible] of the game was the battery work of Cushing and Stacey. The Kerites played a very brilliant game.

TRADE NEWS.

The elegant Manhattan office building in St. Paul, Minn., and the fine residence of James S. Hill of the same city, have recently been wired throughout with Grimshaw wire.

"Light-Power" is the title given to the handsome catalogue issued by the Card Electric Motor & Dynamo company of Cincinnati, O. The company explains the merits of its well-known machines in an attractive manner, the letterpress being illustrated by finely executed cuts.

The Short Electric Railway company has equipped a special car with its gearless motors. The car will first be sent to Albany, N. Y., where it will be put into regular service on the State street grade, averaging about 8 per cent. for a distance of half a mile and 5 per cent. or 6 per cent. for a much longer distance. It will afterward be operated in other cities. The Jamestown Street Railway company is operating the Short double reduction motors and the management has placed three additional orders for equipment. The motors are obliged to propel an 18-foot vestibule car with a trail car up heavy grades under all conditions of track and traffic. The Short Electric Road at Rockford, Ill., is meeting with excellent success and is about to extend its lines. The Houston Street Railway company has placed an order with the Short Electric Railway company for gearless motors to be used upon its lines.

BUSINESS.

Chandler & Taylor company of Indianapolis have issued a little circular giving reasons why the Reliance safety water columns should be on every boiler.

The Crocker-Wheeler Electric Motor company, New York, is full of business. It has just finished a 1/2 horse power motor for the new Chilian cruiser now being fitted out in England.

The Triumph Compound Engine company of Cincinnati, manufacturer of Eickershoff's patent compound engines, reports business as satisfactory. These engines are claimed to be economical, durable, simple in construction and practically noiseless.

The Vulcanized Fibre company of Wilmington, Del., in a recently issued price list, calls attention to the fact the words "vulcanized fibre" constitute its trade mark, and requesting buyers desiring its goods to see that each sheet is branded with these words.

The latest catalogue of the Electrical Supply company relates to electrical house goods, and telegraph, fire alarm, district messenger and school supplies. Like all of this company's publications, it is well printed and copiously illustrated. Diagrams of circuits are included.

The Wm. Powell company of Cincinnati has just issued a catalogue of steam brass work, embracing a full line of goods used by steam fitters, engine builders, electric light stations, etc., including the latest improvements in the company's specialties, which embrace sight feed lubricators, sight feed signal oilers, and the well known Star valves.

The New York & Ohio company, manufacturers of the Packard incandescent lamp, has just completed arrangements with the Electric Engineering & Supply company of Syracuse, N. Y., to look after its interests in Pennsylvania, [illegible] the New England states, and the Dominion of Canada. This company will also represent the Packard [illegible] convention.

The New York Insulated Wire company has issued a useful little pamphlet on electric light wiring installations. [illegible] builders and owners, and con[illegible] illustrated by explanatory cuts. Extracts from the rules of different boards of fire un[illegible] office of the com[illegible] street and the [illegible] on application.

Gould's triplex electric pumps are attractively illustrated [illegible]

[illegible]

materials, one of a high electrical resistance, the other, an [illegible] adapted to resist the [illegible] Over the special insulating materials is superimposed a braid which in its turn is saturated with the same material to prevent capillary attraction on the exposed ends of the cable to protect it from the rotting effects of gas, and to increase lasting qualities, making it exceptionally durable. The cable is then lead-covered. The lead is alloyed with tin, to secure sufficient hardness and to resist abrasion in drawing through ducts, yet assuring sufficient ductility to enable the cable to be easily handled without rupture. The Acme lead cable is introduced by the International Okonite company.

James Leffel & Co., Springfield, O., hydraulic and mechanical engineers, and makers of the James Leffel water wheel, have issued a new water wheel pamphlet. It is well printed, on finely finished paper, is handsomely illustrated throughout, and contains a large amount of useful and practical matter to those improving water power. A great number of plans for placing wheels are shown, both upon upright and horizontal shafts. Entirely new tables of the wheels are published, containing new features never before presented, it is said, by any water wheel maker. This firm has been making the James Leffel water wheel for thirty years continuously; 110 different sizes and styles are made.

ELECTRICAL PATENTS.

Issued Aug. 25, 1891.

458,154. Automatic Gas Lighting Apparatus. George D. Clarke, Chicago, Ill.

The object of this invention is to provide means whereby gas may be lighted and extinguished at such times as may be desired during the twenty-four hours; and it consists in clockwork used in connection with suitable electrical apparatus and so arranged that as long as the clock continues to run the gas will be lighted at a certain predetermined hour and extinguished at another hour.

458,162. Electric Motor. Ludwig Gutmann, Fort Wayne, Ind.

This invention relates to an electric motor so constructed as to operate by the action of an alternating or similar inducing electric currrent.

458,163. Alternating Electric Current Heater. Ludwig Gutmann, Pittsburg, Pa.

This invention relates particularly to the construction and regulation of electric heating apparatus for domestic services as operated by alternating, pulsating, or intermittent currents.

458,164. Method of Operating Alternating Electric Motors. Ludwig Gutmann, Pittsburg, Pa.

The object of this invention is to provide an alternating current motor which possesses the property of being self starting, self-regulating within certain limits of load, and of such high efficiency as to be applicable for practical use.

458,170. Art of Electric Welding. Herman Lemp, Lynn, Mass.

This invention consists in covering the conducting blocks, clamps, or clamping surfaces, particularly at their working parts and also the work pieces where clamped or connected, with a continuous layer or film of liquid, such as water, whereby the metal is protected from the air, and cannot therefore, coat with scale from the oxygen of the air combining with the metal, and whereby the metal surfaces in contact and traversed by exceedingly heavy currents are cooled, so as to preserve their normal conducting power without increasing thereof and, further, whereby the contact obtained is virtually improved or made better by the inserting of capillary films of the liquid between the surfaces almost in contact or separated only by microscopic spaces.

458,177. Adjustable Electric Clamp. Herman Lemp, Lynn, Mass.

This invention relates to improvements in electric welding and metal working apparatus, and particularly to those parts of the apparatus which supply the work pieces with the heavy heating electric currents.

458,178. Electric Alarm Clock. Charles Lester, Chicago, Ill.

458,184. Electric Coal Mining Machine. Edmund C. Morgan, Chicago, Ill.

458,188. Electric Clamp. E. Rasmussen, Lynn, Mass.

In the commercial operation of electric metal working apparatus it is found that the metals worked are often rough and dirty on their surfaces and must be used in this condition, in order not to increase the cost by expensive methods of preparation previous to the welding or other operation. The continual abrasive action of these rough surfaces upon the conductor terminals or contact blocks causes a rapid and unequal wearing away of the contact pieces, thus lessening their conducting surface and greatly increasing the power required.

The object of this invention is to provide means whereby the surfaces of the clamps are protected from the abrasive action of the work pieces and the best of electrical connection obtained between said clamps and work pieces.

458,206. Electric Alarm Clock. Louis Winterhalder, Brooklyn, N. Y.

458,221. Insulator. Murray C. Chase, Chicago, Ill.

This invention relates to insulators, particularly such as are adapted to be employed for supporting electric railway [illegible] where they pass about curves.

458,236. Armature for Dynamo Electric Machines. Laurence A. McCarthy, Brooklyn, N. Y.

The [illegible] of this invention is, in combination with the [illegible] of the Siemens H armature and the drum armature [illegible] an armature for direct current motors [illegible] a little [illegible] as possible, and [illegible] will be simple in con[illegible] readily [illegible] previously prepared.

458,24[illegible]. Electric Lamp Socket. Horace L. Swift, Boston, Mass.

[illegible]

458,255. Spring Jack Commutator for Telephone Switch-[illegible] Alfred Berthon, Paris, France.

[illegible]

[illegible] Electric Stop Mechanism. Ernest Boening, [illegible]

[illegible] desired time, either [illegible]

458,279. Portable Electric Lamp. Lars Bristol, Bromley, England.

458,316. Electric Conductor. Frederick E. Degenhardt, Chicago, Ill.

The invention described herein relates to certain improvements in the manufacture of electric conductors and cables, and has for its object a construction and arrangement of the protective covering of the conductors and cables, whereby provision is made for the retention of air or gas within the protective covering, thereby decreasing the static capacity of such conductor.

458,343. Circuit Closer. Percival D. Richards, West Medford, Mass.

The object of this invention is to provide a circuit-closer of simple construction, fitted to be grasped by the hand, and which by the compression resulting from the closing of the hand around the same may be caused to complete the circuit, for instance for the purpose of sounding a bell.

458,372. Electric Alarm Clock. James O. Newton, New Haven, Conn.

458,376. Arc Lamp Electrode. Walter S. Richards, Natick, Mass.

This invention relates to carbon electrodes for arc lamps which are provided with capillary conductors of refractory material adapted to conduct a liquid hydrocarbon to the arc or burning end of the electrode, where said hydrocarbon is converted into gas, which intensifies and improves the quality of the light.

458,377. System of Electric Propulsion for Vehicles. Walter S. Richards, Natick, Mass.

Claim one reads:

"The combination of a way or road, primary electric coils disposed in series along said way and connected with a dynamo or other source of electricity, a vehicle adapted to travel on said way, propelling mechanism on said vehicle, an electric motor on said vehicle for operating the propelling mechanism, and secondary coils on said vehicle connected with said motor and adapted to be inductively electrified by said primary coils."

458,386. Electric Arc Lamp. Nathan M. Garland, New York, N. Y.

Claim one reads:

"An arc light having its upper carbon provided with a movable projecting cap or hood of refractory material of substantially the same internal diameter as the carbon, but shaped to bear against the coned end thereof and adapted to move in the direction of the support of the carbon as it burns away.

458,387. Electric Arc Lamps. Nathan M. Garland, New York, N. Y.

This invention is directed particularly to arc lights of the type in which two or more carbons are fed toward each other in alignment, either by the action of gravity or through the medium of various forms of well-known devices, the arc being produced at the juncture of the carbons; and it has for its object, first, an increased length of life of the carbons; second, the prevention of the combustion thereof through the combined effects of atmospheric air; third, the utilization of means which travel with the moving carbons as they are consumed for decreasing the resistance offered to the electrical current as it passes through the lamp; fourth, the diffusion of heat created at the arc, whereby a decrease in the general temperature of the entire lamp and of the space in its immediate vicinity is effected.

458,388. Electric Arc Lamp. Nathan M. Garland, New York, N. Y.

Claim two reads:

"An arc light having a pair of protecting caps or hoods, one for each carbon, made of refractory material, in combination with a conducting-sleeve attached to one hood, and conductors of heat connecting the sleeve and both hoods to the frame of the lamp, said hoods being united together by one or more sustaining springs.

458,389. Electric Arc Lamps. Nathan M. Garland, Boston, Mass.

458,396. Cut-Out. William F. Irish, New York, N. Y.

458,424. Secondary Battery. Oraxio Lugo, New York, N. Y.

The object of this invention is to produce a secondary battery in which there will be no chemical action when not in use, thus conserving the energy of the battery.

458,425. Secondary Battery. Oraxio Lugo, New York, N. Y.

This invention consists in a relatively electro-positive metal or substance, and a relatively electro-negative metal or substance, both coated with a suitable oxide such as oxide of lead, and placed in a liquid, such as a solution of borax or ammonia, which will not act primarily upon either, but will act secondarily upon both. Furthermore, in a secondary electric or so called "storage" battery composed of a relatively positive metal or substance, such as lead, both coated with oxide of lead, then suitably formed and charged, and placed in a liquid, such as a solution of borate of ammonia, which will not act primarily upon either element, but will act secondarily upon both.

458,427. Support for Trolley Wires. John H. Palmer, Boston, Mass.

458,479. Telephone. Eloy Noriega, Mexico, Mex.

458,486. Electric Gas Lighter. Horace A. Pinkham, Philadelphia, Pa.

458,489. Electrical Signal and Switch Moving Mechanicism. Joseph Ramsey, Jr., Edward W. Harden and Charles Morris Wilder, Cincinnati, Ohio.

The object of this invention is to provide a device which can be operated by electricity to move a switch rail, signal, or gate, and is so constructed that the opening and closing of the same can be effected by the rotation of the armature of the motor employed, and so that the motive force is arrested at the completion of each movement, that is, the device will be locked when the switch, gate or signal has been either opened or closed, whether the armature is stopped in its rotation or otherwise—and so that by the rotation in one direction alone, the device to be moved is either opened or closed by the starting of the motor, which is employed as the moving power.

458,500. Electric Arc Lamp. Hermann W. Sander, St. Louis, Mo.

This invention has for its object to produce an electric arc [illegible] the [illegible] remain at a given point and [illegible] the carbon [illegible] are consumed, and it further relates to [illegible] a larger amount of carbon [illegible] the ordinary form of arc light.

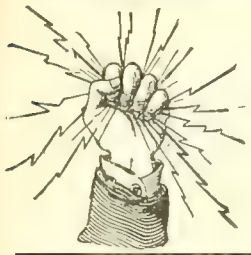
458,536. Electric Uterine Supporter. George F. Mohn, Los Angeles, Cal.

458,545. Electric Motor. Charles E. Egan, Columbus, Ohio.

458,551. Insulating Compound. James L. Marmaud, Malden, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used. Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the Boston Fire Underwriter's Union, under date of March 24, 1886, he says: "A Thoroughly Reliable and Desirable Wire in Every Respect."

The rubber used in insulating our wires and cables is specially chemically prepared, and is Guaranteed to be waterproof and will not deteriorate, oxidize or crack and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole all ked with Clark's Patent Compound, which is water, oil, acid, and to a very great extent, fire proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager HERBERT H. EUSTIS, Electrician

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS,

4 LaSalle Avenue, Chicago.

☞ Write us for Prices.

CHICAGO.

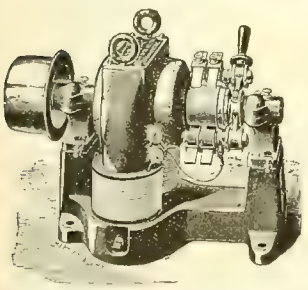
The Electrical Construction Co.

43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

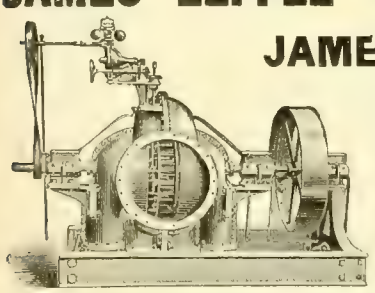
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS



BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

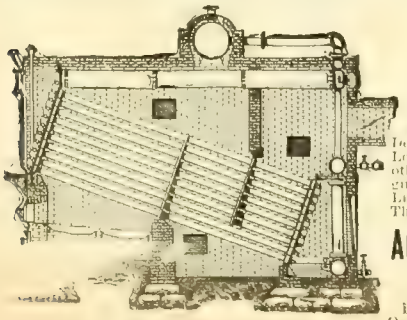
Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE.



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the Electric Light Companies of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City, and a great many others; also by the Ammonton & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass., and the Thomson-Houston Electric Co., Lynn, Mass.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

WANTED.

An electrician, now in charge of [illegible] in electric station, desires [illegible] a prominent Eastern railroad. Would like [illegible] change. Seven years in the electric business, four years in Central Station management. Thoroughly posted on [illegible] Westinghouse and Edison systems in construction work. Address "EASTERN." Care WESTERN ELECTRICIAN.

SITUATION WANTED.

[illegible] Address "H. S. L." Care Western Electrician.

Wanted Immediately.

Two Draughtsmen well acquainted with work of designing electrical machinery. Applicants should give reference, wages expected, and an outline in brief of their experience. Address

ELECTRIC LIGHT,

Care WESTERN ELECTRICIAN.

ELECTRIC SLATE

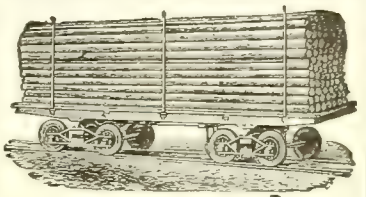
Switch-boards a Specialty.

Small samples of [illegible] and marble [illegible]

T. J. MURPHY,

Electrical Engineer Bldg. 136 Liberty St., Room [illegible] NEW YORK.

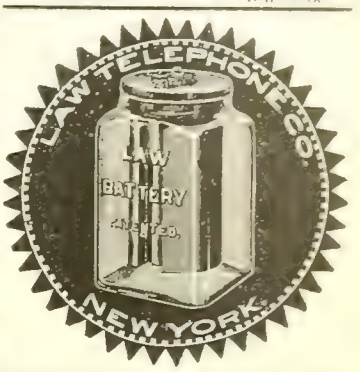
ELECTRICAL WOOD.



Telegraph Telephone Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES. Room 410 Com'l Bldg., St. Louis, Mo.



The Winner of 1890 will win again in 1891. Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., Brooklyn, N. Y.

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES A SPECIALTY.

L. BLATZ, 103-107 West Monroe St., CHICAGO.

"MAGNETIC VANE"

AMMETERS AND VOLTMETERS

ARE THE BEST INSTRUMENTS FOR

Central Stations, Isolated Plants,

Marine Installations, Electric Railways

Correspondence Solicited.

Send for Illustrated Circular 235.

QUEEN & CO., PHILADELPHIA.

AN EXPENSIVE DELAY

Will Not Occur If You Order Supplies from Us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers

Packard High Grade Lamps: Eddy Motors:

"Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

931 Rookery, CHICAGO. 413 Jackson St., ST. PAUL. 409 W. Michigan St., DULUTH

SEND FOR CATALOGUE AND DISCOUNT SHEETS.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.
FITCHBURG, MASS., U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

THREE HARVEST EXCURSIONS.

The Burlington Route, C., B. & Q. R. R., will run Harvest excursions, Tuesdays, August 25th and September 15th and 29th, from Chicago, Peoria, Quincy and St. Louis to St. Paul, Omaha, St. Joseph, Kansas City, Denver, Helena, Salt Lake and all other points in the Northwest, West and Southwest. Rates very low. Tickets for sale at all principal ticket offices at points on and east of the Mississippi River. Many connecting lines will accept these tickets. Inquire of agents for full information, or address P. S. Eustis, Gen'l Pass and Ticket Agt., Chicago.

EVERYTHING IN

WIRE—FUSE—STRIPS.

WRITE US.

MANUFACTURED BY

The Sperry Electric Mining Mach'ne Co.,

39th St. and Stewart Ave., CHICAGO.

Manufacturers of

OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

ELEMENTS OF ELECTRIC LIGHTING.

BY PHILIP ATKINSON, Ph. D.

260 Pages Cloth Binding, Illustrated, Price $1.50.

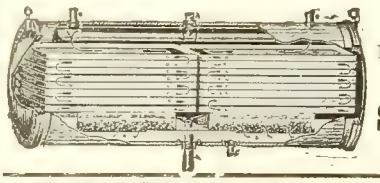
A thorough revision and revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. It treats of: Principles of the Dynamo; Alternate Current Dynamos; Direct Current Dynamos; Electric Terms and Units; Electric Measurements; Incandescent Lamp; The Storage Battery; Electric Distribution.

Sent postpaid on receipt of price.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, Chicago.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

Write for Prices and Samples. **S. TAUSSIG, Agent, 45 River St., CHICAGO.**

TO AMERICAN INVENTORS.

Woodhouse & Rawson,

UNITED, LD.,

88 Queen Victoria Street,

LONDON, ENG.,

NEW YORK OFFICE, 36 WALL STREET.

Are Prepared to Negotiate and Introduce Inventions of Merit into Great Britain and all Parts of the World.

CORRESPONDENCE INVITED.

ALUMINUM

50 Cents per Pound.

THE COWLES

Electric Smelting & Aluminum Co.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum at 50 cents per pound for ton lots in ingots.

Aluminum sheet, wire and castings at lowest market price.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

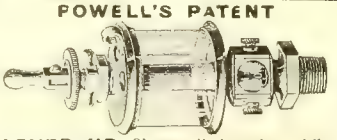
Correspondence solicited.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

---

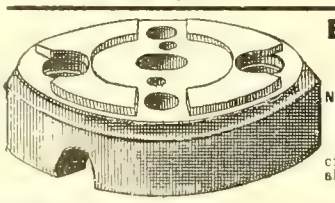
POWELL'S PATENT



LEVER UP—Shows oil dropping while machinery runs.

SIGNAL OILERS

Still in the Van as the BEST for **HIGH-GRADE ENGINES and DYNAMOS.** The stop feed features prevent waste of oil which item alone will more than save their cost in a short time. **HAS OTHER EXCEPTIONAL POINTS OF MERIT.** Send for full descriptive circular. Address **THE WM. POWELL CO., CINCINNATI, OHIO.**



EMPIRE CHINA WORKS,

114 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

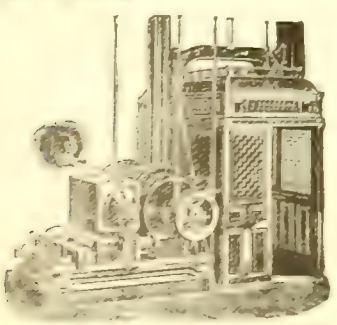
TRUE HARD PORCELAIN.

BINDERS

FOR THE WESTERN ELECTRICIAN,

ONE DOLLAR.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

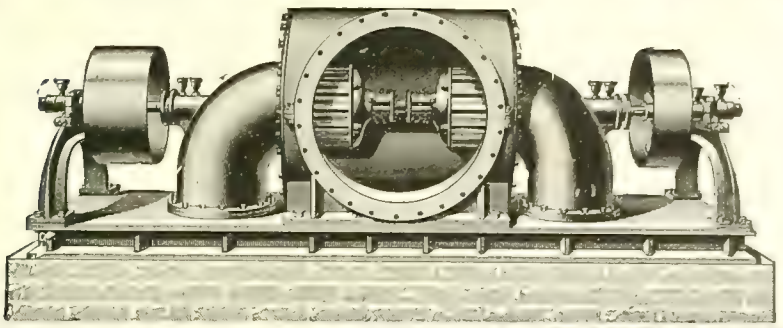
MANUFACTURERS OF

PASSENGER AND FREIGHT

Hydraulic and Electric

ELEVATORS.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC [illegible] CELEBRATED WATER WHEEL [illegible] on account of its remarkably steady motion, high Speed and great Efficiency, and large Capacity, [illegible] diameter, being double the Power [illegible] number of the [illegible] ical use of water [illegible] ful effect guaranteed.

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" [illegible] required, and it can be [illegible]

The accompanying [illegible] VICTOR TURBINES [illegible] Tube, End Bearing [illegible] a substantial [illegible] strictly first-class in every particular. We are now prepared to furnish Victor Turbines, [illegible] admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),

DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

FOR HANDLING

GRAIN, COAL, TAN BARK, SEEDS, ETC.

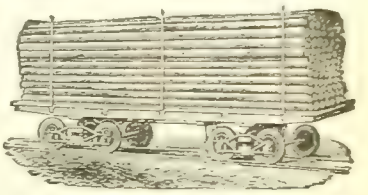
Will convey all kinds of grain without mixing.

Will carry two different kinds of material in opposite directions at the same time.

Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

VULCANIZED FIBRE CO.

ESTABLISHED 1878.

SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

1000 HOURS LIFE.

2000 " "

3000 " "

4000 " "

5000 " "

SUNBEAM LAMPS.

WRITE US FOR PRICES AND PARTICULARS.

The Sunbeam Incandescent Lamp Co., Chicago, Ill.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

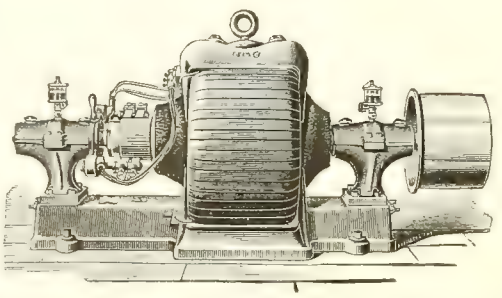
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

PERRET ELECTRIC MOTORS AND DYNAMOS.

REMOVAL NOTICE.

To Our Friends and Patrons:

To meet the increasing demand for Perret Motors and Dynamos, another increase in our facilities has been necessary, and to accomplish this we have moved our factory and general office to Springfield, Mass., where we have secured the property on State Street, formerly known as the Bullard Repeating Arms Works. This property is one of the finest in New England, and is conveniently situated for receiving and shipping goods by all the railroad lines centering in Springfield. With these enlarged and increased facilities, and with a large increase in capital, we shall be able to serve our customers better than ever.

For the convenience of our patrons in that vicinity, we have established an office, storeroom and workshop at 89 Liberty Street, New York City, in charge of Mr. Robert Watson.

NEW YORK OFFICE,
89 Liberty Street.

Respectfully,
THE ELEKTRON MFG. CO., Springfield, Mass.

DICTIONARY
—OF—
ELECTRICAL WORDS, TERMS AND PHRASES.

By EDWIN J. HOUSTON, A. M.

656 Pages. 397 Illustrations. Cloth Binding. Price, postage prepaid, to any part of the world, $2.50.

This Dictionary includes close upon 2,500 distinct Words, Terms or Phrases. Each of the great classes or divisions of electrical investigation or utilization comes under careful and exhaustive treatment. For some reasons it deserves rather to be called an **Encyclopædia** than a dictionary.

The Scheme of Treatment is as follows:

1st. The words, terms and phrases are invariably followed by a **short, concise definition**, giving the sense in which they are correctly employed.

2d. A general statement then follows of the **Principles of Electrical Science** on which the definition is founded.

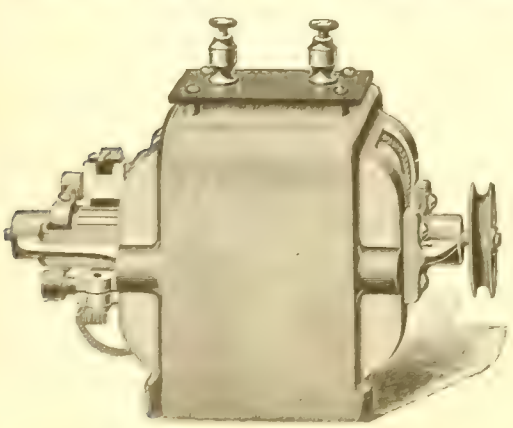
3d. When, from the complexity of the apparatus, or from other considerations, it has been thought desirable to do so, an **Illustration or Diagram** of the apparatus is given.

4th. To facilitate study, an elaborate system of **Cross References** has been adopted so that it is as **easy to find the definitions** as the words, and aliases are readily detected and traced.

In applying these rules great care has been exercised to secure **CLEARNESS**, to the end that while the definitions and explanations shall be SATISFACTORY TO THE EXPERT ELECTRICIAN, they shall also be SIMPLE AND INTELLIGIBLE to those who have had no training at all in electricity, or are novices in the art.

ELECTRICIAN PUBLISHING CO.,
6 LAKESIDE BUILDING, - - - - - - CHICAGO, ILLINOIS.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer.
47 and 49 S. Jefferson Street, CHICAGO.

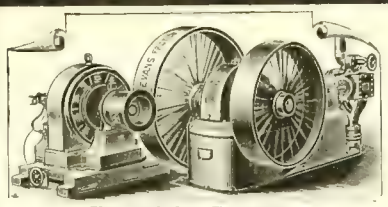
DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

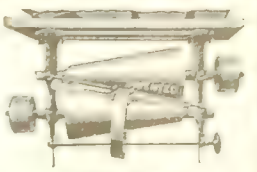


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones, For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." PATENT **"K. K."** LINE WIRE TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

THOMAS STURGIS, President. WM. C. LANE, Secretary and Treasurer. C. P. MACKIE, General Manager. S. S. BOGART, General Agent.

ELECTRIC SECRET SERVICE CO.,

45 BROADWAY, NEW YORK.

Owning the patents of Mosher, Gill, Hatch, Foote, Kintner and Moore for

INDIVIDUAL TELEGRAPH CALL AND CUT-OUT APPARATUS.

OTHER PATENTS PENDING.

The only practical and reliable system of electric selection invented.

Use either ***Morse Key*** or ***Automatic Transmitter.***

From every station selected an ***Automatic Answer Back*** is received.

Gong rings until shut off by operator.

Any office on line can be selected without disturbing the others and either called up or cut out. No interference with regular telegraph service. No resistance added to main line. Easily applied. Economical. Convenient. Reliable.

Applicable to arc lights, singly or in groups; fire alarm service; police telegraph; electric motor circuits; railroad signals, etc.

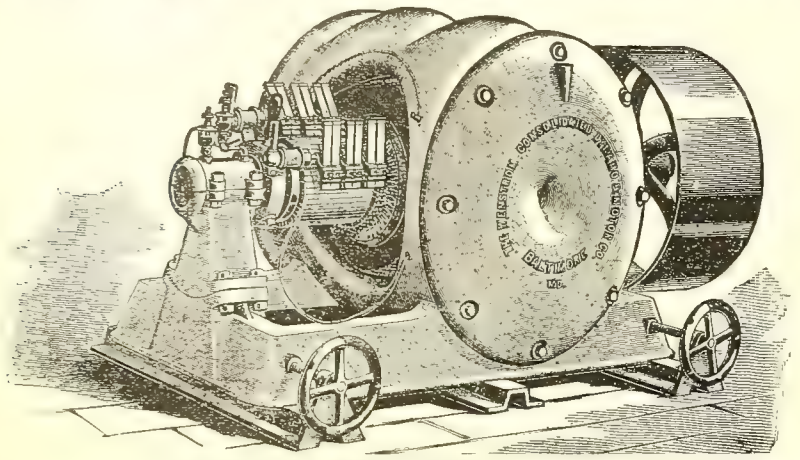
The public is warned against infringing companies and devices.

For terms and other particulars, address as above.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

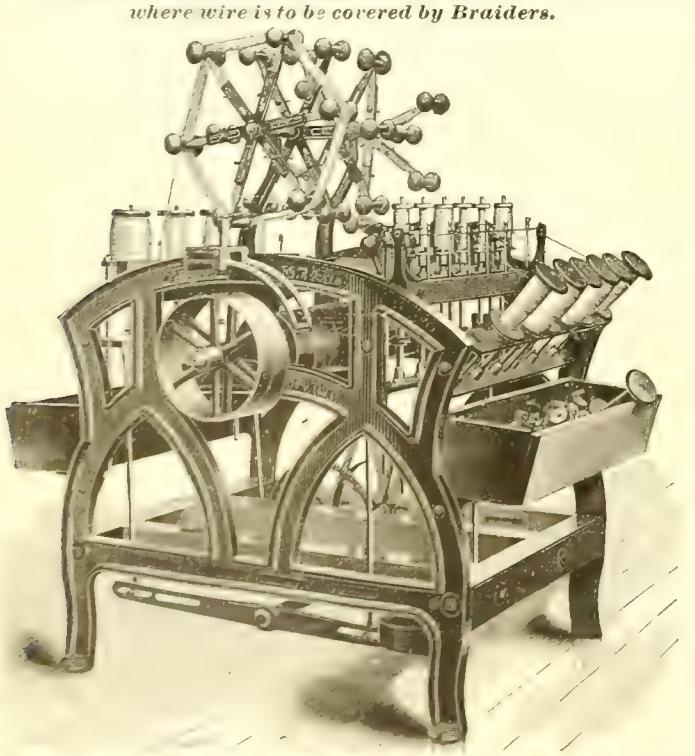
THE WENSTROM CO., Baltimore, Md.

GEORGE W. PAYNE & CO.,

MANUFACTURERS OF

BRAIDER SPOOLERS,

Used in connection with Braiding Machinery for Electrical Work where wire is to be covered by Braiders.



Machines built when required to double two or more ends, with drop motions to stop spindle when end breaks, also when bobbin is full.

Works 102 Broad St., PAWTUCKET, R. I.

The SOLUTION of the PROBLEM of SAFE GUARDING

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

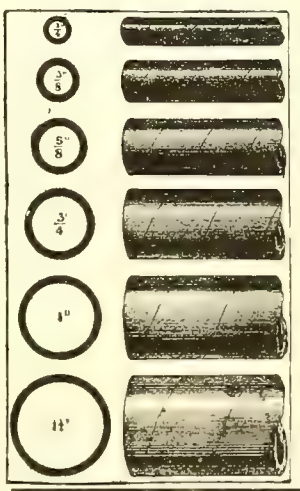
THE INTERIOR

CONDUIT AND INSULATION CO.,

WORKS: 527 to 631 W. 34th St., 626 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Electrical Engineering Co., 320 Dearborn St., Chicago, Ill.
Southern Electric Co., Baltimore, Md.
Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
B. Frank Johnson, Provident Bldg., Philadelphia, Pa.



COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT

IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP

FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt

ALL LEATHER

NO IRON ROD OR HINGE. OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISSION SUPERSEDED.

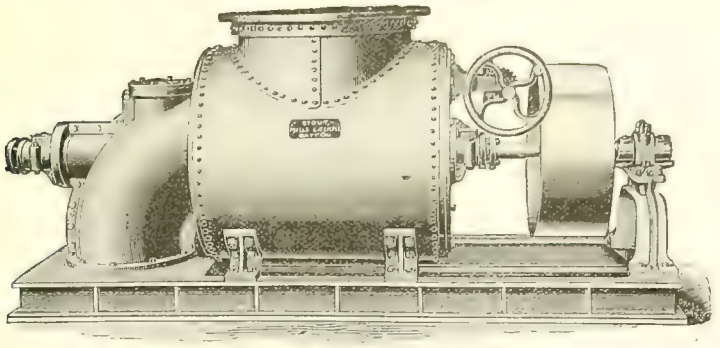
OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE THE ONLY PERFECT BELT MAKE NO SLIPPING OR LOST MOTION

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY. BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

RAWHIDE LACE LEATHER AND PICKER LEATHER.

BRANCHES: 164 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 S. Third St., Philadelphia, Pa.; 69 W. Monroe St. Chicago. | **St. Louis, Mo.**

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

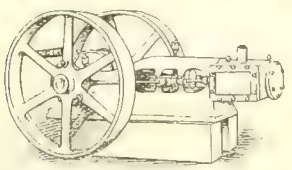
ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, regularity of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 447 North Street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY THE BALL ENGINE CO ERIE PA.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

STEAM PLANTS

INSTALLED BY

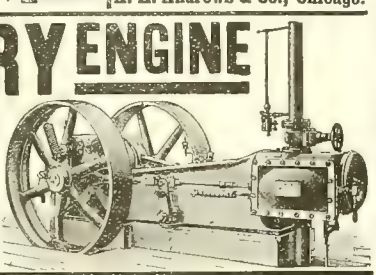
W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE.
— Catalogue sent on application. —
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES | Philadelphia, 942 Drexel Bldg. | San Francisco, 29 & 31 Spear St.



WESTINGHOUSE ENGINES

A FEW PROMINENT MISCELLANEOUS USERS

(*Excepting Governments and Railroads*).

Adams Express Company; Allegheny City Light Plant; Allegheny County Light Company; Anheuser-Busch Brewing Company; Arbuckle Brothers; Ashcroft Manufacturing Company; E. Balbach & Son; Baldwin Locomotive Works; Bowers Dredging Company; Brooks Locomotive Works; Brown & Sharpe Manufacturing Company; Brush Electric Company of Baltimore; Brush Electric Light Company of Buffalo; Burlington Electric Street Railway Company; Calumet & Hecla Mining Company; Cambria Iron Company; Carnegie, Phipps & Company; Cincinnati Gas Light & Coke Company; Coxe Brothers & Company; Crescent Steel Works of Miller, Metcalf & Parkin; Cumberland & Presumpscot Mills; Denver Consolidated Electric Company; Detroit Dry Dock Company; Detroit Electric Light & Power Company; Dunnell Manufacturing Company; East End Electric Light Company of Pittsburgh; Elgin National Watch Company; Federal Street & Pleasant Valley Electric Street Railway Company of Pittsburgh and Allegheny; Forest Paper Company; Gate City Oil Mills; Glen Echo Electric Street Railway Company of Washington; Herkimer Paper Company; Howe, Brown & Company; Illinois Steel Company; Lehigh Avenue Passenger Electric Street Railway Company of Philadelphia; Lombard, Ayres & Company; McConway & Torley Company; McKeesport Electric Light Company; Metropolitan Electric Light Company of London; Missouri Electric Light & Power Company of St. Louis; Muncie Pulp & Paper Company; New England Dredging Company; Newton Paper Company; G. H. Nichols & Company; Ohio Paper Company; Oliver Oil Company; Omaha & Council Bluffs Electric Railway Company; Omaha Electric Street Railway Company; Otis Iron & Steel Company; Pacific Rolling Mill Company; Pencoyd Iron Works; Pennsylvania Steel Company; Philadelphia & Reading Coal and Iron Company; Pittsburgh Locomotive & Car Work; Robert Poole & Son Company; Quaker City Dye Works; St. Charles Car Works; Sawyer-Man Electric Company; Schenectady Locomotive Works; Williams Sellers & Company; Sherman Oil & Cotton Company; Shoenberger & Company; Southern Cotton Oil Company; Claus Spreckels' Sugar Refinery; Tacoma Light & Water Company; Terre Haute Electric Street Railway Company; Union Switch & Signal Company; United Electric Light & Power Company; Vancouver Electric Street Railway & Light Company; Wellman Iron & Steel Company; Westinghouse Air Brake Company; Westinghouse Electric & Manufacturing Company; Wilmington City Electric Street Railway Company.

Over 3000 other users.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENN'A, U.S. OF A.

FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO.

HALF TONE PLATES A SPECIALTY.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

BEST MAST ARM IN USE.

More Lamps Trimmed. No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRON TOWER CO., FORT WAYNE, IND.

SEND FOR New American Electrical Directory, just published; very complete lists. Invaluable for its information of Lighting and Railway Plants.

COOLIDGE FUEL & SUPPLY CO.,

RAILROAD CROSS TIES AND PILING.

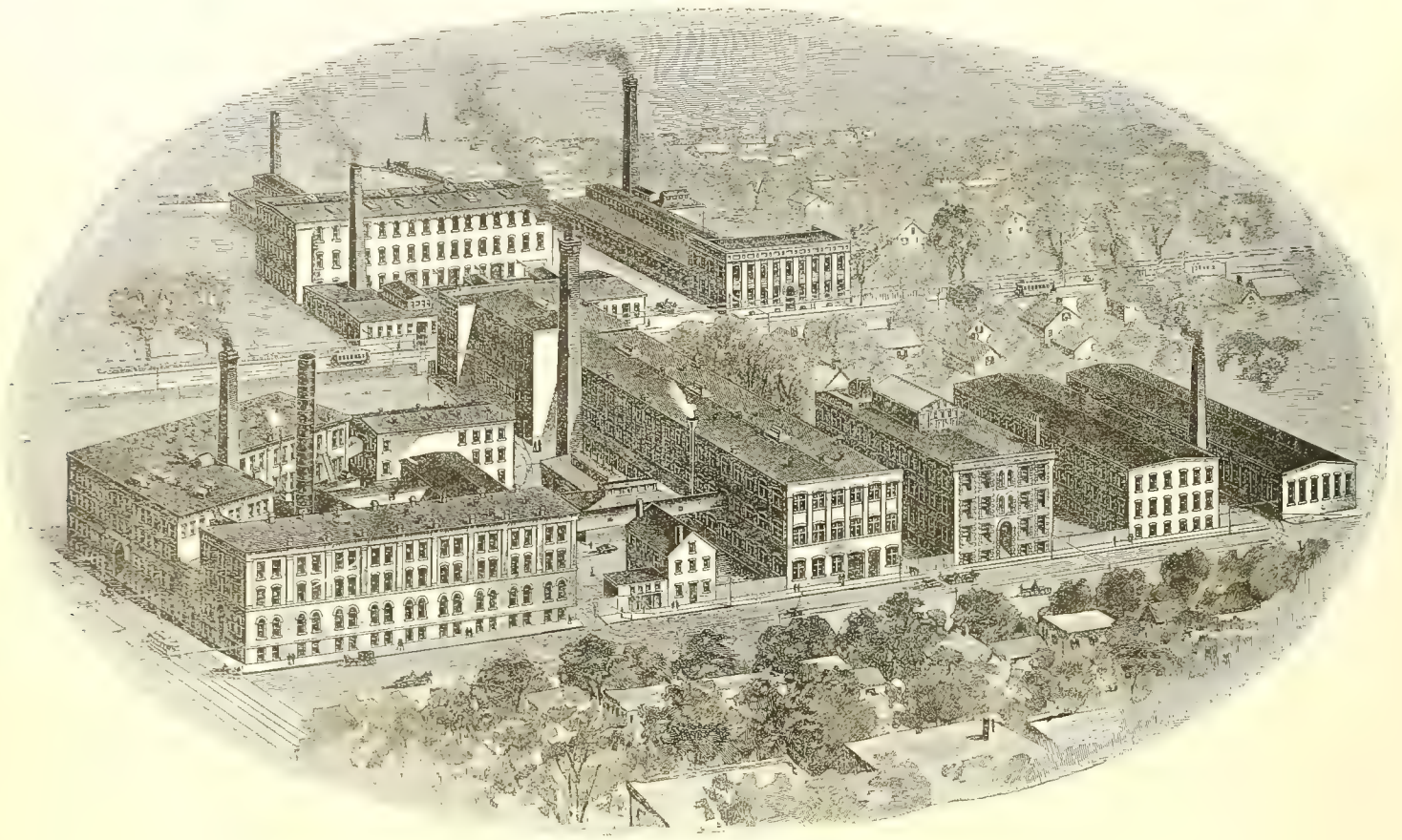
CEDAR AND OCTAGONAL PINE POLES.

CROSS ARMS. PINS AND BRACKET.

—MANUFACTURED BY—

J. R. CLARK CO., Minneapolis, Minn.

THE PROBLEM SOLVED.



CUT OF FACTORY, 1890.

TOTAL NUMBER OF LOCAL COMPANIES, JANUARY 1, 1891, USING

ARC APPARATUS.	DIRECT INCANDESCENT.	ALTERNATING.
630 Companies,	108 Companies,	415 Companies,
87,131 Lamps.	**79,905 Lamps.**	**435,550 Lamps.**

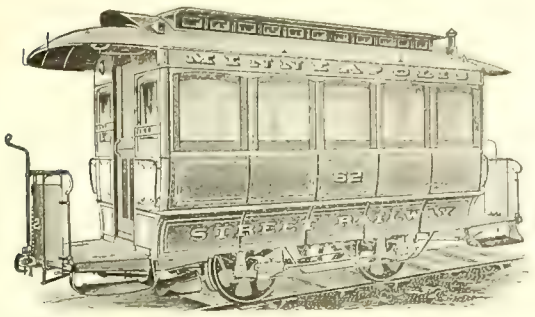
The above increase would seem to answer most emphatically in the affirmative.

All purchasers of Electrical Apparatus should thoroughly investigate the acknowledged merits of OURS before buying any of the CHEAP SYSTEMS now on the market.

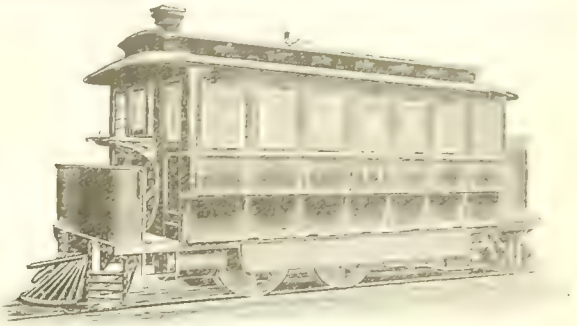
Thomson-Houston Electric Company,

WESTERN OFFICE:
148 Michigan Ave., Chicago, Ill.

PRINCIPAL OFFICE:
620 Atlantic Ave., Boston, Mass.



STREET CARS



FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

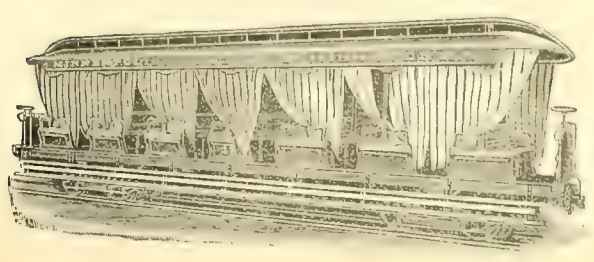
MINNEAPOLIS STREET RAILWAY CO.,

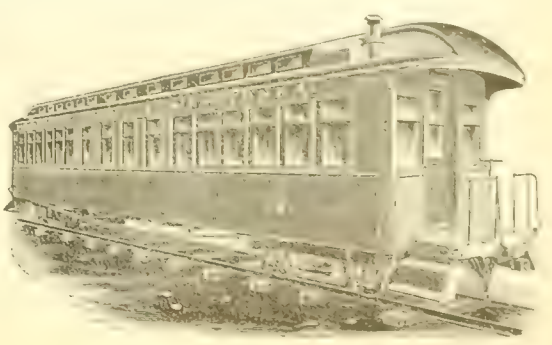
Of Minneapolis, Minn.,

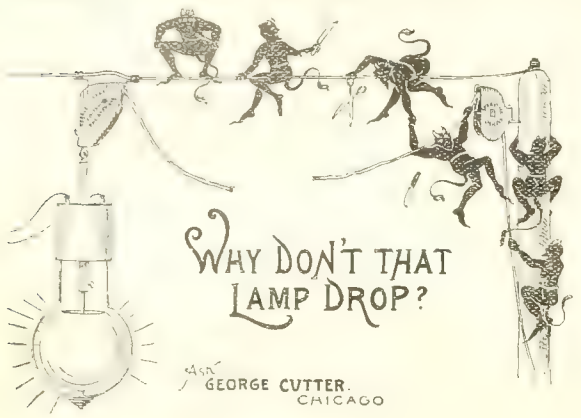
OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.







GEORGE CUTTER,

333 "The Rookery," CHICAGO.

SAFEGUARDS FOR ELECTRIC LIGHT CIRCUITS.

COUNT THE COST—

One falling Arc Lamp;
One ton of Coal;
One Dynamo burnt out.

THEN JOIN THE WISE USERS OF

Simplex Braided Rubber Wire,
Cutter's Lamp-Supporting Pulley.

For "that new indoor circuit," get Simplex Braided Rubber Wire.

READ THE FOLLOWING.

EDISON ELECTRIC ILLUMINATING CO. OF BROOKLYN.

BROOKLYN, August 17, 1891.

THE ELECTRIC CONSTRUCTION & SUPPLY CO., New York.

GENTLEMEN: It might perhaps interest you to know the success with which the Ward Arc Lamp is meeting in Brooklyn. We installed, eighteen months ago, two (2) of your lamps and to-day have 740 connected to our low tension circuits. To show you that they give satisfaction it is merely necessary to mention that every day we are replacing high tension lamps and for no apparent reason, except that the light is steadier and more brilliant, and that the consumer has control over each pair of lamps.

I think, from the results we are obtaining here, it would be to the advantage of every station supplying incandescent lights to add this new and profitable source of income to their system.

Yours truly, W. S. BARSTOW, Gen'l Supt.

REMEMBER WE GUARANTEE "WARD" LAMPS TO BE EXACTLY AS REPRESENTED.

THE ELECTRIC CONSTRUCTION & SUPPLY CO., Established 1881.

PHENIX BUILDING, CHICAGO, ILL. TELEPHONE BUILDING, NEW YORK CITY.

The KNAPP ELECTRICAL WORKS,

GENERAL AGENTS FOR

"SAFETY"

WIRES, CABLES AND CORDS

For Inside, Underground and Submarine Use.

"SAFETY" Fire-Proof House Wire. "ATLAS" Line Wire.

R. B. WATSON & CO., Agts.,
DETROIT, MICH.

J. W. MASON, Agt.,
527 Delaware Street,
KANSAS CITY, MO

POST & CO., Agts.,
CINCINNATI, O.

THE PERKINS ELECTRIC LAMP CO.

LAMPS

TO FIT ANY SOCKET.
ANY CANDLE POWER.
ANY VOLTAGE.
LONGEST LIFE.
HIGH EFFICIENCY.

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF EVERY DESCRIPTION.

54 and 56 Franklin Street, CHICAGO.

SEND FOR CATALOGUE.

THE ELECTRIC RAILWAY CATALOGUE

No. 31.

FRESH FROM THE PRESS!

250 Pages, Handsomely Illustrated.

NOT A STALE LINE IN IT.

CRISP, CRACKLING, NEWSY,

BRISTLING WITH INFORMATION.

From the first Fly Leaf to the last Signature, from Introduction to Finis, the thread of intense Practicability holds the reader's attention.

NOT A DULL CHAPTER!
NO MEDIOCRE CHARACTERS!

It should be in the hands of every man interested in the developing or management of Electric Railways. Send for a copy, and keep in the vanguard of Progress.

Published by

THE ELECTRICAL SUPPLY CO.,

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

SUN ARC LAMP!

For Direct Incandescent Circuits.

For Arc Circuits.

ONLY ARC LAMP IN THE MARKET WHICH BURNS ON AN INCANDESCENT CIRCUIT

SUCCESSFULLY.

SINGLY OR TWO IN SERIES.

COMPLETE SUCCESS!

Everybody Delighted With It. See Testimonials Next Week.

CONVINCE YOURSELF

By sending an Order for one Or two to us.

Great Western Electric Supply Co.,

201, 203, 205, 207 SO. CANAL STREET,

Selling Agents. **CHICAGO, ILL.**

Special Inducements to Supply-Houses.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

WORKS AND GENERAL OFFICES. BALTIMORE, MD.

Long Distance Series Incandescent Lighting

—BY THE—

HEISLER SYSTEM.

HAS NO EQUAL

In the Economical Subdivision of the

ELECTRIC LIGHT.

No Transformers or Other Translating Devices.

We distribute the capacity of our largest dynamo on a No. 8 wire, and thus avoid the excessive cost of conductors as used for other methods of distribution.

Awarded gold medal at Paris Exposition, 1889.

Estimates furnished on application for the complete installation of plants in any section.

Write for price list of series lamps for use on arc light circuits. State for what current and system.

Correspondence solicited.

HEISLER ELECTRIC LIGHT CO.,

DREXEL BUILDING, PHILADELPHIA, PA.

Send for Circular.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, SEPTEMBER 12, 1891. No. 12

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

The Minnesota Brush Electric Company

HAVE JUST BOUGHT

82½ MILES

of Arc, Incandescent and Power Cables

INVESTIGATION PROVED IT THE BEST.

OF THE Standard Underground Cable Co.,

New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

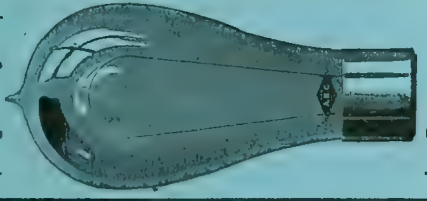
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,

20 CORTLANDT ST., NEW YORK.

GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."



WRITE US FOR PRICES OF ALL GOODS

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,

MANUFACTURERS, IMPORTERS AND DEALERS IN

THE "CHAMPION" BATTERY,

Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.

THE TRADE WILL BE PROPERLY PROTECTED.

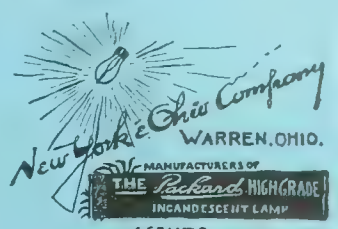
Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies

Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.



AGENTS

J. W. PEALE, 1 BROADWAY, NEW YORK
CENTRAL ELECTRIC CO. CHICAGO, ILL.
ELECT. ENG. AND SUPPLY CO. ST. PAUL, MINN.

CLOWER, HARRIS & CO.,

CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.

The Largest Electrical Supply House west of the Mississippi River.

Everything Electrical

289 ELM STREET. - - DALLAS, TEXAS.

FOR SALE.

One 3 Horse Power Electric Motor.
One 5 Horse Power Electric Motor.

Both in excellent condition, having been used but little.

ERIE ELECTRICAL SUPPLY CO., ERIE, PA.

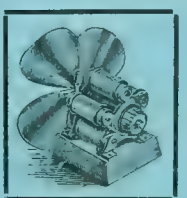
WRITE FOR PRICES ON

TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.

R. D. Nuttall Company,

Allegheny, Pa. New York.

THE 1891 ELECTRIC MOTOR AND BATTERY.



SIMPLE. DURABLE. ECONOMICAL. EFFICIENT.

For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at

ONE-HALF PRICE.

Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers. F. CAZENOVE JONES, Manager of Factories.

The International OKONITE COMPANY, LIMITED.

13 Park Row, New York.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

For Aerial, Submarine and Underground Use.

Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

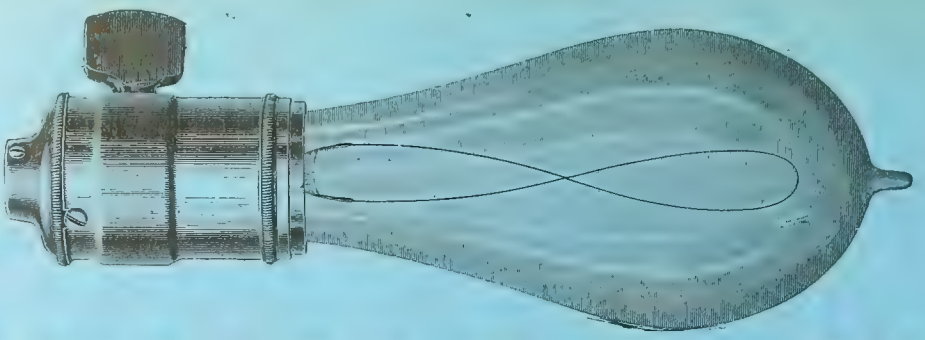
THE BALL & WOOD CO.,

OWNERS OF BALL PATENTS AND BUILDERS OF

Improved BALL Engines.

Office 15 Cortlandt St., New York.

W. B. PEARSON & CO., Agents, - Home Insurance Building, CHICAGO, ILL.



LONG LIFE INCANDESCENT LAMPS.

SEE WHAT PURCHASERS SAY:

BURLEY HOUSE,
Belle Plaine, Iowa.

State of Iowa }
Benton County } ss.

I, B. B. Burley being duly sworn upon oath depose and say, that I am a resident of Belle Plaine Benton County, Iowa, and proprietor of the "Burley House" in said City — That Sept. 20th 1889, the Un'n A. Hunter Electric Company, placed a 32 Candle power — 52 volt incandescent lamp, of the Thomson-Houston System, on the porch at my said Hotel — That said lamp burned continuously for 4620 Hours, burning out July 15th 1891. —

B. B. Burley

Subscribed in my presence and sworn to before me August 10th 1891.

John H. Miller
Notary Public in
& for Benton Co., Iowa.

B. B. BURLEY,
Prop. BURLEY HOUSE,
Belle Plaine, Iowa.

Extract of letter from Manitou Electric Co., Manitou Springs, Colo.

DATED AUGUST 23, 1891:

"We have got T. & H. Lamps burning and giving good light that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston Lamps still burning that have burned 5000 hours. The lamps were all I could ask. Have tried 'Sunbeam,' 'Edison' and other lamps made in Chicago, and the 'Perkins,' all of which are no good on earth."

MANITOU ELECTRIC CO.,
By C. F. TINGLEY, Manager.

THE IRON MOUNTAIN ELECTRIC CO., IRON MOUNTAIN, MICHIGAN, state that they have lost but 2 lamps in three months, with one thousand installed.

In the face of these Facts, why do you buy lamps that are of Short Life, Low Candle Power, and that quickly Blacken?

We make our own lamps and can furnish them at once

From 45 to 116 Volts,
From 6 to 150 Candle Power.

Write for Price Lists.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Avenue, BOSTON, MASS.

148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....xxx
Abendroth & Root Mfg. Co.. ——
Alexander, Barney & Chapin.....i
American Electrical Works.....xv
Andrews & Co., A. H..... ...xxi
Automatic Switch Co.....xii
Baggot, E.....xvi
Bain Electric Mfg. Co..... iv
Ball Engine Co.....xxi
Ball & Wood Co., The..... i
Baxter Electric Motor Co..... xxx
Bernstein Electric Co..... x
Blatz, L.....——
Borden & Selleck Co.....xvii
Braun Illustrating Co.....xxi
Brownlee & Co.....xiv
Brookfield, Wm.....xiv
Brush Electric Co.....xix
Butler Hard Rubber Co.....iv
Buxton, Geo. B xxiii
C. B. & Q. R. R..... .xvi, xxi
C. & C. Electric Motor Co...xviii
Card Elec. Motor & DynamoCo——
Central Electric Co..... ...vii
Chase, M. C.....xiv
Chicago Electric Mfg. Co.....xvi
Chicago Electric Motor Co..... xv
Chicago Rawhide Mfg. Co..... x
Clower, Harris & Co.....i
Chicago Insulated Wire Co... xix
Colburn Electric Mfg. Co..... xvi
Coolidge, Fuel & Supply Co... ——
Consol. Elec. Mfg. Co., The.... —
Cowles Electric Smelting and Aluminum Co.....xvi
Crocker-Wheeler Electric Motor Co.....vi, xv
Cutter, Geo..... xxvi
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co..xxi
Eastern Electric Cable Co..... xv
Edison General Electric Co.....viii
Edison General Electric Co., Cable and Wire Department.....ix
Electric Construction & Sup. Co.xxvi
Electric Merchandise Co..... iv
Electric Secret Service Co.....xx
Electrician Pub. Co....xii, xx, xxiii
Elec. Construction Co., The.... xv
Electrical Engineering Co..... xv
Elec. Eng. & Supply Co., The ——
Electrical Supply Co., The..xxviii
Elektron Mfg. Co.....xviii
Empire China Works..... .xvi
Erie E'ectrical Supply Co..... i
Evans Friction Cone Co..... xix
For Sale xv
Foster, O. A.....i
Fort Wayne Electric Co..... xxx
Freeman, Coleman & Co.....xxiii
Globe Carbon Co.... xvii
Great Western Elec. S. Co... x, xxix
Greeley & Co., The E. S.....i
Hale Elevator Co..... xii
Heisler Electric Light Co.....x
Hill Clutch Works.....xxiii
Hine Eliminator Co.....xiv
Holmes, C. H..... xv
Holmes, Booth & Haydens... xix
Hood, Wm.....xii
India Rubber & Gutta Percha Insulating Co.....xxiv
Interior Conduit &Insulation Co. x
International Okonite Co..... i, vi
Kartavert Mfg. Co..... xvi
Keller & Degenhardt..... xiv
Knapp Electrical Works.....xxvii
Law Telephone Co..... xv
Leonard & Co., H. Ward.....xxiv
Leffel & Co., Jas..... xv
Loud, H. M. & Sons Lumber Co.xvi
McLaughlin, James xv
Manhatten Elec. Supply Co.... xvi
Mason, James H xv
Mather Electric Co..... ...xviii
Milliken Bros.....iv
Minneapolis Street Railway Co.....
Monitor Electric Co xii
Mosher Arc Lamp Co.....xvi
Munsell & Co., Eugene..... xv
Murphy. T. J.....xv
N. W. T. H. Electric Co..... v
National Carbon Co.....iv
National Electric Mfg. Co..... xi
N.Y.Belting & Packing Co... ....
New York Insulated Wire Co.... ix
New York & Ohio Co..... i
N. W. Elec. Specialty Co..... —
Nuttall Company, R. D..... i
Ostrander & Co., W. R.....xvi
Palste, H. T..... xxv
Page Belting Co.....xvi
Partrick & Carter Co.....xii
Payne & Co., Geo. W.....
Pearson & Co., W. B.....xxi
Phoenix Glass Co..... iv
Pond Engineering Co..... xxi
Powell Co., The Wm..... ——
Queen & Co..... xv
Rockford Electric Mfg. Co.....xiv
Sargent & Lundy..... xv
Sawyer-Man Electric Co.....xiii
Schieren & Co. Chas. A.....xiv
Schoonmaker, A. O.....xiv
Schuyler Electric Co..... x
Short Electric Railway Co.....xiv
Shultz Belting Co.....xxiii
Sperry Electric Mining Machine Co.....xvi
Standard Underground Cable Co....i
Standard Paint Co.....xiv
Stanley Electric Mfg. Co.....xxiii
Star Iron Tower Co..... —
Stearns Mfg. Co.....xxi
Sterling, W. C.....xvii
Stilwell & Bierce Mfg. Co. xvi, xvii
Sunbeam Incand. Lamp Co xvii
Taussig, S..... .—
Temple, J. C.....xvii
Thomson-Houston Elec. Co . ii, xxii
Turner Brass Works..... xv
Union Electric Mfg. Co., The.. xii
Union Electric Works..... iv
Union Hardware Co..... xiv
U. S. Electric Lighting Co... xiii
Van Nuis C. S..... i
Vulcanized Fibre Co.....xvii
Wanted ..... xiv, xv
Wenstrom Consolidated Dynamo & Motor Co., The xx
Western Electric Co xx
Westinghouse Elec and Mfg Co..—
Westinghouse Machine Co..... xxi
Weston Electrical Instrum't Co.vi,xiv
Williams Engine Works.... .. xxi
Woodbridge & Turner Engineering Co xvii
Woodhouse & Rawson, Ltd....—
Worthington, Henry R..... xiv
Wrigley. Thos.....xxiii

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelting & Aluminum Co.
Fre eman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co.. The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co.
N. W. T. H. Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co.,The.
Foster, O. A.
Law Telephone Co.
Manhatten Elec. Supply Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Manhatten Elec. Supply Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Chicago Rawhide Mfg. Co.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry Co.
Rochester Railway Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Keller & Degenhardt.
Leonard & Co., H. Ward.
Mather Electric Co.
McLaughlin, Jas.
N. W. T. H. Electric Co.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Palste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
Mather Electric Co.
National Electric Manufacturing Co.
N. W. T. H. Electric Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrollers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Manhatten Elec. Supply Co.
Monitor Electric Co.
Northwestern Electric Specialty Co.
N. W. T. H. Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Glass Cutters.
Taussig, S.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.
Chase, M. C.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Chase, M. C.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cutter, Geo.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Supply Co., The
Electrical Eng. & Supply Co
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Western Electric Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Card Electric Motor & Dynamo Co.
Chicago Electric Mfg. Co.
C. & C. Electric Motor Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Electrical Manufacturing Co.
Erie Electrical Supply Co.
Fort Wayne Electric Co.
Mather Electric Co.
Stanley Electric Mfg. Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
Rochester Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cutter, Geo.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Toggle Bolts
Wrigley, Thos.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens
Knapp Electrical Works
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

UNION ELECTRIC WORKS,

207 SOUTH CANAL STREET, CHICAGO, ILLINOIS.

The BEST ELECTRIC BELL in the market; Nickel plated Gongs: Double magnet, Platinum Contacts, side adjustments with set screw. The simplest and most durable Annunciator, all sizes, for elevat rs, hotels and offices.

— WRITE FOR PRICES. —

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class Work.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

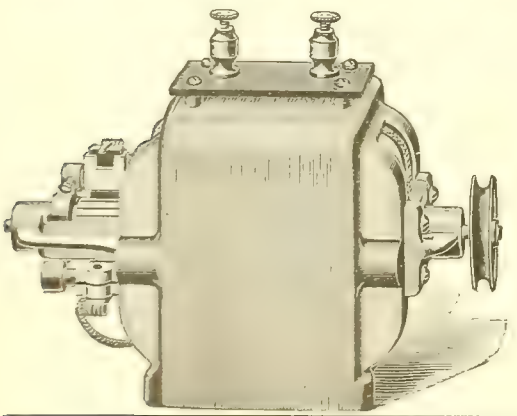
Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. B. Mc[illegible], General Manager.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

—GENERAL AGENTS FOR—

ALL PRODUCTS

—OF THE—

THOMSON-HOUSTON ELECTRIC CO.,

—FOR—

Northern Wisconsin,
Minnesota,
North Dakota,
South Dakota,
Montana,
Wyoming,
Idaho,
Washington,
Oregon.

PRINCIPAL OFFICE:

403-405 Sibley Street, St. Paul, Minn.

H. M. BYLLESBY, President. HOWARD C. LEVIS, V.-P. and Treas. B. F. MEEK, Jr., Secy. and Asst. Treas.

GEO. C. DUFFIE, Asst. Secy.

BRANCH OFFICES:

Cor. A and Front Streets, PORTLAND, ORE.

H. W. GOODE, Manager.

Thompson Block, HELENA, MONT.

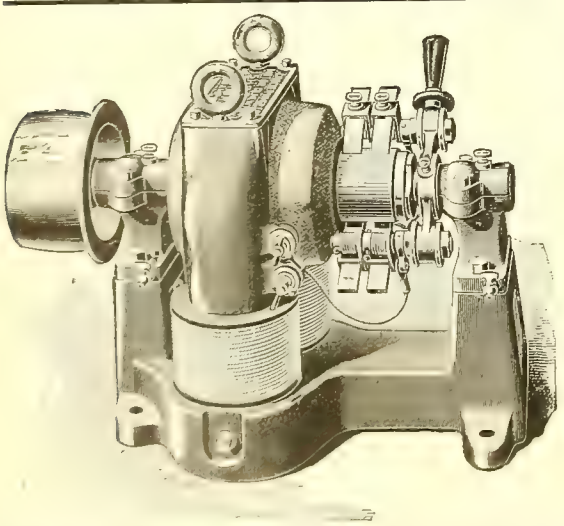
H. W. TURNER, Manager.

RESPECTFULLY SUBMITTED TO THE MEMBERS OF THE N. E. L. ASS., U. S. A.
FOR ASSOCIATION BADGE.

INTERNATIONAL **OKONITE COMPANY,** LIMITED.

13 PARK ROW, NEW YORK.

Largest Manufacturers of Insulated Wires and Cables in the World.



CROCKER-WHEELER

Perfected Motors.

CORRESPONDENCE INVITED.

430-432 West 14th Street,

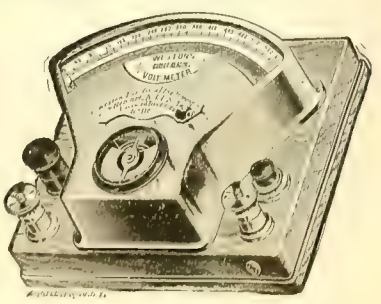
NEW YORK CITY.

The Standard Voltmeter.

THE STANDARD AMMETER.

WESTON'S PORTABLE DIRECT-READING VOLTMETER.

Weston's Portable Direct-Reading Ammeters and Mil-Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges [illegible] for every kind of work.

SEND FOR ILLUSTRATED CATALOGUE.

WESTON ELECTRICAL INSTRUMENT COMPANY,

Office and Factory, 114 & 116 WILLIAM STREET, NEWARK, N. J.

OUR ST. LOUIS BRANCH.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 LOCUST ST., ST. LOUIS, MO.

OUR KANSAS CITY BRANCH.

OKONITE

GATE CITY ELECTRIC COMPANY,
522 DELAWARE ST., KANSAS CITY, MO.

YOU CAN'T AFFORD

TO BUY YOUR

Weather-proof Wire, Underwriters' Wire, Moisture-proof Wire, Insulating Tape, Rubber Tubing, Sockets, Lamp Cords, Switches, Cut-outs, Branch Blocks,

Without getting our prices and letting us show you our samples.

CENTRAL ELECTRIC COMPANY,

116 AND 118 FRANKLIN STREET, CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE COMPANY'S SYSTEM.

OUR DENVER BRANCH.

OKONITE
TRADE MARK

ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., DENVER, COLO.

OUR OMAHA BRANCH.

OKONITE

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., OMAHA, NEB.

Edison

General

Electric Co.

EDISON BUILDING,

BROAD STREET,

NEW YORK.

Announcement!

WE ARE NOW FURNISHING:

INCANDESCENT LAMPS,
Of any Voltage to Fit any Socket.

ARC LIGHTING SYSTEM,
Embracing many New and Valuable Features, Notably Lamps that will Burn 7 or 14 Hours.

SLOW SPEED MOTORS,
From 1-12 to 1-2 Horse-Power. Most Economical and Reliable Small Motor Manufactured.

MOTORS,
Of any Capacity, from 1-2 to 210 Horse-Power. Highest Efficiency, Lowest Price.

FIXTURES, ELECTRIC AND COMBINATION GAS,
Being the most Complete and Artistic Line now on the Market.

WIRE AND CABLES,
Including the Famous Cables of Siemens & Halske, of Berlin.

ELECTRIC RAILWAYS,
Both Single and Double Reduction Motors.

ELECTRIC MINING APPLIANCES.
Percussion Drill, Diamond Drills, Locomotives, Hoists, Pumps, Fans and Coal Cutters.

GENERAL SUPPLIES,
Carried in Stock at Each District Office.

DISTRICT OFFICES.

CANADIAN DISTRICT:
Edison Building, Toronto, Can.

CENTRAL DISTRICT:
173-175 Adams St, Chicago, Ill.

EASTERN DISTRICT:
Edison Building, Broad St., New York.

NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.

PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.

PACIFIC NORTHWEST DISTRICT:
Fleishner Building, Portland, Ore.

ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.

SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga.

CUT-OUTS, JOINTS, DISTRIBUTING BOXES, ELBOWS ETC., ETC.

CORRESPONDENCE SOLICITED.

THE NEW SAFE-DUCT AND COMPLETE METHOD OF WIRING FOR ALL ELECTRIC LIGHTING SYSTEMS.

"VULCA"

NEW YORK INSULATED WIRE CO. NEW YORK
MOISTURE-PROOF
VULCA
ELECTRICAL
WIRE-DUCT
NON-INFLAMMABLE
TRADE MARK

ELECTRICAL WIRE DUCTS.

AND CHICAGO.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

THE NATION'S CHOICE.

Grimshaw White Core Wire.

B. D. WIRE, TAPES AND COMPOUNDS.

ALL SUPPLY STORES KEEP THEM.

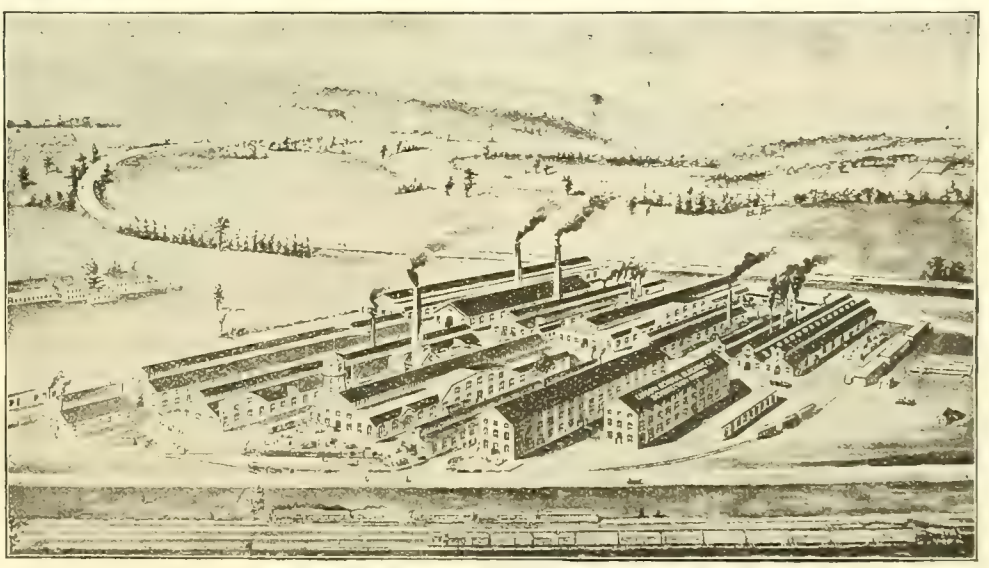
NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street, CHICAGO,

MAIN OFFICE: 649-651 Broadway, New York. GEO. H. MEEKER, Western Manager.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

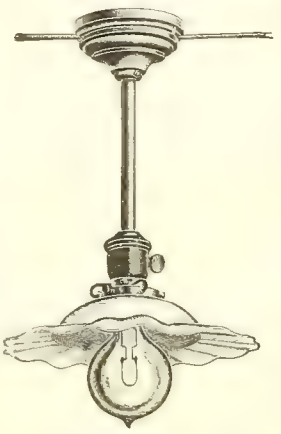
BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS

—FOR—

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.



The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,

BOSTON, - MASS.

The SOLUTION of the PROBLEM of SAFE GUARDING ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

THE INTERIOR

CONDUIT AND INSULATION CO.,

WORKS: { 527 to 531 W. 34th St., 626 to 628 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Electrical Engineering Co., 320 Dearborn St., Chicago, Ill.
Southern Electric Co., Baltimore, Md.
Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
B. Frank Johnson, Provident Bldg., Philadelphia, Pa.

RAWHIDE DYNAMO BELTING.

GREATEST ADHESIVE QUALITIES. A NON-CONDUCTOR OF ELECTRICITY. CAUSES LESS FRICTION THAN ANY OTHER BELT.

Rawhide Pinions for Electric Motors a Specialty.

LACE LEATHER ROPE AND OTHER RAWHIDES. GOODS OF ALL KINDS BY KRUEGER'S PATENT.

This Belting and Lace Leather is not affected by steam or dampness; never becomes hard; is stronger, more durable and the most economical Belting made.

The Rawhide Rope for Round Belting Transmission is superior to all others.

THE CHICAGO RAWHIDE MFG. CO., 75 Ohio Street, CHICAGO, ILL.

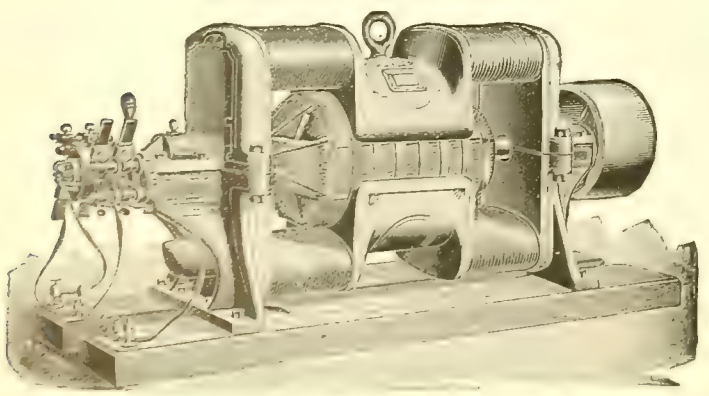
The Only Manufacturers in the Country.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

Long Distance Series Incandescent Lighting

—BY THE—

HEISLER SYSTEM.

HAS NO EQUAL

In the Economical Subdivision of the

ELECTRIC LIGHT.

No Transformers or Other Translating Devices.

We distribute the capacity of our largest dynamo on a No. 8 wire, and thus avoid the excessive cost of conductors as used for other methods of distribution.

Awarded gold medal at Paris Exposition, 1889.

Estimates furnished on application for the complete installation of plants in any section.

Write for price list of series lamps for use on arc light circuits. State for what current and system.

Correspondence solicited.

HEISLER ELECTRIC LIGHT CO.,

DREXEL BUILDING, PHILADELPHIA, PA.

Send for Circular.

THE NATIONAL TRANSFORMER SYSTEM

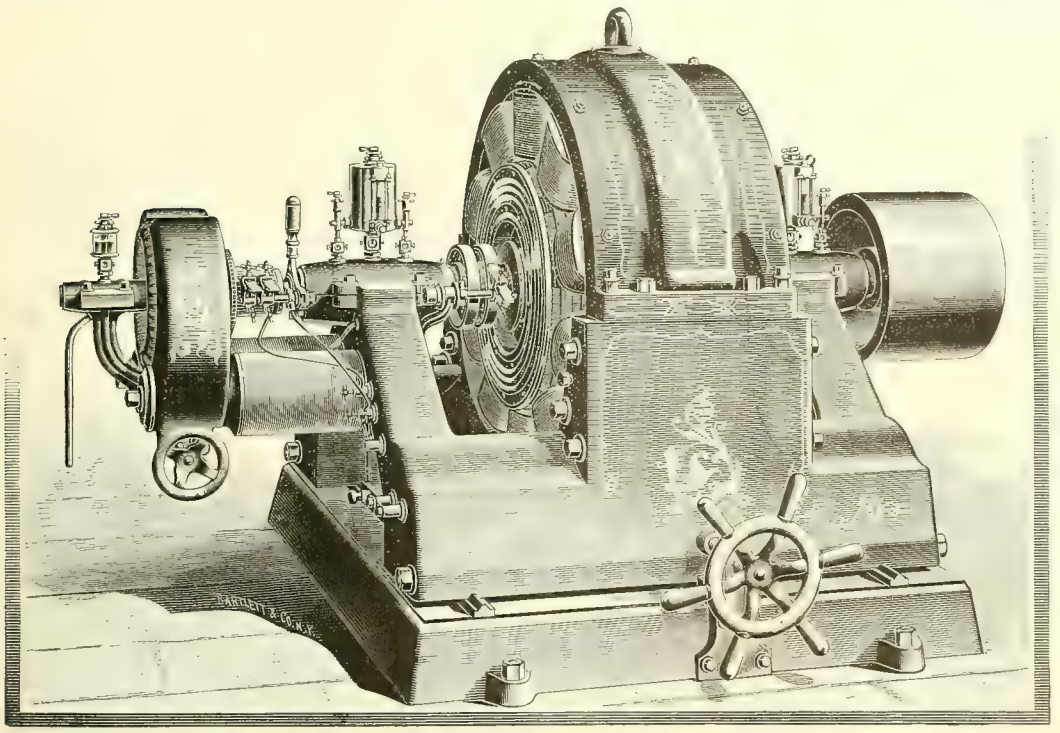
OF INCANDESCENT LIGHTING.

Florence, S. C., August 19, 1891.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.:

GENTLEMEN:—I write this to tell you of the wonderful performance of our Alternating Dynamo, which is a 750 lighter of your manufacture. Last night, while at supper, a cross got on our mains by their sagging on to a telegraph wire, and my engineer, who is a new man, ran the dynamo with the ampere meter needle clear on the end of the scale, which is about 80 amperes, or equivalent to approximately 1,600 lamps. It ran that way until it chocked down a 100 H. P. engine with 110 pounds steam, and then he sent for me. Strange to relate, the machine was not damaged a particle. The excessive current had melted all of the 4 fuses on the board, but the engineer had put in new ones and heavier ones, and had started up again. I consider that we have the only dynamo on earth that would stand such a strain and not be injured. I shall of course see to it, that a thing of this kind does not happen again.

[Signed] A. A. FORMAN, Supt. Florence Impvt. & Mfg. Co.



Self-Contained Alternator. Capacity 1,000 16 C. P. Lamps.

THIS IS THE MACHINE THAT WE BUILD.

SEND FOR CIRCULARS AND PRICES.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

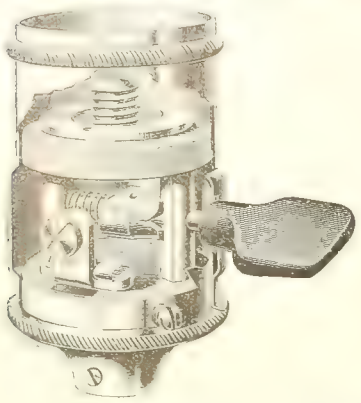
COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	DETROIT, MICH.,	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	DENVER, COLO.,	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	SAN FRANCISCO, CAL.,	National Electric Development Co.
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.	KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
SEATTLE, WASH.,	Chas. H. Baker & Co.	DULUTH, MINN.,	The Electrical Eng. & Supply Co.



THE FACT that COMPETITORS are IMITATING our SOCKET is PROOF ENOUGH for ANYONE that it is the

BEST SOCKET ON THE MARKET.

THE UNION ELECTRIC MFG. CO., BRIDGEPORT, CONN.

NEW YORK: Alexander Barney & Chapin. BOSTON: The Eastern Electrical Supply Co.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

Electrical Supplies

OF ALL KINDS.

House Goods A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

WM. HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

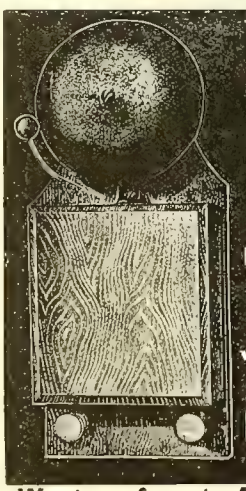
PRICES:

16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.



MONITOR

WOOD · BOX

BELLS

ARE THE BEST.

Polished Case, Nickel Plated Trimmings, Heavy Magnets, Quick Stroke, Clear Ring.

Write for Quotations to

C. A. HARMOUNT, M'gr,

MONITOR ELECTRIC COMPANY

149 Wabash Av., CHICAGO, ILL.

Western Agents Alfred F. Moore's Wires and Cables.

OTIS

ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

PASSENGER AND FREIGHT

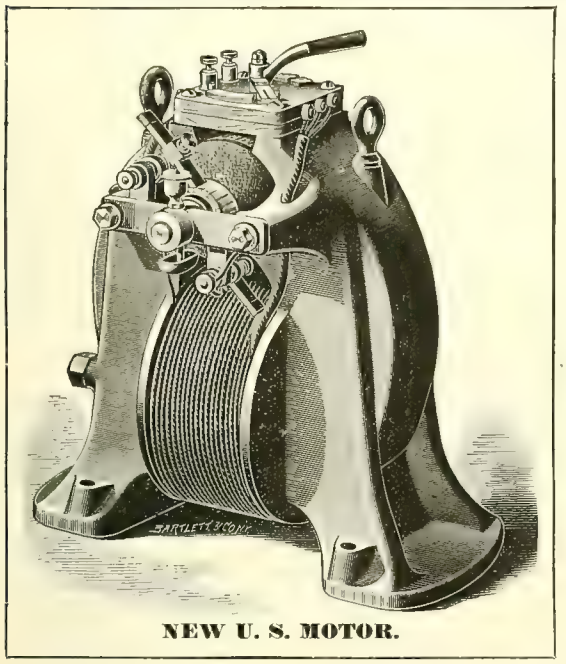
Hydraulic and Electric

ELEVATORS.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

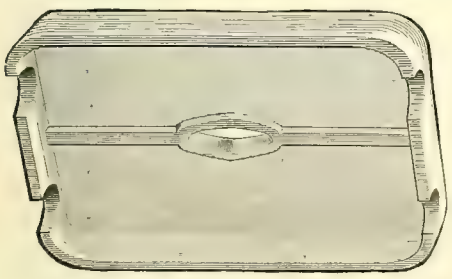
MOTORS and GENERATORS

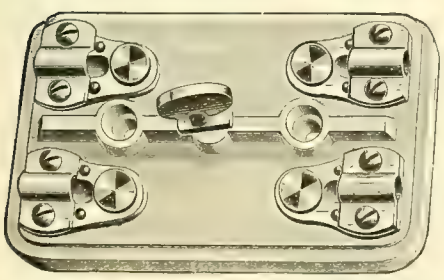
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

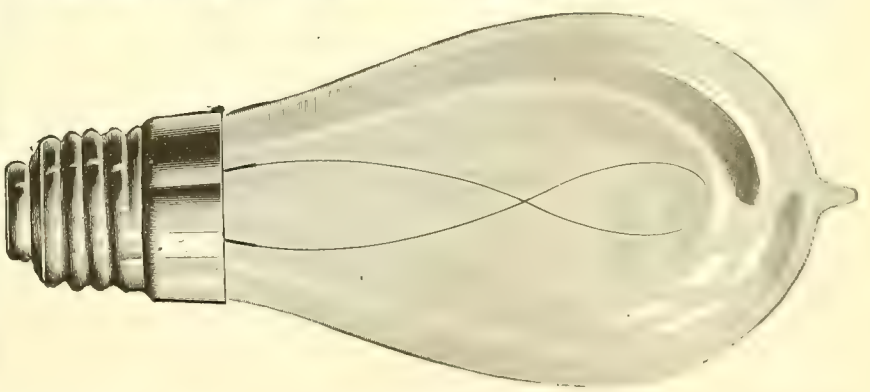
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

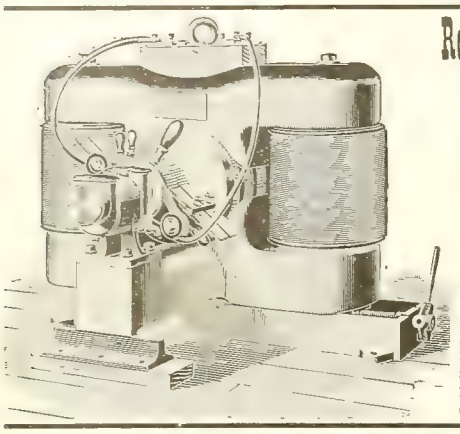
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

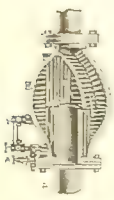
MOTORS,

(Stationary and Railway).

Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.



KNOW WHAT YOU'RE GETTING!

HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

In a test of the best known "Separators" recently made at Cornell University this ELIMINATOR demonstrated percentages of efficiency over ALL competitors ranging from 11 to 59 per cent. The full report of test with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street, NEW YORK.

REMEMBER That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

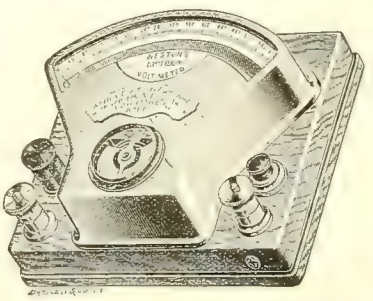
CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

SITUATION WANTED.

Wanted—Position as superintendent of electric station. Six years' experience in the business as electrician and engineer, and in the selling of machinery and in construction work. The best of references. Address "**H. S. E.**," Care WESTERN ELECTRICIAN.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER F. E. DEGENHARDT

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING. - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

ATTENTION, STREET RAILWAY MANAGERS.

The Jamestown (N. Y.) Street Railway Co. report that the total time lost by 10 cars from June 10th to August 29th (11 weeks) was two (2) car days.

Short System.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, O.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

P. AND B. Armature Varnish, Insulating Compounds, Insulating Tapes, Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, **NEW YORK.**

Western Electrician.

EVERY SATURDAY.

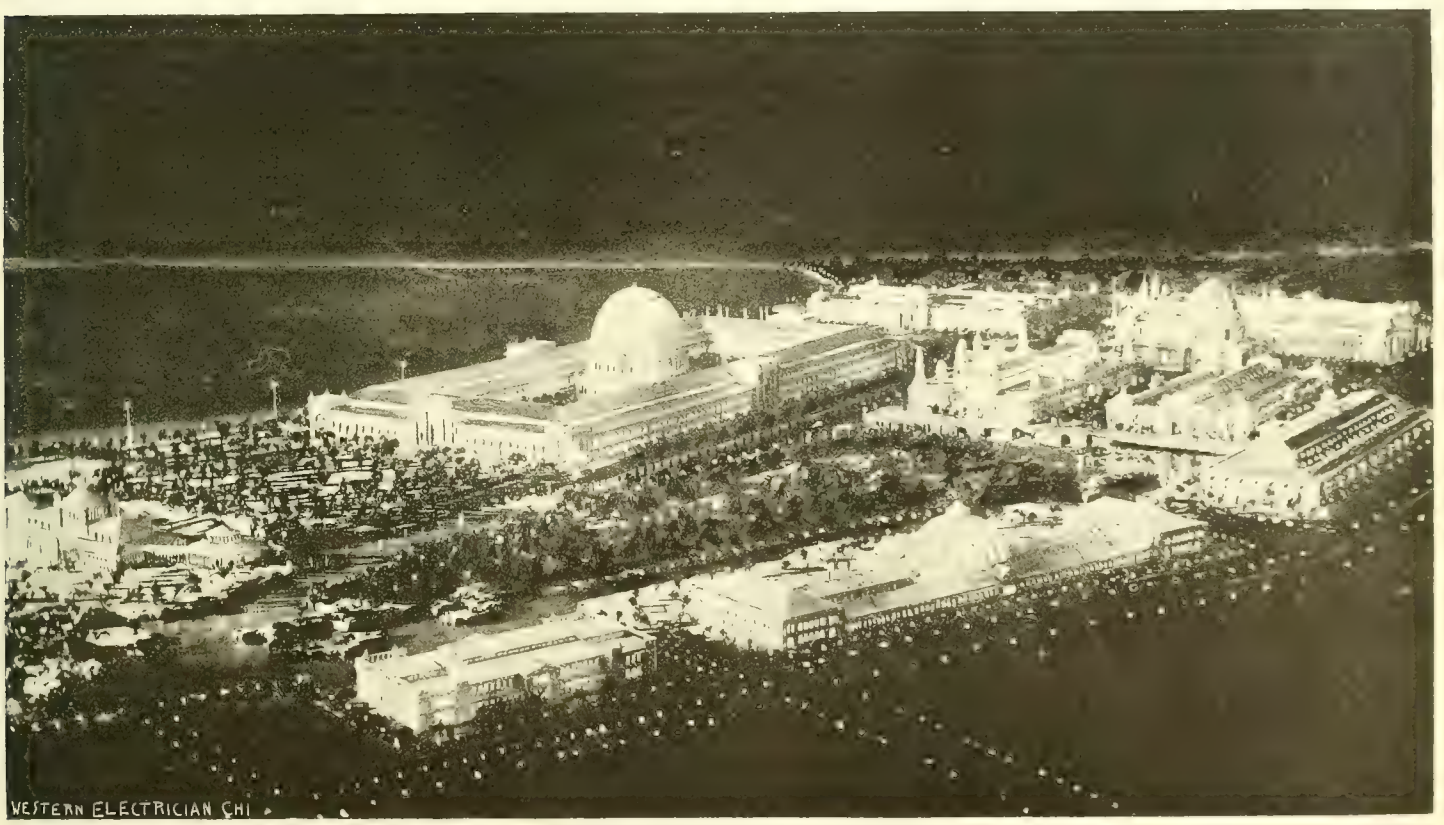
Vol. IX. CHICAGO, SEPTEMBER 12, 1891. No. 11

World's Fair at Night.

A short time ago mention was made in the WESTERN ELECTRICIAN of the model representing the grounds and buildings of the World's Fair, which had just been opened for exhibition in the Exposition building on the Lake Front, Chicago. The chief attraction of this model lies in its illumination by the electric light. Upon entering the building, the spectator finds himself on a platform raised only a few feet above the miniature park which lies stretched out before him. The model represents the buildings and grounds on the scale of one inch to eight feet. The structures represented are the machinery, agriculture, administration, electricity, mines, transportation, manufactures and liberal arts, government, horticulture, fisheries, the Illinois state and the women's buildings. These are shown as they will appear when completed, and are placed correctly in their relative positions. The lagoons, grounds and a portion of Lake Michigan complete the model, which covers an area of about 3,000 square feet.

The view from the first platform represents the Fair as it would appear at an elevation of 300 feet, the second at an elevation of 500 feet, the one above at a height of 800 feet and the highest at an elevation of 1,050 feet. In the ceiling of the room are placed a number of electric lamps arranged in rows, their light being concentrated directly on the model by means of reflectors. These lights give the effect of daylight. Gradually the lights are turned down. A powerful calcium light is next thrown upon the model The effect is quite beautiful. Colored glasses are passed before the calcium, revealing the buildings and grounds under varied tints. But it is not until the lights in the ceiling and the calcium are completely turned off and the effect of night is obtained that the scene attains a completely realistic aspect. Suddenly the interiors of the darkened buildings are flooded with light from thousands of tiny electric lamps. Hundreds of miniature street lamps also illumine the grounds and cast their reflection into the miniature lagoons. The model at this point will give the spectator a very good idea of the appearance of the World's Fair as viewed from some lofty point at night. The accompanying illustration will give the reader some idea of the appearance as just described. A spacious grotto affords the spectator a pleasant place of rest when weary of viewing the model. Some interesting spectacular effects produced by the electric light, as arranged by M. J. Steffens, may here be seen. The electrical work on the model was done by the Electrical Construction company of Chicago.

All visitors are enthusiastic over the electric lighting effects. The soft glow of hundreds of tiny incandescent lamps makes the buildings fairly luminous when the current is turned on and the roof lights are extinguished. The result is very pleasing and is intensified by the sparks of light lining the water front and scattered about the grounds, representing street lamps. The whole electrical installation is capitally managed. Current is furnished from the Edison station on Adams street.



WORLD'S FAIR AT NIGHT.

Electrical Decorations at Detroit.

On the occasion of the recent national encampment of the Grand Army of the Republic at Detroit much attention was attracted by the elaborate electric light decorations on the city hall. The idea originated with Comptroller Peter Rush of Detroit, who, with Mayor Pingree and Alderman Amos, constituted the committee on decorations. Bids for the work were invited, and the designs of J. J. McKenna of the Electrical Equipment company were accepted.

The work of preparation was completed in six days, about thirty men being kept busy day and night. Nearly a ton of copper wire was used. The badge, which was the principal feature of the design, was 48 feet high and 16 feet wide, the eagle [illegible] brought out by a mass of electric lights. The words "Hail, Victorious Army," were shown in letters seven feet high, 600 16 candle power lamps being required for this alone. In addition the G. A. R. motto and [illegible] 12-foot letters, red, white and blue lights being used. This was visible, it is said, for ten miles down the Detroit river. There was also an anchor, representing the navy, and a horse's head, standing for the cavalry. These took about 100 lights each. All told, the display was undoubtedly the most elaborate of the kind ever shown in the state. It excited the greatest enthusiasm among the visitors and citizens, and it was generally conceded that the electrical decorations far exceeded in brilliancy and effect the $6,000 pyrotechnic display made on the river. In all, nearly 2,000 lights were used. The area surrounding the city hall was lighted up so brightly that the glow was visible, it is said, for a distance of five miles in every direction. Current was furnished from the Edison station.

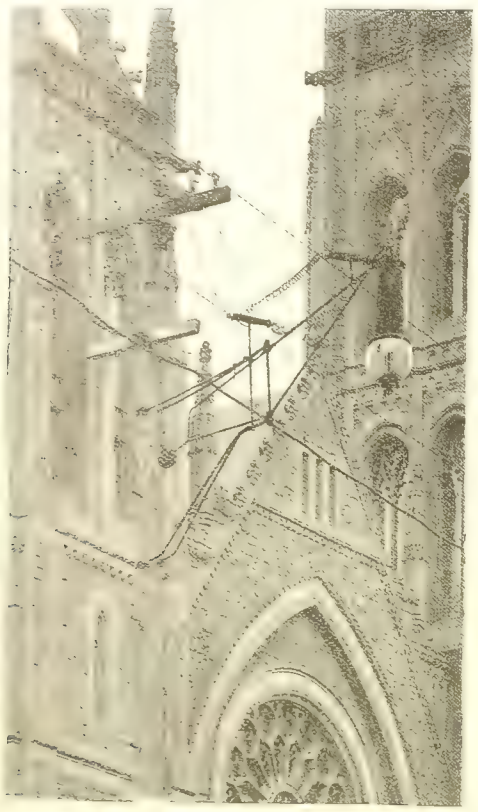
J. J. McKenna and A. S. Hatch, of the Electrical Equipment company, had direct supervision of the work.

Electricity at the World's Fair.

Meetings of the committee on electricity are [illegible] regularly, and much routine business is being transacted. At the meeting held last week Thursday at Chief Burnham's office several outside electricians were invited to meet the committee. After the meeting it was stated, however, that no definite action had been [illegible] of importance.

An important appointment recently confirmed by the board of directors is that of L. W. Robinson, chief of the department of machinery. This department will be intimately associated with the department of electricity, and the members of the electrical fraternity will be interested in the statement that the new chief is a man of [illegible] and

progressive views, well up in the applications of electricity. Mr. Thomson is a native of Philadelphia, and served with distinction in the war. His chief recommendation for the position he is to assume is his management of the great machinery exhibit at the Centennial Exhibition in 1876. He has been at work during the last three years



METHOD OF SUSPENDING ARC LAMPS IN THE STREETS OF MONTREAL.

aiding in the construction of the new cruisers, being detailed for duty principally at Cramp's ship yards. At present he is engaged in conducting an examination of candidates for promotion in the naval service. When this is finished, which will be in a few days, he will seek leave of absence from the Navy Department to consult with the managers of the World's Fair.

The project of sending a representative of the electrical department to Europe seems to meet general approval.

The necessity of prompt action in this matter will at once be recognized by all who have followed the tone of the foreign technical papers. There is a lack of enthusiasm which shows that unless something is done at once little may be expected of the foreign electrical concerns. The London *Electrician* of Aug. 14th devotes its leading editorial to this subject. Following is an abstract:

The decision of the English Government to lend official support by voting a grant of £25,000 and by the appointment of the Council of the Society of Arts as a royal commission, and the recent arrival of the exhibition commissioners in this country, warn us that those connected with the industries of Great Britain will shortly be called upon to make up their minds whether or not these industries shall be worthily represented in 1893 at the Chicago exhibition. The American de'egates, it must be admitted, have displayed during their brief stay on our shores the energy and push for which their nation is so justly famed. [illegible] and been interviewed, dined and been dined. No one in the remotest degree likely to contribute to the success of the exhibition, from [illegible] secretary of state for [illegible] and the London Chamber [illegible] at the present [illegible] being vigorously [illegible] to say [illegible] greeted, [illegible] are cordially [illegible] or more [illegible] body, [illegible] in the proposed [illegible]

[illegible] of the National Electric Light association [illegible] of the meeting a pronounced success and his former achievements in this line leave no doubt that he will arrange a display far superior to anything of the kind that has ever been presented in the Dominion.

force to the electrical industry. While no good Englishman can be got to admit for one moment that American electrical engineers turn out such efficient plants as we do, there is no gainsaying the fact that they turn out considerably more. Until a few years ago the English electrical engineer spent his enforced leisure in bringing dynamo and engine design to a science. Meanwhile, across the ocean, there was an immediate and large demand; dynamos had to be constructed somehow, and were generally constructed anyhow. Just at the time when we were celebrating the passing of that act of reparation known to lawyers as the Electric Lighting Act (1882) Amendment, our American friends, having solved the problem of electric lighting after their kind, were turning their energies to electric traction, in which branch of applied electricity there seems to be every chance of history repeating itself. The net result is that the Americans have evolved, under the conditions peculiar to them, several systems which meet the exigencies of trans-atlantic work; and they can now get along very well to their own satisfaction without us. Even if free trade prevailed between the two countries we doubt whether the United States would offer a very favorable market to English electrical apparatus, and with a prohibitory tariff in full swing, the attempt to force a market by dint of superior quality is hopeless. In Germany electric lighting is fairly prosperous and progressive, import duties, though high, are not prohibitive, and German engineers can boast neither of the experience nor of the ingenuity of their American brethren, yet, in spite of the great exertions of the promoters, the title is, perhaps, the most international feature of the Frankfort Exhibition.

With its vast area and population, the diversity of its climate and products, and the ingenuity and energy characteristic of the race, the people of the United States should be able to get together a "fair" which will astonish the world, and in this 'fair" no department will be of greater interest than that devoted to electricity. Englishmen will there be able to see the many strange things in electricity that America has brought forth during the past ten years. There will be much to learn, and, perhaps, something to unlearn, and a harvest of knowledge will be reaped in a few hours which, without the exhibition, would require months of weary journeying in "palace cars." English electrical engineers may well wish success to the exhibition, though they fail to discover valid reasons for taking part in it.

The Montreal Convention.

The National Electric Light association convention at Montreal this week has attracted more than usual attention on account of the elaborate preparations that have been made for the entertainment of the visitors.

The outlook for a large attendance is unusually good and the programme for the meetings include several papers upon subjects of more than ordinary interest. Elaborate arrangements have been made for an extensive ex-

Isolated and Central Station Lighting at Montreal.

The favor with which electric lighting has been received in the metropolis of Canada is shown no less in the large number of isolated electric lighting plants than in the great advancement made in central station lighting. In the accompanying cuts are illustrated three finely equipped plants which furnish current for commercial buildings.

In Fig. 1 is presented an excellent view of the dynamo room at the main station of the Canadian Pacific railroad. The plant is installed in a separate building at the southeast end of the train shed.

A 100 horse power horizontal tubular boiler, made by J. Dotty of Toronto, furnishes steam at 90 pounds. There are two Armington & Sims engines—one 65 horse power and the other 35 horse power.

The 65 horse power engine drives one 300 light Thomson-Houston incandescent machine, and one 12 light arc machine. The smaller engine drives a 300 light incandescent dynamo. The building is wired for 600 incandescent lamps, and the train shed is illuminated by 12 arc lamps. The depot building is built in six stories. There is a distributing switch board in the basement, and from this the lights of any story or one half story can be controlled. The depot is wired on the three-wire system, but when the load is light the circuit may be so connected at the switch-board that it becomes virtually a two-wire system. The plant was installed in February, 1889, by the Royal Electric company, Montreal. William Allen is in charge of the plant.

The Montreal *Gazette* Printing company's lighting plant is a complete and somewhat extensive installation, as will be seen from the accompanying illustration, Fig. 2. The dynamos are two in number, Edison No. 20, each of 115 volts, and supplying current to 1,000 16-candle power lights. The motive power is supplied by two engines, one of 150 and one of 100 horse power, manufactured by Laurie Brothers of Montreal especially for electric lighting service. There is also a reserve Corliss engine of 150 horse power used for driving the presses and other machinery of the establishment. The boilers, three in number, each of 150 horse power, are from the Macdougall works in Montreal. The machinery is all of Canadian manufacture. In the *Gazette* building itself about 500 lights are in use. Outside establishments are supplied to the extent of some 800 lights. Power is rented to a limited extent to operate electric motors near the building—about four horse power being supplied.

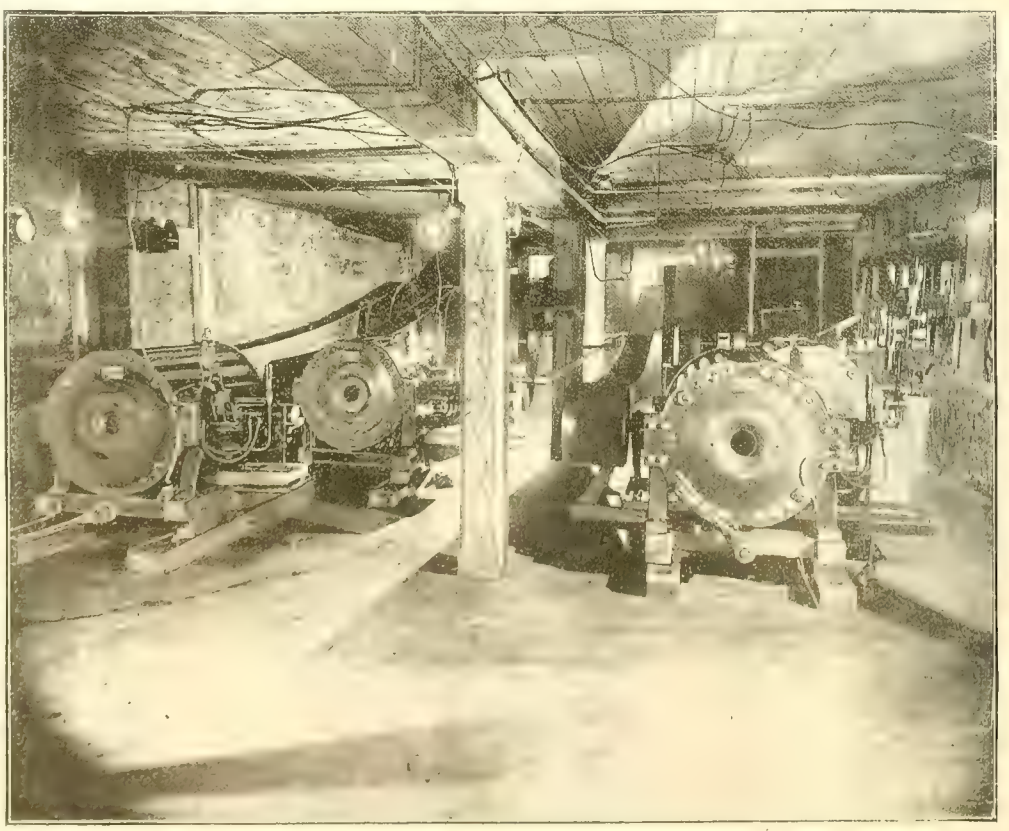


FIG. 3. ISOLATED AND CENTRAL STATION LIGHTING IN MONTREAL.

The Perrault electric light and power station is in the basement at 58 Fortification lane. This plant, illustrated in Fig. 3, has a capacity of 1,200 16 candle power incandescent and 20 arc lamps. The arc lamps are run on the incandescents circuit and are of the Universal type.

Steam is supplied from three boilers of 60 horse power each. These were made by Brush of Montreal. There are three engines belting to a main shaft, which in turn drives the dynamos. The 90 horse power engine is of the Corliss type, manufactured by Laurie Bros., Montreal. The other two engines are respectively 80 and 35 horse

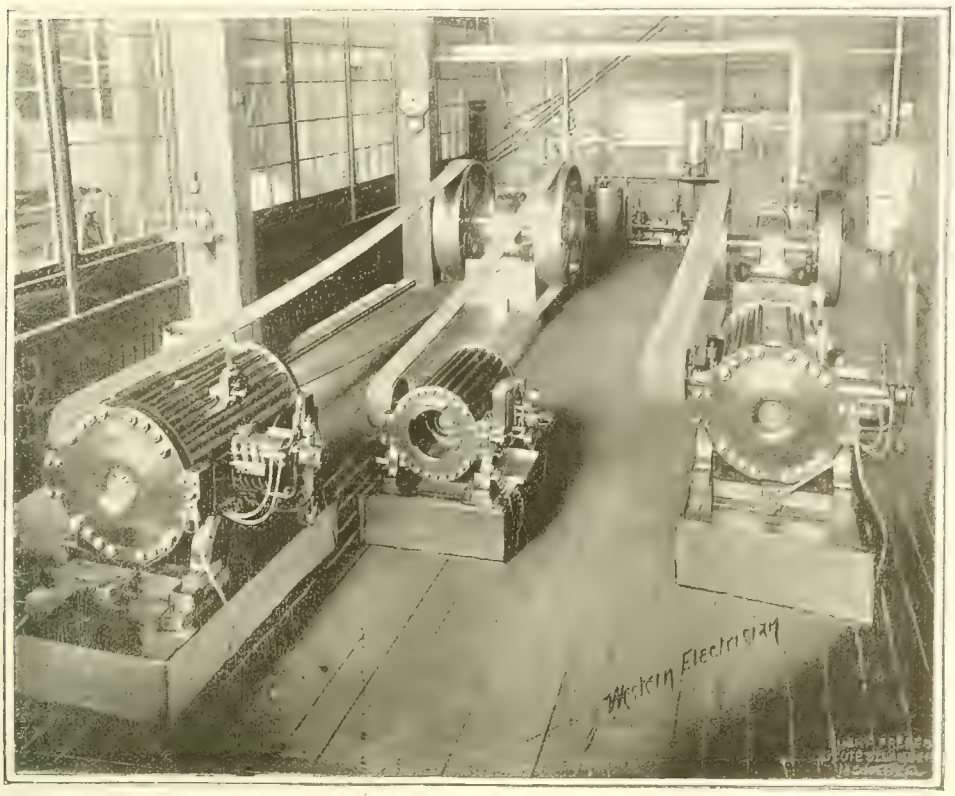


FIG. 1. ISOLATED AND CENTRAL STATION LIGHTING IN MONTREAL.

power of the Ball automatic pattern, made by Leonard & Son, London, Ontario. There are four Thomson-Houston incandescent machines of 300 lights each. The three-wire system is used. It may be mentioned also that this plant supplies power from the lighting circuit during the day. Eight motors are furnished, aggregating about 40 horse power. Storage batteries for dental use are charged also. The Perrault plant was started with one 300 lighter three years ago. Louis Goullioud is superintendent. The Perrault people claim the distinction of having supplied the current to the first elevator motor run in Montreal.

Minimum First Cost of Plant and Maximum Economy of Operation in the Electrical Transmission of Power.

To the Editor of the WESTERN ELECTRICIAN:

In your last issue I find an article on "Minimum First Cost of Plant and Maximum Economy of Operation in the Electrical Transmission of Power," by H. Ward Leonard. In this article Mr. Leonard takes issue with me on this subject, as treated in two of the chapters of the "Electric Transmission Hand book."

Mr. Leonard commences his article as follows: "A great deal has been and is being written and said about the condition governing the minimum first cost of a plant for the transmission of power by electricity, and also about the conditions governing the maximum economy of operation of such a plant, and some radical errors and false deductions have been made by those who are considered authorities upon this subject, so that it is not surprising that a somewhat erroneous idea at present exists in the mind of the electrical public upon this question."

The "authorities" cited by me and thus referred to by Mr. Leonard, are F. J. Sprague, Sir Wm. Thomson, Gisbert Kapp and Professors Ayrton and Perry. Mr. Leonard's statement is, to use Chicago vernacular, "very tough" on these illustrious gentlemen, and the little side attacks on myself can, of course, be easily borne in such good company. It is quite apparent that in Mr. Leonard's estimation there is but one electrical engineer who has correct ideas on this subject. This is not the first time, it should be remembered, that Mr. Leonard has posed as an authority on electrical problems. I beg to draw attention in this connection to a paper called the "Comparative Value of the Continuous and the Alternating Current Systems for the Commercial Distribution of Electric

ity," by H. Ward Leonard, read before the Chicago Electric club in March, 1888. Mr. Leonard was then the champion of continuous current distribution from central stations. He concludes the article with the following paragraph:

"From the foregoing comparisons, I consider the alternating current is not applicable to central station lighting, as it is at present operated, except as a possible occasional adjunct, or else upon an extremely small scale in cases where a few lights very greatly scattered are required, and where power is cheap. In cases where cheap power exists at a distance of several miles from a town capable of supporting a station of 2,000 lamps and upward, high initial electromotive force becomes both desirable and necessary, but the continuous current converter, which already exists in several forms, and which is receiving the attention of the best electricians and inventors of the

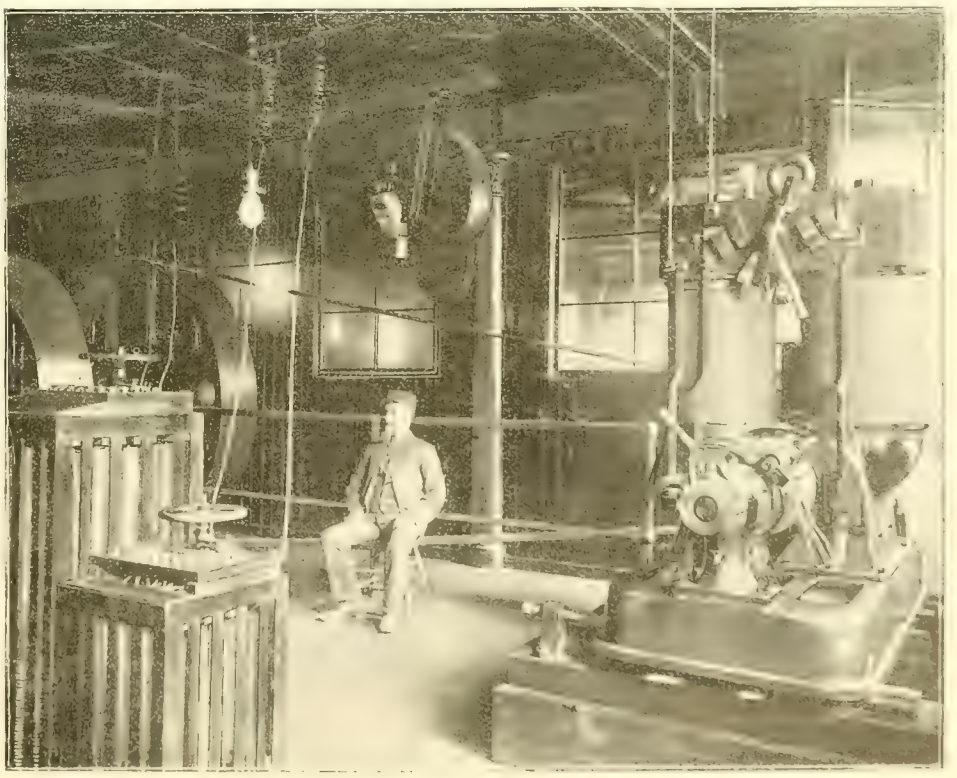


FIG. 2. ISOLATED AND CENTRAL STATION LIGHTING IN MONTREAL.

Thomson-Houston Electric company alone, which has been manufacturing both direct and alternate incandescent [illegible] direct current system in operation and none on the alternate, while on the [illegible] Thomson-Houston direct current incandescent systems with [illegible] and 10 [illegible] Houston alternate current system with 435,550 lamps.

In view of [illegible] "some radical errors and false deductions have been made by those who are considered authorities upon electrical subjects," and "that it is not surprising that a somewhat erroneous idea at that time existed in the minds of the electrical public upon certain questions."

Mr. Leonard also calls my unpretentious little volume a compilation, while in the same paragraph he states that I deduced certain formulæ [illegible] Mr. Leonard's opinion, incorrect manner; that these formulæ, however, when properly interpreted are entirely correct. It seems to me that Mr. Leonard's own statements prove that my deductions, and therefore the results, namely, certain formulæ, are original, and not, as he claims, copies of his own formulæ.

It is surprising that Mr. Leonard should have remained quiet "on the vital errors in some of the most noteworthy papers" and that such a *compilation* should arouse him to an answer.

Another surprising fact is that while Mr. Leonard writes about ten columns on the question of "Minimum First Cost of Plant," he writes only half a column on "Maximum Economy of Operation," although this latter question in my opinion is by far the more important one.

Kapp's latest formulæ Mr. Leonard does not care to discuss, as he has not seen Mr. Kapp's paper.

It would also appear that the last statement of Mr. Leonard's article, "that under no circumstances would it be economical to lose more than 50 per cent. in the conductor," was his own, while, as a matter of fact, this sentence appears in the "Electrical Transmission Hand-Book" and was taken from Gisbert Kapp's paper.

In quite a number of instances Mr. Leonard quotes me wrongly and makes me responsible for certain statements, which are in quotation marks [illegible] that they are quotations and not original statements.

As it is my desire to have this [illegible] next issue, I shall confine myself [illegible] general remarks, but reserve the [illegible]

the merits of Mr. Leonard's paper at some future time In the meantime I hope that my "authorities," especially Lieut. Sprague, will answer some of Mr. Leonard's statements, as the latter are not so much directed against me as against "the authorities." Yours very truly,

[illegible], 1891. F. B. BADT.

H. Ward Leonard's Criticism of F. B. Badt's Hand-book.

BY THOS. G. GRIEF.

The electrical world has been treated to an exhaustive treatise on Mr. Badt's "Electric Transmission Hand-Book." The criticism is by H. Ward Leonard, and has without doubt been prepared with much thought and labor. There are a few of the many in the electrical fraternity who will conscientously examine the array of formulæ and examples presented to them in this apparently complete mathematical demonstration of the statement "that vital errors in some of the most noteworthy papers on the subject have remained unnoticed."

The subject of minimum first cost of plant and maximum economy of operation in the electrical transmission of power is an important one.

Mr. Leonard has opened a most aggressive bombardment in his article, and such authorities as Sir William Thomson, Kapp, Sprague, Badt, Ayrton and Perry are attacked.

It is very true that every one is liable to error, and it is possible that the foremost of our mathematical electricians may wander off into paths divergent from the truth.

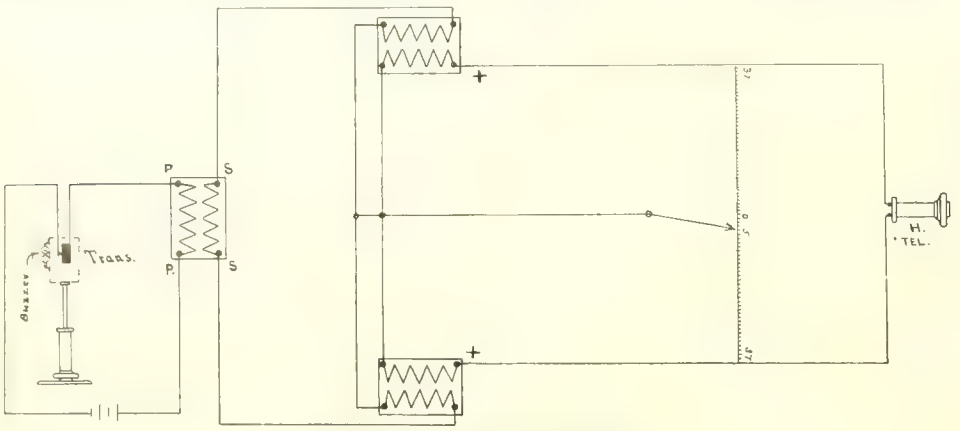
In 1888 H. Ward Leonard read before the Chicago Electric club a paper full of strength and theoretical deductions. From his clear and concise reasoning he proved most conclusively, according to his own ideas, that alternating current transmission of electrical energy would never become any considerable factor in the commercial world.

Yet to-day the alternating current apparatus is found in practical and successful operation in every section of the civilized world, and even in uncivilized regions, where the name of H. Ward Leonard has not yet reached, the alternating apparatus is making missionary efforts in the first steps of civilization.

Again Mr. Leonard comes before the public, and how much he is in the right and how much those he attacks are in the wrong will no doubt be demonstrated as the fall advances.

O'Connell's Short Core Repeating Coil.

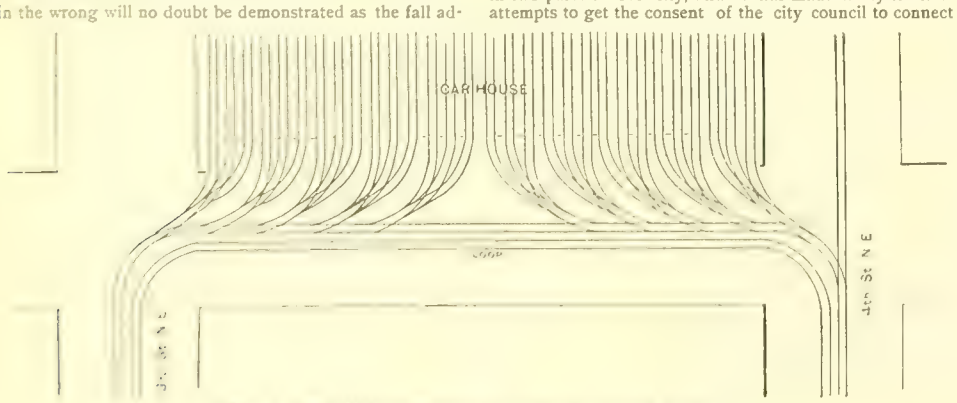
In the accompanying diagram is shown an electric circuit, connected with the transmitter and receiver of a telephone, arranged to determine the efficiency of the short core repeating coil devised by J. J. O'Connell of Chicago, as compared with the ordinary long core coil. The drawing needs but little explanation, as the greater power of the shorter coil is graphically shown. Mr. O Connell claims that the short core repeating coil is more efficient, owing to the greater quantity of iron employed and also to the extremely short core, which is charged and discharged more rapidly. He says that the longer time necessary to charge and discharge the long core muffles the tone in the telephone and makes conversation more difficult. In the diagram O'Connell's core is on the lower line and the long core on the upper line, directly above.



O'CONNELL'S SHORT CORE REPEATING COIL.

The Trouble at Harrisburg.

Mayors of cities seem to think, in too many instances, that it is a very brave and wise thing to throw all possible obstructions in the way of electrical construction in the towns over which they preside. The latest to catch the fever is the doughty official who is the occupant of the mayor's office at Harrisburg, Pa. His name is Fritchey, and he is said to have opened war on the electric street car company in that city. The company has a line of tracks in two parts of the city, and it has made many fruitless attempts to get the consent of the city council to connect



[illegible] RAILWAY SYSTEM.

[illegible] Early on the morning of Aug. 25th a large gang of laborers began work to make the connections.

The mayor appeared, and ordered the foreman to abandon the work. Upon refusing to do so he was arrested on [illegible] default was sent to jail, notwithstanding the protest of a director of the company, who offered bail for the prisoner.

The judge of the county railway on its vacation and Judge Weller of Cumberland county was sent for to grant a writ of habeas corpus. He arrived two hours later, and the foreman was released. The company threatens to bring suit against the mayor for false imprisonment. Work on the connection has ceased pending the habeas corpus hearing.

Henry Villard's Reported Resignation.

It was reported last week that Henry Villard had resigned the presidency of the Edison General Electric company and would retire from that organization. The report has not been confirmed officially.

The St. Paul-Minneapolis Electric Railway System.

The street railway system of St. Paul and Minneapolis is one of the largest in the country and is the first system of such magnitude on which electrical equipment has been adopted throughout. There are 225 miles of track in the system and the average number of cars operated is 380. The overhead trolley system is used throughout and center pole construction prevails, iron poles being employed in the business streets and interurban line and octagonal wood poles in the suburban districts. There are two power houses—one at St. Paul and the other in Minneapolis. An excellent view of the dynamo room of the former is presented in Fig. 1. The generators are arranged in groups of four on the floor above the engines to which they are belted. The machines are of the Edison type, each having a capacity of 150 kilowatts. A view of the switch board is shown in Fig. 2.

In Fig 3. is shown a car house and the arrangement of the switches and in Fig. 4 is a diagram of the arrangement of the tracks. The method of disposing of the cars on this system will be readily understood from these cuts.

The power plants of this system are complete in every detail. The St. Paul plant is equipped with six 270-horse power Babcock & Wilcox boilers fitted with crude oil burners. As auxiliary to these and part of the steam plant are the necessary circulating pumps for oil and water. In the engine room are three 900-horse power condensing triple expansion engines made by the E. P. Allis company of Milwaukee. The clutches are of the Hill company's manufacture and are so placed that all four generators may be run singly or in concert without unnecessary friction of shafting. The air pumps for each engine are situated in pits beneath the floor line of the engine room. The ultimate capacity of the station, when all the engines are in place, will be 4,500 horse power.

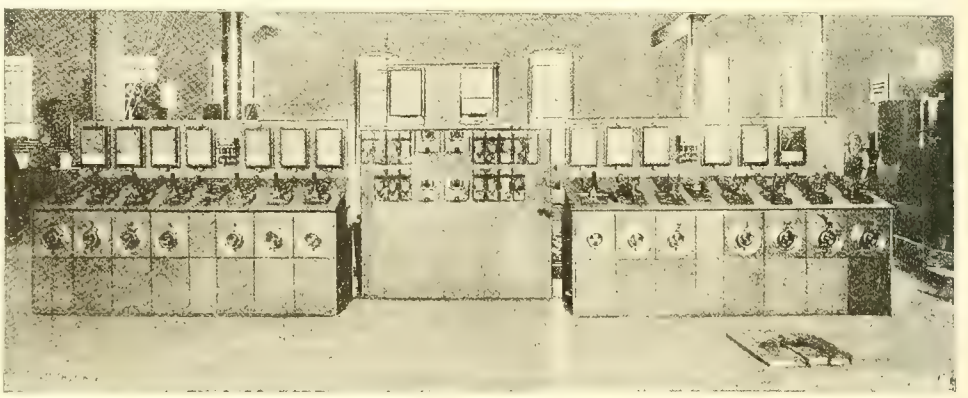


FIG. 2. ST. PAUL MINNEAPOLIS ELECTRIC RAILWAY SYSTEM.

The use of oil for fuel has proved quite satisfactory and productive of excellent results as regards labor, the absence of ashes, the ability to maintain a uniform pressure and the high efficiency attained by the boilers. The oil tank is located beneath the floor of the boiler room, and the pump discharges into a standpipe fitted with an overflow, so that the oil reaches the burners at a constant pressure under an eighteen-foot head. The daily consumption is about 4 500 gallons.

The car house at Minneapolis is 330 feet front and contains 30 tracks. Half of the house is provided with pits under each car for cleaning and repairing of motors. In order to obtain as many tracks as possible, and at the same time to allow the cars to enter the building squarely, the house was set back ten feet from the building line and provided with a ten foot vestibule, giving thereby 55 feet between the nearest track and the doors.

The set of curves laid for entering this car house was designed by Engineer W. F. Carr of the Minneapolis Street Railway company. This plan shows the main line on Central avenue and its connecting tracks, with the loop and car house track, the inside curve being used exclusively as a loop for all east side cars, the outside for cars only when entering or going out from the car house.

The main idea in the study of these curves was to obtain

as large a number of tracks as possible in the car house, and overcome the great objection of running through a vast number of switches and frogs. By this design turn tables are done away with, and cars are handled without difficulty or detention.

The company has lighted the entire line to Lake Harriet, a favorite resort a few miles from the business district, with arc lights. The current is furnished by an Excelsior machine situated in the main station.

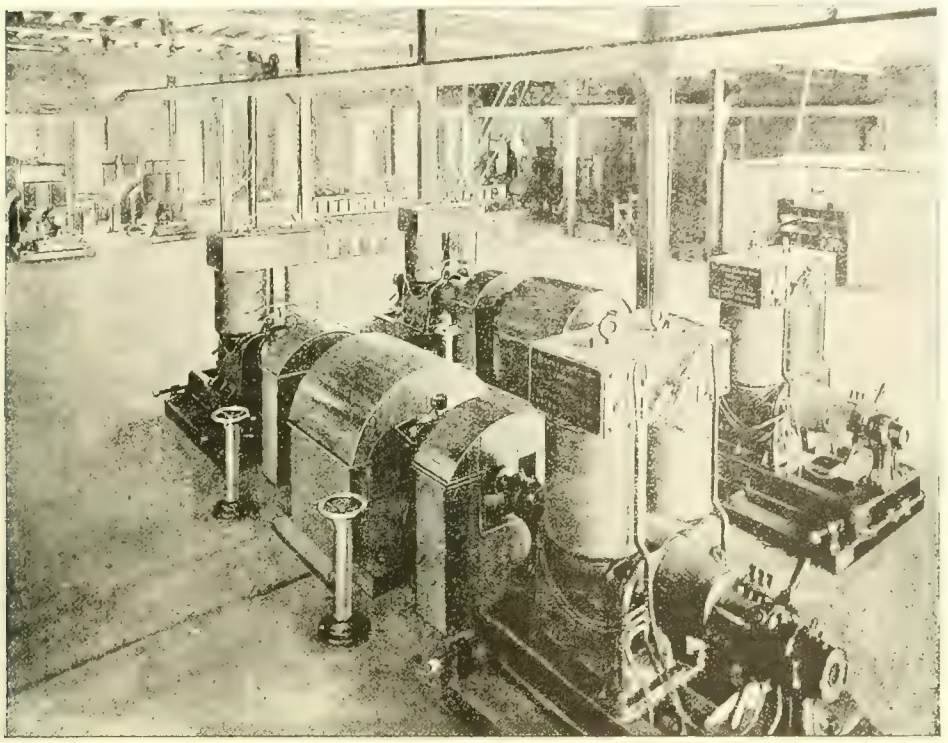


FIG. 1. ST. PAUL MINNEAPOLIS ELECTRIC RAILWAY SYSTEM.

Travelling cranes are in use in both stations, facilitating the erection of machinery to a great degree.

Considerable has been done in laying the feeder wires underground in this system, the underground tubes of the Interior Conduit & Insulation company of New York being employed. The length of the tubes at present employed is 400,000 feet, and repeated tests have shown a very high insulation for the entire system. The belting for the St. Paul plant was furnished by the Chicago Belting company of Chicago. The cuts are reproduced from the *Street Railway Journal*.

Rapid Transit in New York.

Although the Rapid Transit commissioners of New York have made little real progress of late toward the solution of the problem intrusted to their consideration, the subject continues to be uppermost in the public mind, and those who have occasion to take long trips on the surface or even "L" roads of the metropolis are longing for relief. All who have occasion to traverse Broadway realize the necessity of a permanent system of rapid transit. On this point the *Railroad Gazette* says editorially:

"Every one admits the great objections to any further fooling with the surface of Broadway. The condition of the pavement of that street, even when not actually torn up, is a disgrace to a civilized city. The obstructions to traffic caused by the constant opening of the street, and by breakdowns due to bad pavement, are a source of considerable money loss to the business men of the city; and it is by heaven's mercy that the city escapes epidemics, the result of constant disturbance of the sub-surface and of the incredible filth of the surface of its streets. Therefore, it is not wonderful that people should look with something like despair at the prospect of a brand new scheme for tearing up Broadway. But a scheme that would provide for access to all pipes and conduits without ever disturbing the pavement again would be worth a good deal of present discomfort and a good deal of money."

Considering the main question at issue, the same paper says:

"Moreover, the engineering aspect of a deep tunnel has been greatly changed by the results of the borings that the commission has caused to be made. It appears that for a very considerable part of the distance from the Battery to Union Square the material at the level that a deep tunnel would have to take is sand so fine and devoid of grit that it may be classed as quicksand. Tunneling through this material will be difficult and dangerous even by the shield method, and it is probable that this method is the only one that will be considered. But there must be four tracks, and if the tunnels are circular in section it will probably be found that it will be cheapest to have a tunnel for each track. The expense, therefore, would very likely be as great as that of a tunnel near the surface with a gallery for pipes, etc.

"A further consideration that must enter is that the new railroad will have to compete with the most efficient system of rapid city transit that has yet been constructed. On either side of it are the tracks of the elevated railroad, which carry 600,000 people a day with a remarkable degree of speed, comfort and safety. This is said with intimate knowledge of the night and morning crowds, and with due consideration of the meaning of the words used. The new route must be so accessible and so attractive that it will draw away a good deal of the business of the existing roads, as well as create new business. It is obvious that access to the stations of a tunnel near the surface will be easier and quicker than to those of a deep tunnel.

"But here again comes in a complication. A tunnel near the surface can be reached by fewer steps than the platforms of the elevated roads, but at some depth it will be necessary to use lifts. Then must be considered the size and speed of elevators that can handle the morning and evening crowds and the cost of constructing and operating them.

"It will be seen that the selection of the best plan for building the proposed subterranean railroad is a process that requires the nicest and most judicious balancing of many considerations, not only of a technical but of a commercial sort. Therefore it seems as if it would be as well for the critics to abate their zeal for a while and not assert quite so positively that a system of tunneling which was successful in London clay must be equally successful in New York quicksand and rock; and that an equipment which handles less than 15,000 passengers a day at a speed of 12 miles an hour would meet the needs of New York.

"By the way we have heard a great deal of the 'Greathead system' as having settled this most difficult matter for a [illegible] applied to that one enterprise. But it would be quite as [illegible] son, and built in Canada from plates rolled in the United States, and the tunnel was lined with cast iron. But, in fact, [illegible] back still further to the first Thames tunnel which was completed in 1846, with a shield designed by Brunel. Therefore we may perhaps, after all, call it the Brunel system.

"It cannot be that the name is supposed to cover the method of hauling trains by electricity, for that had been done by many people in various lands before the City & South London railway went into operation, and we have been told that Mr Greathead first intended to work his tunnel by cables. Then what is the 'Greathead system?'"

Electrical Engineering at the University of Wisconsin.

In a recently issued circular of information relative to the College of Mechanics and Engineering the faculty of the University of Wisconsin makes the following announcement concerning the course in electrical engineering:

"The course in electrical engineering is nearly identical with the mechanical engineering course during the first two years, since a large part of what is required in mechanical engineering is necessary to a thoroughly equipped electrical engineer. In the last two years those subjects given in the mechanical engineering course which are not important to the electrical engineer are omitted and electrical studies substituted therefor. As now arranged, the special features of the course begin with physics in the second year and are followed by two consecutive years of electrical study. There is given first a thorough grounding in the science and theory of electricity and magnetism and in electro dynamics. This is accompanied and followed by electrical measurements and tests of all kinds, standardizing, method of determining electrical units, economics of electric distribution, electric transmission of power and electric motors, electric locomotives, electric lighting, dynamos, lamps, etc., photometry, management and care of batteries, telegraphy, telephony, electrolysis and electro metallurgy. Important additions to the course are contemplated."

An admirable suite of rooms in Science Hall is devoted to laboratory work in electricity. It is in immediate connection with the physical laboratories and lecture room, which are supplied with an excellent outfit of apparatus of the latest design and most approved manufacture. Among the electrical and magnetic apparatus is a complete set of Sir Wm. Thomson's instruments for electrical measurements, including a new form of magnetometer by [illegible] Dr. Gray, electro dynamometers [illegible] meters, resistance boxes, galvanometers, condensers, and other test instruments for electrical engineering. There are also electrometers by Thomson and Edelmann, electric motors, storage batteries, a large [illegible] cradle for measuring [illegible] Crooke's tubes, switches, standards of electromotive force, etc. The electric laboratories are [illegible] machine shop, where the dynamos [illegible] at present, four of these of different construction.

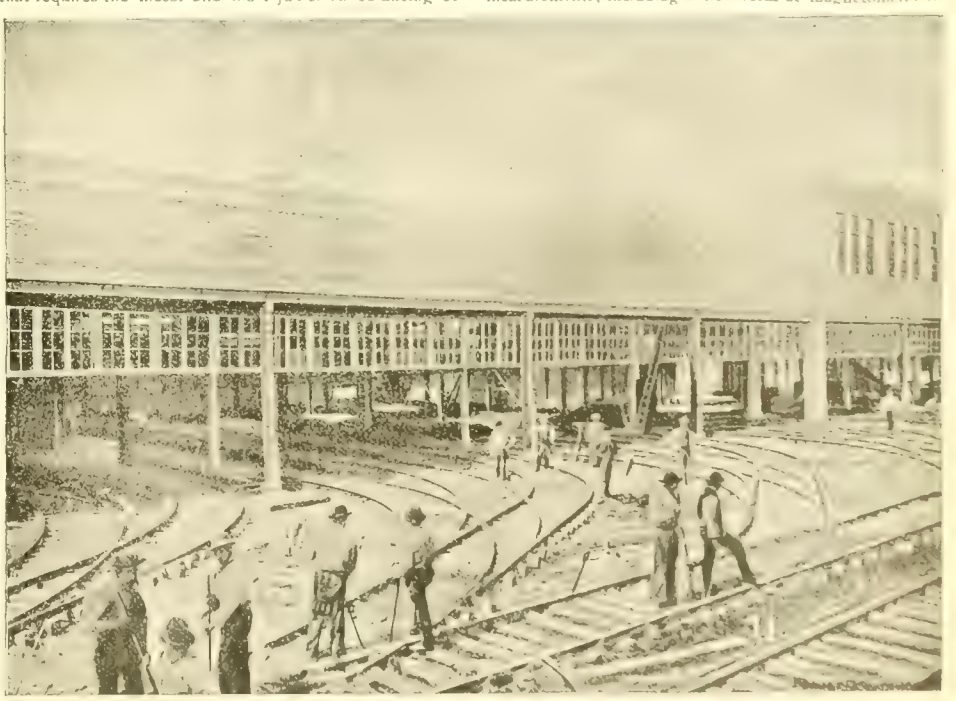


FIG. 3. ST. PAUL MINNEAPOLIS ELECTRIC RAILWAY SYSTEM.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

[illegible], Editor and Publisher.
[illegible] O'HARA, F. L. PERRY, W. E. KELLY, Associate Editors.
[illegible] BAKER, Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. [illegible] OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3 [illegible] for a full year of 52 numbers in clubs of four or more, $2.50, with free extra copy for eight subscriptions, foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.
World's Fair at Night. Illustrated ... 143
[illegible] Decorations at Detroit ... 143
Electricity at the World's Fair ... 143, 144
The Montreal Convention ... 144
[illegible] and Central Station Lighting at Montreal. Illustrated ... 144, 145
[illegible] First Cost of Plant and Maximum Economy of Operation in the Electric Transmission of Power, by F. B. Badt [illegible] ... 145, 146
H. Ward Leonard's Criticism of F. B. Badt's Hand Book, by Thos. G. Grier ... 146
[illegible] Illustrated ... 146
[illegible] ... 146
[illegible] ... 146
The St. Paul-Minneapolis Electric Railway System. Illustrated ... 146, 147
[illegible] ... 147
[illegible] at the University of Wisconsin ... 147
[illegible] ... 148
[illegible] at the Frankfort Exhibition. Illustrated ... 149
[illegible] ... 149
[illegible] ... 149, 150
[illegible] Illustrated ... 150
[illegible] Illustrated ... 150
[illegible] Illustrated ... 150
[illegible] Illustrated ... 150, 151
[illegible] Illustrated ... 151
[illegible] ... 151, 152, 153
[illegible] ... 153
[illegible] ... 153
[illegible] ... 153

DEPARTMENTS.

[illegible] ... 153
[illegible] ... 154
[illegible] ... 154
[illegible]

[illegible] WESTERN ELECTRICIAN [illegible] a [illegible] Montreal [illegible] the [illegible] together [illegible] of the delegates and visitors, descriptions of the exhibits and [illegible]

[illegible]

THE great dynamos of the Frankfort exhibition, illustrated [illegible] the recently completed Willson dynamo in New York, although, of course, the last named was built on an entirely different plan and to accomplish a well defined purpose.

THIS number of the WESTERN ELECTRICIAN is issued several days in advance of the regular day of publication, on account of the convention of the National Electric Light association at Montreal.

THOSE in attendance at the Montreal convention will have an opportunity of hearing all about the World's Fair from the lips of the versatile secretary of the department of electricity, J. Allan Hornsby. Probably a large proportion of the visitors at the Canadian metropolis will make exhibits at the exposition, and will thus be enabled to meet the gentleman through whom their dealings with the department will principally be carried on. In addition, there is a great field for missionary work among the Canadians, and Mr. Hornsby will doubtless avail himself of the opportunity, so far as the occasion will allow.

NOT the least interesting phase of electric lighting is in the arrangement of incandescent lamps for decorative purposes. Many elaborate displays of this character have been witnessed within the last few years and have invariably excited great admiration on the part of the general public. The electrical decorations at Detroit on the occasion of the G. A. R. convention form the latest, achievement of this sort. It is interesting to note that the opinion is freely expressed that in general effect, the electric lighting outshone, figuratively as well as literally the display of fireworks on the Detroit river that cost $6,000.

FOR the first time in the history of the organization the National Electric Light association this year holds its convention outside the United States. It was decided to hold the summer convention in Montreal this year at the earnest solicitation of representative Canadian electricians, who hoped thereby to increase the friendly feeling between the Canadian companies and those of this country. The advancement made in the Dominion during the last few years will no doubt be a pleasant surprise to a majority of the delegates and visitors to Montreal, and, on the other hand, our Canadian neighbors will undoubtedly be greatly surprised if not wholly unprepared for the admirable showing the American visitors will make. The Canadian electricians have watched the progress made by the National Electric Light association with a good deal of interest, and within the last year the suggestion has been made that a similar organization be formed in the Dominion. This proposition has been received with some favor, and when the Canadian manufacturers of electrical machinery and the central station men learn the value of the association there will no doubt be a still greater interest manifested in the movement.

An exchange of courtesies between the Canadian and American electricians cannot fail to produce good results, and may prove a valuable factor in establishing better commercial relations between the representatives of the electrical industries at least. At any rate the American visitors will greatly appreciate the hospitality of their Canadian friends, and the people of Montreal will have no reason to regret the trouble and expense they have assumed in securing entertainment for the visitors.

GEORGE P. LOW's paper on "Hazards of Incandescent Lighting," presented in this issue, is well worthy the perusal of men interested in electrical pursuits, although written for the special benefit of underwriters. Mr. Low shows that his studies of the science and application of electricity have been thorough and complete, and the insurance men of the Pacific coast are to be congratulated upon the possession of so competent an adviser.

While Mr. Low insists on a rigid inspection of electrical installations, and is severe on poor workmanship and materials, he nevertheless recognizes the fact that proper precautions are only necessary to make incandescent wiring perfectly safe. He concludes his instructive paper as follows: "Here then are enumerated the principal hazards of incandescent lighting. Though perhaps formidable in the early days of the art before experience advanced as a teacher, they are no longer to be feared, as preventives have been devised, which, when supplemented by intelligent workmanship, prove absolute in their office. Of course, improvements tending to make electric lighting yet more safe and satisfactory appear almost daily, but despite every precautionary appliance, an ignorant workman, an unprincipled contractor, perchance ruinous competition, with its cheap labor and low-grade materials, may make an incendiary installation of a plant, that, to the un[illegible] perfect. To standardize all work, to educate the wireman, and to supplement all by a system of rigorous inspection, completes this self-allotted task of the fire underwriter."

NOT all of the non-electrical papers in New York are opposed to electric railways, and even the overhead trolley system has many warm supporters among the technical and trade journals. Thus the *Australasian and South American* of that city, in the course of an elaborate and intelligently written article on the practical applications of electricity in the United States, says: "New York and her eastern neighbors, Boston possibly excepted, are far behind their sister cities in the West in this respect (electric railways). At Cincinnati, Ohio, for instance, the electric cars, operated by the overhead or "trolley" system, climb around the hills in a manner that it would be practically impossible for horses, or even steam motors to imitate. In Cleveland, Ohio, the electric cars run hither and thither all through the most crowded thoroughfares, switches and crossovers, turnouts and curves of bewildering intricacy apparently constituting no obstacle to their regular travel. In all weathers these cars run and their advantages, compared with slow, dirty horse trams, puffing steam motors, or even cable lines, that must be run at an invariable speed and are liable to all sorts of interruption by the weather, etc., are immediately conspicuous to the observer. For city transit, electricity is unquestionably the coming system, and as improvements are made in the construction and operation of the electric lines they are bound to become more popular and even more profitable than they have hitherto proved themselves to be."

THE publication of H. Ward Leonard's paper on electric power transmission in last week's WESTERN ELECTRICIAN has had the effect of starting a discussion that will undoubtedly prove highly interesting as well as instructive. In this issue two contributions are presented. F. B. Badt, whose "Electric Transmission Handbook" called up the discussion, presents a preliminary argument in defense of his work, which he promises to supplement at an early day with a more extended article, discussing Mr. Leonard's paper in detail. The second contribution on this subject is presented by Thos. G. Grier, and, like Mr. Badt, he does not appear to be impressed with the idea that Mr. Leonard's argument is conclusive. On the contrary both of these gentlemen recall a former controversy, in which Mr. Leonard made equally positive statements, and supported his theory by an able argument, and what to many appeared a conclusive array of figures. Despite these figures, Mr. Leonard's theory has not been sustained in practice.

It is of course expected that Mr. Leonard will take a hand in the controversy, and it is possible that others quoted by Mr. Badt in his handbook and who, according to Mr. Leonard, "are considered authorities on this subject," may also feel enough interest in the subject to support their position against Mr. Leonard's attack. Mr. Badt has promised to give the matter further consideration, and on the whole the outlook for a spirited controversy is promising.

THE question of municipal ownership of public works is one of vital importance to electric companies. In no department is more interest manifested than in electric lighting. The attacks that have been made on electric companies, by exponents of Bellamistic doctrines have had the effect of awakening the managers of central stations to a realizing sense of the danger which threatened their companies. During the last few years the National Electric Light association has devoted considerable attention to the subject, and a plan of protection was adopted and has since been projected under the direction of the association. State organizations have been formed, attention has been directed to the proceedings of the legislatures, and care has been taken to have the electrical interests represented whenever questions involving their rights were under discussion. As a result the warfare on electrical industries has of late been met with determined and organized opposition, and the projectors of tom-fool theories have been exposed. But the good work has only been begun and there still remains much to be done. It is to be hoped this important problem will not be permitted to rest during the Montreal meeting. Steps should be taken to push the work in every quarter of the country, and form organizations where there are now no state associations.

The members will find much material for argument against further governmental interference in private enterprises by the recent disclosures in Canadian official circles. Americans have already had enough corruption in local politics. By increasing the army of political hangers-on they will increase their already too heavy burdens.

Largest Dynamos at the Frankfort Exposition.

The accompanying cuts illustrate two generators forming part of the exhibit of Siemens & Halske at the Frankfort exhibition. These are are the largest dynamos in the exhibition. Fig. 1 shows a continuous current machine driven by a triple-expansion condensing engine with three cylinders, of 20 inch, 28 inch and 47 inch diameter respectively, and 2 foot stroke. It develops 400 horse power, 500 horse power and 600 horse power, when run

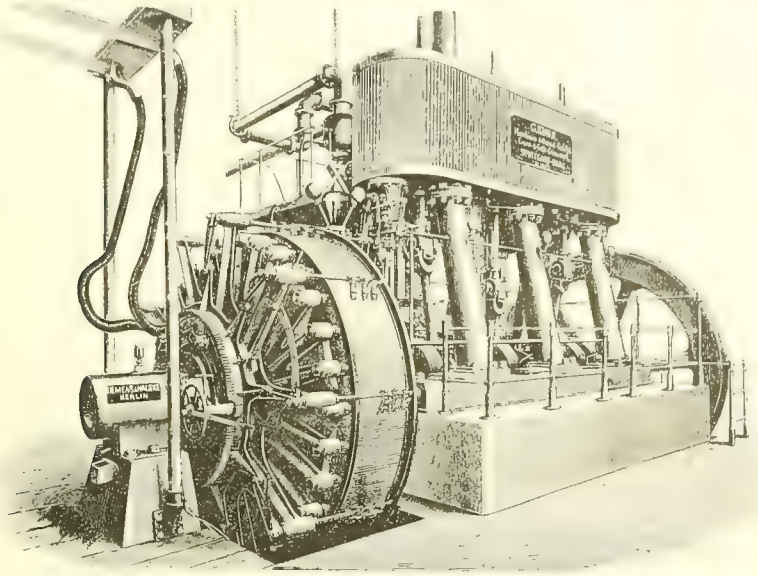


FIG. 1. LARGEST DYNAMOS AT THE FRANKFORT EXPOSITION

at 80, 100 or 120 revolutions per minute. The dynamo, made according to Mr. Siemens' latest design, is coupled direct to the engine shaft. It is a ten-pole machine, with radial electromagnets placed inside a Gramme armature of 10 foot diameter, giving a normal output of 330,000 watts at 65 revolutions per minute, or of above 600,000 watts at 100 revolutions. An interesting feature of these machines is the total absence of a commutator. The outside winding is made of solid copper strips, 1.2 inches high by .2-inch broad, insulated from one another by fibre. The whole of the winding is turned up true on the outside, and ten sets of brushes, corresponding to the ten poles of the machine, collect in parallel. These are mounted on a star shaped casting attached on the outside bearing of the engine proper. This arrangement is exceedingly simple and very accessible. The brush-holders are so constructed that every brush can be independently adjusted during work without disturbing the others, and at the same time the position of all the brushes may be altered at once by an ingenious and simple device, and all the brushes can be lifted off or put on the armature simultaneously by moving the controlling lever. All the positive and all the negative brushes are connected in parallel, and the current is carried off by two thick but flexible cables visible above the bearing in Fig. 1.

Multipolar machines are quite common in Germany, and there is a growing demand for them in this country. In view of this fact it will not be out of place to call attention to one point in connection with this type which, by the way, is far more pronounced in large machines than in smaller sizes.

As the brushes are all in parallel the least want of truth or sinking of the shaft carrying the armature will cause one side of the armature to give a slightly higher pressure than the other. This cannot be corrected in a multipolar Gramme machine, as the armature conductors cannot be joined in series. This trouble may arise in any multipolar machine which has its conductors in parallel, but it is more likely to become serious in large machines in which the armature resistance is low, so that an exceedingly small inequality in the air space may cause a variation of electromotive force which is a large proportion of that spent on the armature resistance.

The alternate current dynamo and engine are shown in Fig. 2. The vertical engine is a two-cylinder condensing machine of the Colman type. The high pressure cylinder is arranged below the low pressure and as close as possible to the low pressure piston rod. The moving systems of the two engines—that is to say, the pistons, piston rods, connecting rods and cranks—are made of exactly the same weight, so as to balance each other perfectly in all positions, while both cranks are placed as close as possible, so that the various thrusts on the bearings are all but compensated. Thus, for a given size, comparatively high speeds are admissible. The engine exhibited, for instance, can easily run at 150 revolutions per minute. At 100 revolutions, which is the normal speed of the alternator, this engine indicates 450 horse power, while the alternator is originally designed for an output of 500 horse power at the speed named. This discrepancy arises from arrangements with the [illegible] ing been made after the dynamo was begun.

The alternator itself consists of a star shaped field magnet and a fixed external armature, both [illegible]

and armature being made of laminated wrought iron. Each contains 60 coils of 56 and 20 turns respectively. The conductors are made of twisted copper rope pressed into a square shape, and soaked with varnish in order to avoid eddy currents, the cross section of copper amounting to about .125 square inch. The cross section of the iron in each core is 20 inches by 3½ inches. The rotating field magnets are excited by a separate generator of the same type as the large continuous current machine already described, and coupled directly on the shaft of a small 60 horse power vertical engine. The stationary armature

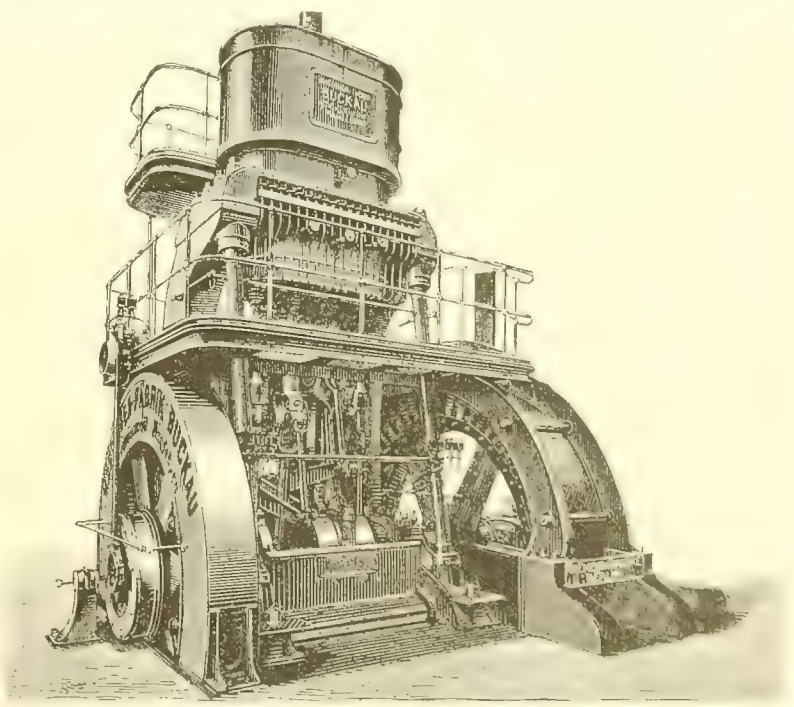


FIG. 2. LARGEST DYNAMOS AT THE FRANKFORT EXPOSITION

of the large alternator contains the same number of coils as the rotating field magnet. The cores are U-shaped stampings, with the free ends turned inward. When wound and put together they form a sort of laminated Pacinotti armature turned inside out. Any coil can easily be disconnected and taken out without dismounting the rest. The alternating pressure generated at the terminals of the machine is 2,000 volts.

The current generated by these machines is utilized in operating all sorts of apparatus, making up a complex [illegible] illuminating the whole [illegible] shafts and wavering [illegible] multiple [illegible] from below between [illegible] whole space between [illegible] columns [illegible] indefinite distance [illegible] reflection of light [illegible] front of them [illegible] mass. The north [illegible] in the great [illegible] we might expect to see on a grand [illegible]

about over the whole exhibition. The cuts are reproduced from *Industrie*.

Cables in the St. Gothard Tunnel.

Two electric cables were laid through the St. Gothard [illegible] been found insufficient for the increased traffic, and recently there have been laid two additional cables for the telephone service, one containing three separate conductors and the other two conductors, arranged concentrically. The experience gained with the old cables (one a seven-conductor telegraph and the other a single-conductor signal cable) has not been quite satisfactory. These cables were laid in an iron trough fixed on one side of the tunnel, and it was found that the water which accumulate in the trough where it sagged between the supports had an injurious effect on the insulation. To determine the nature of this effect 150 samples of water were analyzed, and in many cases found to contain sulphureted hydrogen and sulphates. Moreover, it was found that owing to the slower combustion in the air of the tunnel, the smoke from the locomotives contains considerable quantities of ammonia and sulphurous acid, which, together with the carbolic acid, are absorbed by the water. It was, therefore, determined to abandon the previous method of laying the cables into a trough, and to lay them directly in the ground. The old cables have been relaid in this manner. A trench about 2 feet in depth was dug and filled, first with 2 1-2 inches of gravel, then 2 1-2 inches of sand. Upon this were laid the four cables and covered with 9 inches of sand, covered by granite flags, and the rest made up with ballast. The work in laying was complicated by the necessity of crossing over from one side to the other in the middle of the tunnel to avoid certain springs. This work of crossing over necessitated the frequent taking up and relaying of rails in the short interval between two succeeding trains.

Electrical Sky Effects.

Frank Van Doorn, writing in the [illegible] *Herald*, gives this glowing piece of word painting: "The electric display in the heavens about midnight of Friday was such a one as is rarely observed. As seen from a high bluff overlooking Lake Ontario, with an unobstructed view east, west and north of ten miles or more each way, all the grandeur of it could be appreciated. The night was intensely dark yet the sky was mostly clear and stars shining brightly. Near the northern horizon was a long procession of solid blue-black boulder-like clouds, from behind which the luminous wonder crept up, gradually

with a twenty mile crater, only with the out-put arrested in mid-air, rocks and all. Added to all this were immense irregular white, pink, yellow and greenish bows of wavering light constantly chasing one another from the rock clouds nearly to the zenith, and then below on the lake were reflected the clouds, the flashes and the broad masses of light. For an hour the brilliant changes continued and then gradually paled away." If Mr. Van Doorn is not careful, he will be hailed as the successor of "Sunset" Cox.

Queen's Laboratory Photometer.

The accompanying cuts illustrate a new laboratory photometer recently devised by Elmer G. Willyoung and

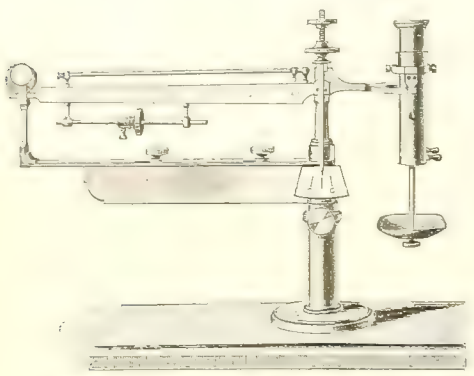
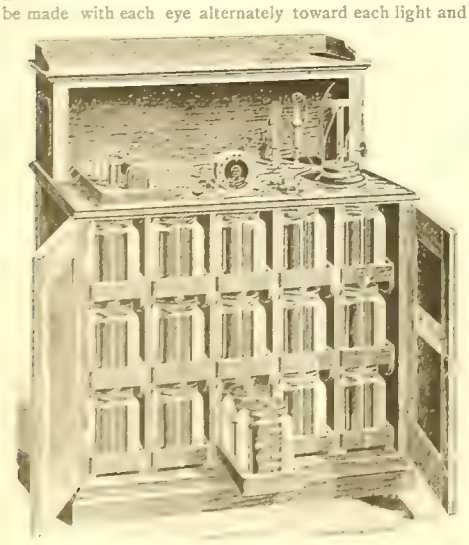


FIG. 3. QUEEN'S LABORATORY PHOTOMETER.

placed on the market by Queen & Co. of Philadelphia. The photometer is of the usual Bunsen type. Two tables, each 4 feet long by 20 inches wide, support the graduated bar and accessory pieces. These tables are of white wood with ebonized top and can be firmly screwed to the floor; The bar is of metal supported by a larger bar of wood; the graduated bar is made in several different lengths and either graduated directly in candle power or else, in the metric system, to half centimeters. The wooden bar is made with a cross rail on the bottom, along which rides the carriage containing the Bunsen disk or "grease spot." This carriage is arranged so as to rotate through 180 degrees about a vertical axis, thus allowing measurements to be made with each eye alternately toward each light and



ed upon a base fitted to these rails and when drawn forward to the limit of the rails is in correct position for use as a standard. Pushing the balance back out of the way, brass bed plates are disclosed, upon which the methven screen or standard incandescent lamp, held by a special socket, may be placed and firmly fixed by means of two milled head screws. The right hand table is also provided with bed plates in such a way that the universal socket, the methven, or the standard incandescent may be placed in position, and their light measured by comparison with any of the other standards; hence the checking of the standards among themselves or the standardizing of the standard incandescent lamp can be very easily and quickly done.

The candle balance, seen more in detail in Fig. 3, has been arranged for weighing candles while burning. The bar of the balance is graduated in half grain divisions, and differences of weight can be read off, by means of the rider, up to 50 grains. Equilibrium is secured by means of a counterpoise weight sliding along a rod beneath the balance beam. The rod itself is threaded at one end so as to be used as a micrometer adjustment when the counterpoise weight is fastened by means of the check screw. Either one of the two candles may be used as desired. The balance also has an adjustment in its own length for bringing the line passing through the centers of the candle flames exactly at the zero of the scale.

For holding the incandescent lamp to be measured the universal socket, shown in Fig. 4, has been devised. By means of this socket any lamp of any make may be presented at any angle whatsoever to the sight box. This socket consists essentially of a lamp socket with its central axis perpendicular to a graduated circle. This socket can be rotated about this vertical axis and clamped in any position; the amount of rotation is measured by means of an index attached to the socket. A small set screw allows the index to be set at zero when the plane of the carbon filament is at right angles to the table length. The socket as a whole can also be rotated about a horizontal axis, cutting the line passing through center of sight box and center of illumination of the standard; the amount of rotation is read here also by means of an index and graduated circle. In order to bring the axis of greatest illumination of the lamp into the axis passing through the center of the sight box, the frame supporting the socket proper may be raised or lowered to whatever point desirable and there fastened. With the universal socket, as with the candle balance, there is a small adjustment in the length of the table, thus allowing the axis of greatest illumination to be placed exactly at the end of the scale. Both circles are graduated to every five degrees.

Curtains are provided for excluding extraneous light and all metal parts are finished dead black.

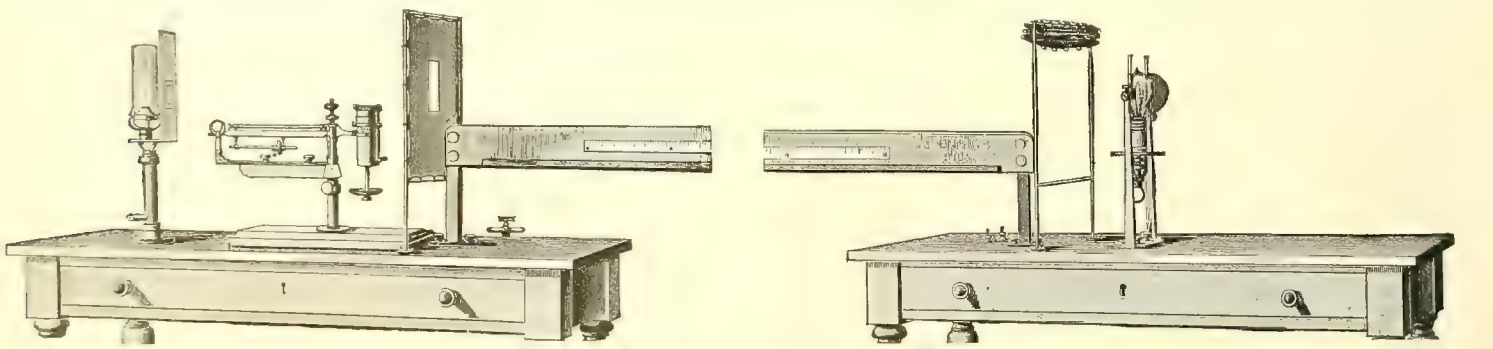


FIG. 1. AND 2. QUEEN'S LABORATORY PHOTOMETER.

Cope Automatic Wire Puller.

The accompanying illustration of an automatic "come-along" or wire grip for linemen handling light or heavy cables, was invented by T. J. Cope, Philadelphia. It consists of two jaws, slightly corrugated on the inner side, and working loosely in two stationary supporting jaws in such a manner that when the wire or cable is placed between the loose parallel jaws and drawn, the jaws are closed from mere contact to sufficient pressure to hold the cable or wire. It will be seen that there is no more pressure on the insulation or wire than is necessary to hold the same, and the direct pull and long jaws prevent twist or kink in the wire or breaking of the insulation. The wire is easily released by merely reversing the pressure on the tool.

The power house of the Asbury Park, N. J., Electric [illegible] company which takes the place of that destroyed by fire last June, is almost completed. The single trolley system is being substituted for the double in use formerly. The Thomson-Houston system will be used.

Electro-Therapeutical Office Outfit.

In the accompanying cut is shown an electro therapeutical office outfit conveniently arranged in a cabinet. In addition to the Law batteries used, there are shown in the cut a Faradic coil milliammeter switch and current regulator. The arrangement of the apparatus is simple, making the

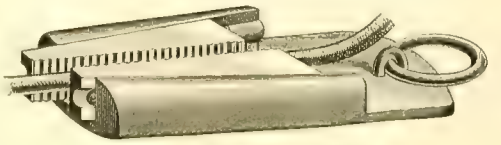
FIG. 4. QUEEN'S LABORATORY PHOTOMETER.

probabilities for accidents very small. The outfit is placed on the market by the Law Telephone company, New York.

Manchester Square Electric Light Station.

The accompanying cut illustrates the dynamo and engine room of the Sardinia street station of the Metropolitan Electric Light company, London, commonly known as the Manchester Square station.

The row of dynamos shown, coupled to comparatively small-sized engines, developes no less than a million watts, the engines indicating 2,000 horse power. There are ten of these dynamos. The engines are Willans' triple expansion, running at 350 revolutions per minute. There are four 60 horse power Willans engines at the far end of the room, driving Parker direct current exciters. Only two of these are needed to excite the whole of the alternators, but it is considered advisable to have a complete duplicate exciting plant. There are also storage batteries which can



COPE AUTOMACTIC WIRE PULLER.

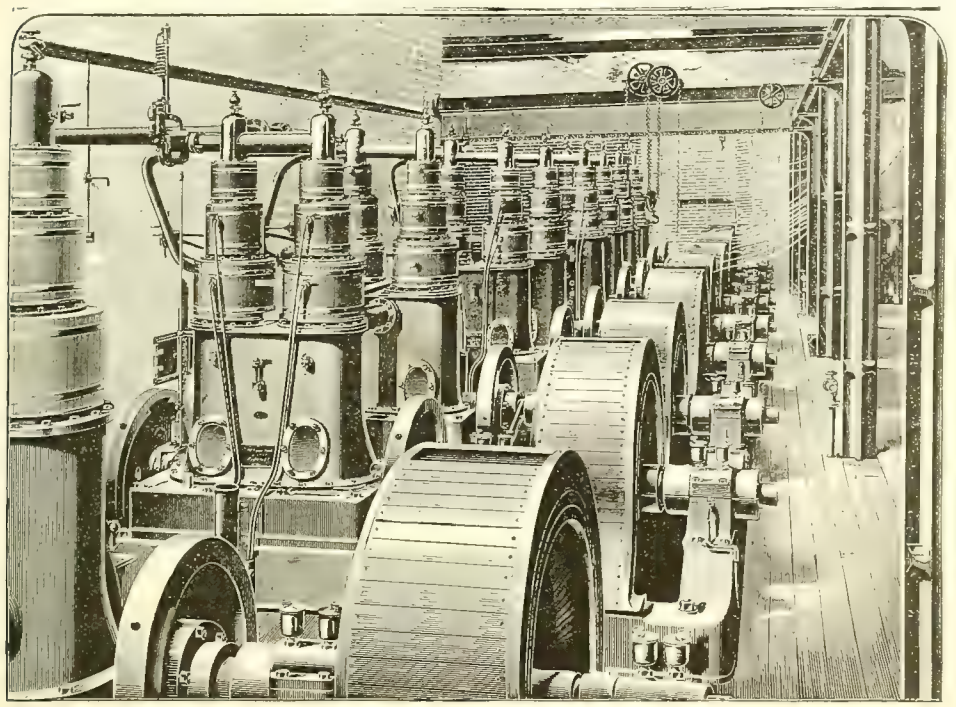
excite the alternators, and are used during very light loads, when there is not enough for one exciter to do.

The greatest care has been taken to avoid the least vibration. The engines and dynamos stand on foundations 7 feet deep, built of blue brick and cement, which is supposed to deaden sound and vibration better than the more homogeneous concrete foundation generally employed. The foundations stand in a pit without touching its sides, and rest on a quarter of an inch of felt, so as to be practically insulated as regards sound. The felt is covered with lead to keep it dry and to prevent decay.

The machines employed are Parker's 100 unit alternators. The main switch-board, which runs along the right side of the engine room is arranged somewhat like a telephone switch board. The dynamo leads runs horizontally at the

back of it. Each external circuit is connected to two pairs of vertical bars on the front of the board. It is of course only connected to one pair of vertical bars at a time, a positive and a negative. These vertical bars can be plugged through to the dynamo bars, so that any circuit can be put on any dynamo, or several dynamos can be run in parallel, and so on. To change over, the idle vertical bars are plugged to the dynamo to which the circuit is to be transferred, and the throw-off switches transfer it.

There are nine Babcock & Wilcox boilers, each capable of evaporating 6,000 lbs. of water per hour. Assuming the Willans engines to require 20 lbs of steam per indicated horse power per hour, the maximum demand possible is 42,400 lbs,of steam,and the boilers can generate 54,000 lbs. This large margin is to insure easy firing. The steam pipes are arranged so that any length can be taken out or any joint repaired without shutting down the station. Two or three boilers feed into one drum,which supplies one pair of engines. These drums are connected by two 4-inch pipes, which also form a duplicate service to the exciters and pumps. They are 6 feet from the drums, with connecting branches at right angles, so that there is enough elasticity in the system to meet all expansion without special expansion joints. The greatest diameter used is only 5 inch, so the danger of a system of large steam pipes does not exist. The arrangement of coal bunkers is such that the coal is dropped from the wagons into them, and the stokers can



DYNAMO ROOM, MANCHESTER SQUARE ELECTRIC LIGHT STATION.

at once reach it with their shovels without further handling. The exhaust steam is carried up the inside of the chimney the whole way to the top, where it is discharged, clean and dry, and causes no nuisance. The chimney is 130 feet high, and it is 8 feet square inside at the bottom and 9 feet square inside at the top. Water is supplied from the water company's mains, but there are three tanks, holding about twelve hours' supply, or 14,000 gallons, which are always kept full in case of a breakdown in the mains. There is an underground tank, into which the

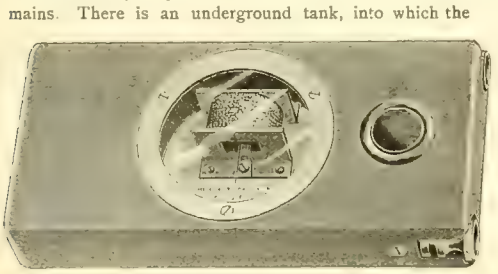


FIG. 2. ELECTRICAL SUPPLY COMPANIES' SPECIALTIES.

boilers are blown off, provided with vent pipes leading to the roof of the station. A special ejector is also connected to the blow-off pipe, by which a small quantity of cold water may be mixed with the hot just before discharge, if necessary. The cut was taken from *Industries*, London.

The Lockport Electric Railroad company's line is to be completed by January 1, 1892. A 250 horse power plant will be put in. The Westinghouse system will probably be used.

Electrical Supply Company's Specialties.

The specialties illustrated in the accompanying [illegible] have recently been introduced by the Electrical Supply company, Chicago.

The Wirt brush, shown in Fig. 1, was designed to combine the advantages of the carbon and copper brushes. The principle involves the use of a lamination of perfect and imperfect conducting materials, a good conductor being placed between two layers of higher resistance. The result is that the main current is carried away [illegible]

FIG. 1. ELECTRICAL [illegible]

pally by the middle portion with a minimum of heat, while the wasteful currents are partly prevented and in part "wire drawn" to a point where the energy is too small to do mischief. The construction gives a "cushion" touch on the commutator, permitting the use of a very light tension.

A very neat and desirable instrument is shown in Fig. 2. It is the Wirt pocket testing set. It is quite small, measuring only 6x3x1¼ inches, and contains a small cell of standard dry battery, a key, and a very sensitive galvanometer. The latter has been designed with greatest pains to secure an unusual sensitiveness. It is equally useful in the factory or for outdoor or indoor wiring work. It can be carried in the hip pocket and will indicate a fault having as high resistance as 100,000 ohms.

The insulated gas connector shown in Fig. 3 is a new and simple form of Wirt joint. The constructive features are well defined in the engraving, and embody many points of merit. It is made by the Electrical Supply company, corner Randolph street and Michigan avenue, Chicago.

Incandescent Lighting; Its Physical Hazards and Means of Restricting the Same.[1]

By Geo. P. Low.

Arc lighting had hardly established a recognition in the commercial world when it became apparent that an electric light in smaller units would have to be perfected before the new system could work its way into general use for indoor illumination. The arc light was found to be specially adapted to street lighting, but for indoor use its intense rays were dazzling; its sometimes frequent flickering and hissing were injurious to the eyes and almost intolerable; the lamps under the best circumstances were unsightly, and the wires, which were not permitted to be concealed, formed great streaks of discoloration along the ceiling, even though separated four or six inches from it. To overcome these defects and to effect the "subdivision of the electric light" as incandescent lighting was first called, an entirely new and more complex system of distribution, together with its indispensable accessories, was devised.

It is essential in every constant potential installation

1 Abstract of paper read before the Fire Underwriters [illegible] Pacific, Aug. 18, 1891.

incandescent circuit half a mile from a central station is [illegible]

plants, in event any two wires come into actual contact of [illegible]

the entire energy of the dynamo will center at the point of trouble. The current developing at that point, wherever [illegible]

ground conduits, will be limited only by the maximum capacity of the dynamo or dynamos supplying the current. In event of such an occurrence the wires would either be melted or maintained red or white hot. In some cases the energy developed would be simply terrific, and it has been stated by a most eminent and conservative authority that in one case in New York city cobblestones forming a street pavement were melted by the current from an underground incandescent circuit of low potential.

In constant current systems safety may best be assured by preserving the circuit rigidly intact, and free from possibility of contact with other conductors, thereby preventing the formation of an electric arc, with its irresistible heat. On the other hand what is most to be feared in constant potential systems of low voltages is the overheating or melting of conductors by excessive amperage. The fire hazard attending the introduction of an agency capable of reducing cobblestones to a molten mass into out of the way places in residences, stores, buildings anywhere and everywhere, to be handled by anybody and everybody, would be fearful to contemplate, yet the means for controlling this enormous energy are so complete and perfect that it is not impossible to make its use as universal as that of gas without an iota of danger to either life or property. Unhappily this condition of affairs has not yet been fully reached, workmen and even electrical contractors, to many of whom an understanding of the hazards of electric lighting is as a sealed book, being yet deficient in a knowledge of what to do and what not to do in each instance to effect absolutely safe installations.

A most efficient protection against the hazards of constant potential distribution is afforded in the use of safety cut-outs, and under this expression may be enumerated all other several synonymous terms, such as safety devices, fuses, links, plugs, strips, circuit breakers and overload switches. First, and above all, let it be understood that an incandescent system is as a chain which will safely bear a given current strength, and that the safety cut-out is purposely the weakest point in that chain. In event the current thrown upon this chain of wires and appliances becomes sufficiently heavy to injure it by heating, the weakest link first gives way, breaking the circuit, the burden is removed and safety is assured. Safety fuses or cut outs, as you may know, consist essentially of strips of wires of some soft metal such as lead, or an alloy which is easily fused at a low temperature. They are introduced directly into the circuit which they protect, or, in other words, the current for burning the lamps on any given circuit is taken from feeder wires by, and supplied to the circuit in question through a safety cut-out of such a size that it will melt and so interrupt the current flow in event the safe carrying capacity of the wires is exceeded. So sensitive are these cut-outs that should a short circuit occur, throwing current on the circuit materially in excess of its safe carrying capacity, the fuse wires will melt and break the circuits before the wires have time to become appreciably warm. Being designedly the weakest part of the system, it is plain that in the event of trouble it will first appear at the safety cut-out. There the weakest link will first become hot, then break in globules of red hot or melted metal; there the flame and flash attending the breaking of a circuit will appear, and there the possibility of an electric arc exists. Is it not inexplicable, then, that some electric lighting concerns, and influential ones at that, while fortifying the remainder of the installation [illegible]

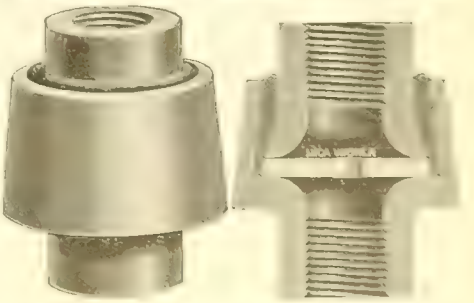


FIG. 3. [illegible]

class insulation, with wires of abundant carrying capacity, with ample separation between [illegible] unimpeachable workmanship, should mount fusible cut-outs upon a wooden base and [illegible] cover, making [illegible] at the point of [illegible] danger the [illegible]

The impression frequently, if not commonly prevails that the purpose of the safety device is to protect the lamps from excessive current. Though such may have been the

[illegible] the idea is now proven to be entirely [illegible]. The [illegible] mission of the safety fuse is to protect wires forming the circuit, not the lamps. In this connection I cannot refrain from condemning the prevalent custom of fuse nomenclature. The capacity of different fuses is now designated by amperes or lamps, the latter being most generally used when the number of lights burned on the circuit is small, as a three light fuse, but when the current carried is comparatively heavy we speak of a fifty ampere fuse, for instance. Let us analyze these prevalent terms: If we speak of a 3-light safety fuse the very name carries the false idea that 3 lamps are protected. Then three 20-volt lamps would absorb $7\frac{1}{2}$ amperes of current, three 50-volt lamps would absorb 3 amperes, while three 100 volt lamps would take but $1\frac{1}{2}$ amperes. To designate a fuse wire by a number of lights cannot therefore be considered either as generic or proper. But how about the ampere nomenclature? True it is a little more to the point, but when we speak of 50-ampere fuse it is not stated nor is it generally known whether fifty amperes represent the carrying capacity of the fuse, whether it will melt or whether it will protect a wire the carrying capacity of which is fifty amperes. Either supposition may be correct with a few brands of fuses, while in a majority of cases it is probable that neither will hold and that it may require any current from 75 to 150 amperes, or even more to blow the fuse. If a 50-ampere fuse be inserted in a circuit the safe carrying capacity of which is 50 amperes, and if the fuse refuses to blow until it is carrying 150 amperes, it is probable that trouble will ensue. A safety device of this character is safe only in name, and in fact the whole existing custom of fuse nomenclature is wrong, but before suggesting a better one, it may be well to refer to a few of the many tests that I have made with different fuses.

Take, for instance, one of those misnamed three-light-fuse wires whose intended fusing current is, of course, unknown, yet which may be variously estimated at from three to five or six amperes. As many believe in long fuses about three inches of the wire was supported across terminals half an inch above the base, then the current flowing through it was gradually increased. Two amperes were not appreciable, at three amperes it began to warm slightly, while five amperes made it so hot that for a moment a faint bit of smoke arose from its length. An ampere or two more being thrown on, the wire became soft and slowly settled down until it rested along the wood base, the ends rising abruptly to the terminals. A little more current brought it to a red heat, when it became enveloped in a film or jacket formed by oxidization, and with increased current it charred its way into the wood base. The wire then carried 12 amperes which was slowly increased until a trifle under 21 amperes was reached, when the jacket was burned through, and the fuse blew. Such a device is far worse than none, yet within the present month I found similar fuse arrangements carrying from 25 to 75 amperes in one of the finest hotels in the state. It is perhaps unnecessary to add that the overhauling of the installation in question is not being delayed. But to continue: Of a lot of 10-ampere fuses of one make it took not less than 26 amperes to blow any one of them; 45-light (100-volt) fuses of another make melted at 96 amperes, while a 110-ampere fuse blew at 238 amperes. In other brands 10-ampere fuses blew at from 12 to 14 amperes, while a very few were found that melted at about twenty five per cent in excess of their rating, indicating probably that the rating shows the safe carrying capacity which may for brief moments be increased twenty-five per cent. without injury. The fuses last referred to are the most reliable, but it must be evident that the whole matter of fuse namings has been viewed from an improper standpoint. As has been stated, a given fuse is designed to protect such a sized wire as will safely carry the volume of current required to melt the fuse in question, then if a certain fuse affords adequate protection to a number 14 Brown and Sharpe wire, why not call that a number 14 fuse wire, and not apply a title to it that is false, misleading, and totally out of place? Comparatively few wiremen have a fair conception of the question of safe carrying capacity. They will sometimes load a circuit to its utmost, then fuse according to the number of lights on it, and if a short circuit occurs the smoke from a red-hot wire tells of the trouble before a safety cut-out, rated under prevalent practices, has had time to act. If, as I suggest, a wireman has a number 16 wire on a circuit it will soon become the most natural thing in the world for him to protect it with a No. 16 fuse, which is certified to break the circuit before the safe carrying capacity of a No. 16 insulated wire is materially exceeded. Such a plan would standardize all fuses, reference to the voltage [illegible] and an understand [illegible] at once become [illegible]

[illegible] of any installation [illegible]

on the circuit. If, however, both the positive and negative wires be cut, the lights will go out and the circuit will be free from either positive or negative potential, rendering it "dead." A single-pole cut-out when "blown" breaks but one side of the circuit, as in the first case, while double-pole cut-outs complete the isolation between the circuit and the source of supply in every instance where harm could come from either pole remaining connected with the dynamo.

The next important matter demanding consideration is the oft-discussed question of insulation. As you will remember, the object of the insulating covering is to confine current to the wire, but to do this effectually it must embody several essential features. So far as is possible for anything to be so, it must be a perfect non-conductor; it must remain unaffected by the action of time, variations of temperature and the weather; it must resist the deteriorating influences of lime or other agencies as may exist; it must be absolutely moisture and water-proof; it must be pliable, and it must be of such material, or protected by such material, as will not be easily abraided. India rubber or gutta-percha satisfy many of these requirements, and their use in a nearly pure state was at first resorted to, but without success. Exhaustive experiments, however, resulted in the development of these substances into the patented compounds constituting the modern high grade insulations, such as the Clark, "E. M. W.," Grimshaw, Habirshaw, Kerite, Okonite, Roebling's Compound, New York Safety and Simplex insulations. It is essential to the safety of any incandescent installation, first, that wires of the opposite polarity shall be so placed that they cannot come into contact or that they shall be thoroughly insulated from all conductors and each other, and, second, that all conductors shall be kept absolutely free from moisture of any sort.

The first requirement necessitates care in running conductors and is satisfied by the use of almost any insulation and by supporting the wires rigidly with a good separation, such as, say, ten inches between them. Wherever possible I always advise running concealed wires on opposite joists or studding, or on the opposite sides of the same timber, either of which renders short circuiting from sagging or swinging impossible. There are places, of course, where it is impossible to maintain a separation of ten inches, as, for, instance at "outlets," where the wires come down to fixtures, beside gas drops, but then, and also wherever wires approach metal piping or metal work of any sort, it is necessary to encase each wire in an insulating tube such as hard rubber. By following these suggestions the actual short circuiting of concealed wires, with its many hazards, becomes an impossibility. It may be asked, "What are fuses for if not to obviate the hazards of short circuiting?" In reply, if the circuits are properly fused and if the short circuit is a "dead short," as a firm contact between wires of opposite polarity is called, then the fuse will blow and trouble will certainly be averted; but if it is not a dead short circuit, but only a partial or intermittent contact, an arc sufficient to ignite the insulation might possibly be drawn out, and the fuse might or might not blow, according to the nature and the actual time of contact, which cannot be pre-determined. There is but one course to take, therefore, and that is to so run the wires so that they cannot be brought into contact.

The second essential of safety, requiring that all conductors be kept absolutely free from moisture, is no less important than the necessity of obviating short circuiting. Moisture is as prolific a source of electrical fires as wood base cut-outs or short circuits, hence it is just as necessary that protection be had against it as it is that porcelain bases be used or that wires be rigidly run and effectually separated. The only materials that will withstand moisture and conform to the other essential requisites for reliable insulation are the rubber compounds, and the chief, though exaggerated, disadvantage to their use rests in the fact that they are all inflammable, some of them when ignited burning like a taper. This is a point frequently raised by makers of inferior insulations who will take a piece of high grade insulation, ignite it, and as it burns will remark in a conclusive tone: "How the underwriters can indorse any wire that burns like that gets me." And it often "gets" the other fellow, if he is credulous. Such an experiment is most unfair and misleading, for in no instance can the conditions under which it is performed exist in a properly constructed installation. The nearest approach to it would be occasioned by an arc drawn from a short circuit between two crossed wires, which should be impossible, but even then the insulation is protected by a non-abrasive covering, which, together with the insulation itself, would render it impossible for a "short" drawing an arc to be caused by anything less than actual and vigorous sawing of one wire by the other. Such an occurrence would be most extraordinary. With one or two noteworthy exceptions, no non-inflammable insulations are made, either rubber or fibrous, as only by the use of inflammable materials can a flexible protection against water—the greatest source of danger—be had. No matter how thoroughly impregnated any fibrous insulation may be with a waterproof compound, moisture will eventually work its way through to the wire, occasioning leakage, grounding, or the hazardous electrolytic action so fully described in the preceding paper. Again, as has been stated, wood may be ignited by wetting incandescent conductors resting upon it, and for these destructive results an occasional dampness, the condensation from steam, or a leak now and then, will sometimes prove sufficient.

A [illegible] for cheaper insulations is sometimes found in indoor wiring, but never in concealed work. [illegible] generally called "weather proof wires," take their name from the fact that they are made for use [illegible] or other outside places exposed to the weather. They constitute the fibrous insulations previously referred [illegible] safely used for exposed or cleat wiring indoors, provided they are run only in perfectly dry places. They are generally as inflammble as the solid rubber insulations [illegible] upon as non fire proof. [illegible] on insulation learned during the first decade of incandescent lighting: Always give preference to high-grade solid rubber insulations for indoor wiring, and never use any other for concealed work.

I have been frequently asked to define the materials and workmanship necessary to a safe installation. First, if the wiring is concealed behind lath and plaster, the insulation should invariably be of solid rubber, the term solid rubber being used to express a distinction between an insulation which is all rubber (except the thin, non-abrasive covering) and one which contains only a rubber film or membrane, to which has been added several fibrous layers. All wires must be tightly run and rigidly secured, so that contact between them will be impossible. As already stated, they should be run on separate timbers or on the opposite sides of the same timber, and if wires approach or cross metal piping, or other wires of any description, they must be encased in insulating and water-proof tubing, such as hard rubber tubing or interior conduit. Do not run wires in places liable to dampness, as under roofs, wash stands, bath rooms, or lavatories, unless the wires are of solid rubber insulation and are encased in continuous and waterproof tubing, such as interior conduit. Wires run along brick walls or under furring strips or if embedded in plaster must also be incased in conduit. At fixture outlets each wire must be protected by a hard rubber tube, rigidly secured and continued above the line of plaster, well away from the gas pipe. In rendering grounding against gas pipes impossible, the tubing prevents the formation of an arc between either wire and the pipe. Such an arc has been known to wear a hole through the pipe and to liberate and ignite the gas. The hazard attending such an occurrence would, of course, be exceedingly great. This calls to mind an electrically caused fire that occurred in one of the leading hotels in San Francisco not many months since. Flexible cord consisting of two conductors of opposite polarity, twisted together, had been used for wiring in concealed places, and where the trouble occurred it was placed in soft rubber tubing and carried up into an iron column through a half inch hole bored through the wood flooring. The place was infested with rats, which have, as many practical wiremen know to their sorrow, a consuming ambition to gnaw every hole large enough to crawl through. To satisfy this desire their ratships set to work at the half-inch hole. The rubber, being soft, was the first to yield, then, doubtless, the insulation was shredded, which occasioned arcing. A blind gas pipe that had been plugged with lead was found near by and whether or not leaking gas was ignited by the arc, or whether the arc itself caused the fire, is of course, a matter of conjecture, but at all events a fire that assumed serious proportions started between the joints in immediate proximity to these samples of botch electrical and gas fitting work.

It is necessary, of course, in wiring a building that each wire be used within the limit of its safe carrying capacity, but it does not follow that because a building is so wired the lights will give satisfaction to the owner. In a Utah town I once found a so-called electrical engineer who was wiring a large building from an insurance table of safe carrying capacities, an act, the enormity of which from the standpoint of good workmanship, can be best understood by competent electricians. Such a thing could be done in a manner acceptable to fire underwriters, but when current is thrown on the circuits it is most certain that a howl long and mighty will be raised, not that the wiring is unsafe, but that the lights will not burn uniformly or at all satisfactorily. An underwriter's certificate of acceptance, therefore, means that the installment in question has been placed in a manner believed to be safe from fire, but it does not assure the owner that his wiring is properly proportioned, or that the plant is perfect electrically.

But to continue the definition of what constitutes a safe installation. Sometimes the weakest point of an installation rests in the joints and splices in wires. They must invarably be firmly made and well soldered, then so covered that their insulatiun shall be equal to that of the remaining conductor. After soldering all acid should be wiped from the joint, which should then be covered by some insulating compound or pure rubber tape. Over this should be wrapped at least two layers of any fibrous non-abrasive tape, and the whole finally given a thick coat of some insulating and waterproof paint, such as "P. & B." insulating compound. Never apply a non-abrasive or fibrous tape or any tape containing sulphur to a copper joint, as the action of sulphur upon cotton is very deteriorating. It is of the greatest importance that incandescent conductors should be kept well separated from other concealed circuits such as annunciator, fire alarm, telephone, or bell wires. In several instances I have found annunciator wires bunched with incandescent leads and even run in the same groove in moldings with them. Should the annunciator wires short circuit with the electric light conductors, as might easily happen, the heavy incandescent current would be thrown on to the delicate paraffine soaked annunciator wires permeating every portion of the building, making them red hot. You will surely agree with me, then, that such an occurrence should be made an impossibility. Finally, among the most important requisites to absolute safety, the current carried on ultimate or lamp circuits which contain the smallest wires, should be restricted to such amperage as cannot cause heating or injury under any contingent. In practice, therefore, the carrying capacity of all ultimate circuits is limited to five or ten amperes, preferably the former.

To close a paper on the hazards of incandescent lighting without a word regarding efficiency of interior conduits would be to depreciate a commendable thing. The conduit system consists of either rigid or flexible tubes of insulating moisture-proof and water-proof materials placed in buildings after the manner of gas piping. It is not claimed that these tubes are non inflammable, but it is impossible for wires p'aced within them to ignite or carry fire. The conduits, being continuous, wires may be introduced into them after the building is finished, and, what is more, in the conduit system of wiring conductors may be withdrawn for inspection at any time. As is the case with every

innovation, interior conduit systems have a few minor details susceptible of improvement, yet these in no way mar their general utility, and if satisfactory results do not follow their installation, the fault rests with the workman, not the systems. Among their many advantages I would emphasize the freedom afforded from the molestation of wires by rats and mice, the absolute immunity from the deteriorating influences of moisture, lime, and atmospheric changes, the facility with which wires may be examined or replaced. and finally the fact that the hazards attending the use of inflammable insulation—the only competent ones—are entirely eliminated when an interior conduit system is used. The advantages of the conduit system are therefore so manifest, that in my opinion the one who advocates their use is a public benefactor.

Here, then, are enumerated the principal hazards of incandescent lighting. Though perhaps formidable in the early days of the art, before experience advanced as a teacher, they are no longer to be feared, as preventives have been devised, which, when supplemented by intelligent workmanship, prove absolute in their office. Of course, improvements tending to make electric lighting yet more safe and satisfactory appear almost daily, but despite every precautionary appliance, an ignorant workman, an unprincipled contractor, perchance ruinous competition, with its cheap labor and low-grade materials, may make an incendiary installation of a plant, that, to the unpracticed eye, may appear perfect. To standardize all work, to educate the wireman, and to supplement all by a system of rigorous inspection, completes this self-allotted task of the fire underwriter.

Electricity and Life.[1]

By Edward P. Jackson.

It seems to be a pretty well established fact that elec tricity may be made at least a powerful stimulant to the growth of plants. May it not be more than a mere stimulant? May it not be an actual creator of life? Beans, rye, corn, oats, barley, peas, potatoes, sunflowers, clover, and flax have all been experimented upon, in some cases with astonishing results. In one series of experiments the seeds were electrified before they were sown; in another, currents were maintained through the soil in which they were planted; and in still another, through the atmosphere immediately above the plants. In several instances the yield of fruit was enormously above the average, and in all the growth was unusually luxuriant. Further experiments are in progress, and it is not unlikely that science is about to add another to her long series of beneficent triumphs, another refutation to the croaking philosophy of Malthus and his disciples.

The results of the experiments have, furthermore, a suggestive bearing upon the relation between electricity and that inscrutable something which we call life. If they do not prove them the same, they at least bring them nearer together than any phenomena which have preceded them. When, in the healing art, enfeebled vitality is restored, either wholly or in part, by the skillful application of electricity, nothing is positively demonstrated beyond mere healthful stimulation, the mere awakening of life which already lay dormant in the system, such as might possibly have followed the use of other remedial agents. But here it is not morbid restored to normal conditions, not dormant life reawakened to action. It is apparently the actual development of vitality not pre-existent in the perfectly healthy and normal organisms under treatment. Electricity itself appears to be converted to vitality, as elsewhere it is converted to light, heat, and mechanical motion.

Whether life can thus not only be renewed, but actually transfused into the veins, or rather the nerves, of man remains for physiological science to determine. It has already been shown that a living body is a species of thermoelectric battery, of which the ectoderm and the endoderm are the opposite poles; that the exhilarating effects of a cold plunge, for example, are due simply to the increase of potential from the reduced temperature of the "cold" electrode. But merely setting a battery into operation, or merely increasing its action, is not increasing its inherent voltage, which is what the recent experiments seem to have done for plants.

But do not heat and the active principle of light artificially intensified produce similar effects? The forcing of vegetable growth in hothouses is an old process, not unlike the one in question, both in method and effect. According to the reports given, however, there is a very great difference in the results attained. If this be true, it would seem to indicate more strongly than ever that of all forms of natural force electricity bears the closest relation to that mysterious form of it which we call life.

1. *North American Review*.

Device for Stopping Electric Cars.

George W. Blanchard of Waterville, Me., has designed a device for preventing electric cars that have been stopped while ascending a steep grade, from running back down the grade before the brakes could be applied. In a bushing fastened to the railing of the car platform there is journaled the horizontal shaft of a hand wheel, the shaft bearing an indicator finger. The feed wire on entering the car passes first to a solenoid and thence to a switch bar having a handle. From this point the feed wire divides, or, speaking more exactly, there are two supplemental wires, one of which extends directly from a contact on a switchboard (attached to the railing of the car platform) to said shaft or an attachment. The other wire extends from another contact post to a small magnet, and thence to the shaft or any attachment. When the switch bar is on the first contact, the circuit is through the solenoid only, and when on the second contact, the circuit is through the small magnet and solenoid also. A magnetic bar is movable endwise up and down in the hollow core of the solenoid. It carries at its lower end a block provided with cogteeth, arranged to engage the motor gears, and thus lock the car whenever the bar and block are left free to descend. While the solenoid is in circuit the block is held up out of engagement and the gears are free to turn, so that the car may run; but a failure of electric current through the solenoid from any cause arising will end the attractive power of the solenoid, and the bar and block will be no longer prevented from falling and locking; but this would be very inconvenient on level ground, and in ordinary circumstances it is preferable to provide the bar on one side with a shoulder or enlargement and arrange a pivoted stop to bear obliquely upward against it, holding the bar from falling. This stop is attached to a hanger or frame, which is made fast to the under side of the floor of the car, and also supports the small magnet. This magnet is in proximity to the stop and arranged so that when energized it will attract the upper part of the stop, which is metallic, away from the shoulder, the stop turning as a pivoted armature against the magnet. When this small temporary magnet is demagnetized, the pivoted stop drops again into position for holding up the bar and block. When operating on level ground, the circuit is through one contact and solenoid, the block is out of gear, and the pivoted stop holds it so. If then the circuit is accidentally broken or the current fails, the gearing will not be locked and the car will run for a short distance by its own momentum, stopping gradually with no jar, or not stopping at all if the defect be remedied in time; but in ascending a hill, or just before doing so, the switch bar is shifted to the other contact, and the other circuit is then through both the solenoid and the small magnet. The former still holds the block out of engagement with the gears, but the latter draws away the stop, as described, so that there is nothing else to support the block. If then the current fails, the bar and block will drop at once before the pivoted stop can check them, and the gearing will be locked, preventing the car from running backward downhill.

Electric Cranes.

In the course of an interesting article in the *Railroad Gazette*, on "Cranes for Railroad Work," William L. Clements, M. E., says of electric cranes:

The use of several motors for the operation of the different motions of an electric traveling crane was made successful in England prior to their general introduction in the United States. In all general types of traveling cranes the transverse movement of the trolley and the hoisting gearing are actuated by longitudinal shafts running the length of the girders or by high speed ropes. These necessitate tumbler bearings, accurate shaft alignment or sheaves with boxes, and all involving deterioration and friction.

With the substitution of a motor connected directly with the trains of hoisting gearing and another connected with the traversing mechanism, shafts, tumblers, sheaves, etc., are unnecessary, wire conductors being the substitute, the deterioration of the motors is slight and confined to few parts. Such a substitution is likewise made with the traveling mechanism, and the use of all clutches obviated. It is essentially electrical, all motions through the motors being reversible and independent. Experience has shown, with such mechanisms, that, through the controlling rheostat, variations of speed for all motions are most easily accomplished. It is evident with such results that these changes greatly simplify the mechanism for the necessary motions of traveling cranes. With a double-trolley machine, as shown, the elimination of parts for the many motions required is still more marked, five motors there independently operating both trolleys and traveling, the variation of speed and running being controlled as before through the rheostats. For every rapid hoisting with light loads a second and rapid speed is given. These remarks apply to machines with single and double trolleys used alone. The combined use of two electric cranes for one transferring operation introduces other important conditions.

Cranes lifting or transferring together necessarily must lift and transfer at the same speeds, and, while one operator working one crane may adjust his switch for a certain speed, it is extremely difficult for the other to adjust his to the same, a most important objection for consideration. No satisfactory remedy in such cases has been proposed; a different design, however, corrects it. With rope or shaft driven cranes speeds are constant and clutches control them. The substitution of one powerful motor for driving all mechanisms otherwise driven by the rope or shaft gives the effect, when done at a uniform speed, of a constant motion for all parts. An electric crane so designed is in all details similar to a rope or shaft driven machine, and two machines may work together or singly.

In the selection of a design there can be no doubt of the great simplicity with electrical power of the single or double trolley crane and its effectiveness and accuracy of operation. While there are advantages with the one-motor system (necessary when two cranes are to be worked together), yet with the uses of all the mechanisms necessary with other motive power, the use of electricity with such cranes is not so pronounced.

The new electric light plant in Salem, Va., has been successfully put in operation. The plant cost $51,000 and is of the Thomson-Houston type,

An interview with Charles Renault is published in the *New York Times*, in which that gentleman describes the proposed Paris underground rapid transit system. Following is an extract: "I don't know what kind of motive power is to be employed on the road when it is finished, but I suppose it will be electricity. You can rest assured that the people of Paris will not have the grime and dust and smoke that afflict the travelers in the old underground system in London. They will not sacrifice comfort and cleanliness to any amount of speed, and the people who are building the road will find themselves without passengers unless they adopt a perfect system."

CORRESPONDENCE.

New York Notes.

[illegible] thing, of importance in the electrical field has taken place. [illegible] secretary, Mr. Beane, both for tickets and exhibition space, is any indication of the progress made. It is certain [illegible] terests of New York.

Damage suits and other litigation will result from the collision of the trolley [illegible] avenue, Brooklyn. In accordance with the preponderance of evidence thus far given it seems that the electric car was to blame for the crash, but the tables may turn before the suit has been completed. This accident on the electric road has been speedily followed by a fatality on the Third avenue steam surface road in the city of churches. A young boy, while stealing a ride on a passing wagon yesterday, was driven off, and in his haste to get out of harm's way ran directly in front of an approaching "dummy" engine and was run over and horribly crushed.

The committee appointed by the Treasury department to arrange plans for a ferry between Ellis Island and this city, in its report to Washington yesterday, recommended that all the buildings on the Battery between the Barge office and the Staten Island ferry-house be removed, and a landing place for the new ferry be built on the site. In all probability the proposed plan will be adopted as the most feasible. A portion of one of the buildings on the present site is occupied by the Western Union Telegraph company, and the new arrangements will necessitate the company's removal.

Mr. Osborne Holmes, Jr., of the Rapid Transit commission of Boston, will soon leave New York for London and the Continent. In London he will meet Mr. Fitzgerald of the commission, who has been investigating the Greathead system of tunnels in that city, and together they will visit Berlin and other cities in which underground or elevated railways are in operation or are proposed. No meeting of the Rapid Transit commission was held this week at its offices in William street. No one seems to know anything definite in regard to the commissioners' movements, and it would require some heavy speculation to determine when the next meeting will be held.

Another trial trip of the McDougall storage battery car was made this afternoon from the Astoria ferry over the tracks of the Steinway and Hunter's Point railroad. Several prominent capitalists were present, and the trip proved to be a most satisfactory one in every respect.

R. M. Lloyd, of the firm of Lloyd & Paxton, leaves on Saturday for a six weeks' European trip. While he is gone he will incidentally have an eye to business regarding the storage battery subject. In referring to the storage battery situation at present, Mr. Lloyd said that the company was lying low and awaiting developments, which would transpire in a few weeks, and which would prove highly interesting. F. T.

Denver, Colo.

Denver, Sept. 2.—A year ago the [illegible] & Golden Railroad company made [illegible] an electric line between this city and Golden, about eight miles distant, and since then there has been a bitter contest between the company and the Denver, Apex & Western Railroad company over the right of way in Golden and the entrance to Denver. On Saturday last the temporary injunction applied for by the Denver, Apex & Western company, to prevent its [illegible] what it claimed to be its right of way, was dissolved by Judge Becker in the Jefferson county court.

Manager Starkweather [illegible] dissolution of the injunction will end the controversy, but ex-Senator Tabor, president [illegible] ern, declares the company will not let the matter drop with Judge Becker's decision.

The track is now complete [illegible] Two power houses will be built, but their location has not been definitely decided upon. Manager Starkweather expects to have freight cars running in three weeks, and passenger trains will be started [illegible]

The city council [illegible] different ways [illegible] veto. The latter declares the resolution inoperative. He says the contract with the [illegible]

company provides that the contracting party on the part of the city must be the mayor and the two branches of the city council. He thinks, however, the matter will be arranged satisfactorily.

The Brighton Water and Electric Light company has just been organized with W. C. Kidder as president and James McKean as treasurer.

Horse car travel in Denver is now a thing of the past. The first line was operated in 1874.

Engineer DeMarr, in charge of the electric light and power plant at Georgetown, is the inventor of a governor that regulates the brilliancy or degree of light of incandescent lamps. It is said to be simple in application and to work successfully.

A new board of directors was chosen at the annual meeting of the El Paso Electric Light company of Colorado Springs, consisting of W. S. Jackson, C. H. White, Dr. B. F. D. Adams, John Curr and C. M. Williams. The company has purchased additional land upon which a new building will be erected. The building, with the increased machinery, will cost $35,000.

The Edison Electric Power company is to erect a plant for the Virginius mine at Georgetown for the transmission of 95 horse power, three and a half miles up over the range, 14,000 feet high. It is claimed there will be a loss of only ten per cent. in this long distance transmission.

Brighton, about eighteen miles from Denver, wants an electric road built from Denver to that point and the citizens are again agitating the project.

E. C. D.

Toledo, O.

TOLEDO, O., Sept. 2.—The Toledo Consolidated Street Railway company's power house is equipped with a fine generating plant. At present the company has two 500 horse power tandem compound engines of Hamilton-Corliss make, each having a drive wheel 20 feet in diameter, carrying a 48-inch belt and making 75 revolutions per minute. One of these engines furnishes the power for five Thomson-Houston dynamos, of 80 horse power each, while the other furnishes power for two Edison dynamos of 250 horse power each. There are four Harrison boilers of 150 horse power each. Natural gas is used for fuel. Of the 125 miles of track, about 40 has been equipped with the electric system, including all of the East Toledo lines. F. H. Lincoln is electrical engineer; H. Hensler assistant electrical engineer, and Chas Phillips, chief engineer of the company.

The "Robisons" have moved into their new quarters, cor. Summit and Madison streets, where their transfer station now is, and their cars are running with more regularity and fewer delays than at first.

The Western Union Telegraph company is preparing to light its offices by incandescent lamps. W. S. Smith, superintendent of the Toledo Electric company, is overseeing the work.

F. C. H.

Cleveland, O.

CLEVELAND, Sept. 2.—The offices and salesrooms of the Edison General Electric company in this city are now located at 160 Public Square. B. M. Barr, formerly of St. Louis, is the manager, vice S. D. Nesmith, resigned. S. M. Brewster is the superintendent of construction, and [illegible] going boss.

The Central Thomson-Houston company has installed [illegible] department at 40 Arcade, with S. D. Nesmith as manager. W. R. Caulkins, its former manager, [illegible] capacity while F. W. [illegible] company soon after [illegible]

[illegible] company, of which W. L. Graves, an electrical engineer of some note, is president, [illegible]

The large Put in-Bay hotel "Victory" will have 2,000 incandescent lights.

The electric light masts owned and put up by the Brush company may soon be useless landmarks only, as the council thinks the ordinary arc lamps give better service. Lake captains will deeply deplore the change.

The new Western Union building is fast going up, while the company is doing the best it can in its "pioneer" quarters.

Andrew V. Kurtz, local manager of the Postal Telegraph and Cable company, will soon resign to engage in the insurance business.

Chas. Rockwell, manager of the Buckeye Electric company, manufacturer of incandescent lamps, says that the new factory will be one of the largest of its kind.

B.

Pittsburg, Pa.

PITTSBURG, Sept. 2.—J. F. Tener of Pittsburg has recently established a factory at Morgantown, W. Va., for the manufacture of insulated pins and brackets. The office of the company is in this city at 54 Bluff street.

The Duquesne Traction company of this city has lately ordered a number of new cars from the J. G Brill company. The cars will only have four wheels and they are to be of very light construction in order to enable them to climb the steep hills in this city.

The Pittsburg Traction company has made arrangements to put a fifteen hundred horse power steam engine in the power house at Oakland.

The Second Avenue Electric Street Car company is now building an addition to its power house at Soho. When completed the capacity will be doubled. The company was compelled to this increase in order to meet the demand for power, which will be made when the extension of the line to Greenfield and Homestead will be completed. These improvements are expected to be finished by October 1st.

The Westinghouse gearless motor, which has been in operation on the Pleasant Valley Electric Street Car company's line for some time, is attracting considerable attention by the traveling public. The motor is a great success, the hills and curves on the line are traversed with the greatest ease, and the Pleasant Valley people are pleased with the work accomplished.

Two new electric roads are contemplated to be built shortly by Pittsburg capitalists. One is to run from the west end to Coroapolis, a distance of eight miles. The other has already assumed definite shape. An ordinance granting it the right of way is now pending in the borough councils of Homestead. It will begin at Atwood and Bouquet streets in the east end portion of this city and from there it will skirt Schenley Park and cross the Monongahela river, which is to be bridged for this purpose.

B. L. W.

PERSONAL.

D. Forsythe Morris of Chicago returned from St. Louis on Friday morning.

W. B. Pearson, Chicago, passed several days in St. Paul during the past week.

E. R. Weeks of Kansas City was in Chicago last Saturday on his way to Montreal.

Lewis S. Greensfelder, vice-president of the company, will represent the Ries Electric Specialty company of Baltimore at Montreal.

H. M. Byllesby, president of the Northwest Thomson-Houston company, St. Paul, has just returned from a business trip to the Pacific coast.

C. A. Benton, of the Detroit Electrical works, was in Chicago last week. His company, he says, is enjoying an unprecedented rush this season.

Louis A. Ferguson of the Chicago Edison company has returned from a pleasant visit to Boston, where he has been enjoying a three weeks' vacation.

S. K. Comstock, who has been employed recently as superintendent of the electrical work on the public buildings in Philadelphia, was in Chicago last week.

G. M. Angier, who has been connected with the Great Western Electric Supply company as manager of the lighting department, has accepted the position of assistant manager of the Knapp Electrical Works. Although Mr. Angier has [illegible] Chicago less than a year, he has many friends among the electrical fraternity who will wish him success in [illegible] position.

The many friends of J. D. Claghorn will regret to learn [illegible] compelled, on account of poor health, to give up the management of the business of the Chicago Electric Manufacturing company. The future management of the [illegible] determined in a few days. Mr. Claghorn [illegible] of the grip, from which he never fully [illegible] He will go to Minnesota for a time, expecting [illegible] Northern Nebraska

NEW INCORPORATIONS.

Mascoutah Electric Light company, Mascoutah, Ill.; capital stock, $5,000; to furnish electric light and power; Peter W. Lill, Belleville, Ill

Cook Electric Light company, McCook, Neb.; capital stock, $30,000; furnishing arc and incandescent lighting and steam and electric power.

Imperial Electric company, Camden, N. J.; capital stock, $25,000; to manufacture, buy, sell, lease, use and trade in machines; Israel Roberts, Camden, N. J.

Oklahoma Water & Light company, Chicago, Ill; capital stock, $300,000; to construct, operate and maintain water and gas works and electric light plants; Ball, Wood & Oakley, 122 La Salle street, Chicago, Ill.

Orne Electric Construction company, Chicago, Ill.; capital stock $11,000; to manufacture electric appliances and speaking tubes, and do a general mercantile business; Chicago & Northern Pacific Railroad company, Chicago, Ill.

Ford & Washburn Electric company, Cleveland, Ohio, capital stock, $200,000; manufacturing electrical instruments, machinery, cars, boats, engines, etc., propelled by electricity, etc.; Sherman, Hoyt & Dustin, Cleveland, Ohio.

Enterprise Electric Light & Railway company, Kankakee, Ill; capital stock, $100,000; to construct and operate a street electric railway and furnish electric light and power; Enterprise Electric Light & Railway company, Kankakee, Ill.

ELECTRIC LIGHT.

The electric lighting of the British Museum is about finished.

The erection of an electric light plant is being discussed at Franklin, Ky.

The Searcy, Ark., electric light works are being enlarged at a cost of $6,000.

Lindsay, Ont., is to be lighted by electricity. The Edison General Electric company of Canada will establish the plant.

At a special town meeting recently held at Peabody, Mass., for the purpose of voting on the proposition to establish a municipal electric lighting plant, in accordance with the provisions of the general act of the state, the vote stood, 459 in favor to 32 opposed.

The board of directors of the Park City Light, Heat and Power company, of Park City, Utah, at a recent meeting, let a contract to R. M. Jones, general agent of the Edison company, for duplicating its plant. The contract requires that the new machinery shall be ready for operation by November 1st. The capacity of the plant, with four dynamos, will be 1,800 16 candle power lights.

The Odessa harbor electric lighting plant constructed by the Thomson-Houston International Electric company has been accepted by the Russian government. There are 64 2,000 candle power arc lamps, and eight 125 candle power incandescent lamps. The arc lamp-posts vary in height from 43 feet to 30 feet. The generating plant consists of four 35-light series-wound arc dynamos, driven by belting from two central valve condensing Willans and Robinson high speed engines. The two boilers are supplied by the Babcock & Wilcox company.

ELECTRIC RAILWAYS.

The construction of an electric railroad is being discussed at Paris, Ky.

Work has been commenced on the extension of the electric railway at Oswego, N. Y., to the fair grounds.

It is rumored that Captain Frazier, of Chattanooga, Tenn., will build an electric road from Tampa, Fla., to Frazier's Beach, a distance of four miles.

The Chattanooga, Tenn., Water and Electric company has issued $50,000 of bonds for the purpose of constructing its electric railway to the top of Cameron Hill.

At Salem, Mass., the Naumkeag Street Railway company has been granted permission to establish an overhead single trolley system on Goodhue, Grove and Tremont streets.

The street railway line of Carthage, Mo., has been sold to J. Guinney, of Peirce City. Mr. Guinney is quoted as saying that he intends doing away with mules and substituting an electric line.

The Syracuse, N. Y., Electric Railway company wants a franchise for the construction of a street railway from the corner of Colvin and Mulberry streets through various streets to the corner of Water and Genesee streets.

At a recent meeting of the Mobile, Ala., Street Railway company a resolution was adopted increasing the capital stock to $300,000 and authorizing the issuance of $300,000 in bonds to raise funds to change its lines to the electric system.

New York capitalists are said to have purchased the property of the Roanoke, Va., Street Railway company. They propose, it is stated, to reorganize the company with a capital stock of $250,000, and use electricity as a motive power.

The San Francisco & San Mateo Railway company, whose electric line was opened on July 29th, has applied for permission to extend its railroad tracks on Asbury

street, from Frederick to Waller, Waller to Stanyan and Stanyan to Haight streets.

The Schenectady, N. Y., Street Railway company has decided to issue trip tickets at three cents, thus enabling working people to ride to and from their work on the electric cars. These tickets will be good from 6 to 7:30 A. M., and 5:30 to 6:30 P. M.

It is reported that a representative of a Boston syndicate was in Fond du Lac, Wis., lately, looking over the street railway with a view of purchasing it. If a favorable report is presented, the syndicate will put in an electric line, using the Thomson-Houston system.

The city council of Shreveport, La., has, it is stated, granted the franchise for the construction of the electrical railroad of the Shreveport Electric & Motive Power company, chartered by G. H. Bernos, E. J. Bryan, C. Lee McMillan and others of New Orleans.

The Los Angeles, Cal., Consolidated Electric Railway company, is replacing its horse cars with electric cars as rapidly as possible. The system adopted is the Westinghouse, and the plant, when finished, will be one of the largest and best equipped on the Pacific coast.

The Fairhaven, Wash., electric railway will soon be completed. Two miles of road will be operated at first, the line from the Ocean dock to the New Whatcom boundary. Seven Pullman cars have been ordered. The Thomson-Houston company is equipping the line.

The Woodland Avenue & West Side Street Railroad company, of Cleveland, O., has decided, after two years of investigation, to equip its lines with electricity, and will adopt the overhead system already in use on three other Cleveland roads. It is the last large line in the city to give up horses.

A contract has been made between the city of Memphis, Tenn., and the Raleigh Springs Railroad company by which the latter secures the right of way through certain specified streets from the heart of the city to the suburbs for twenty-five years. This line is to be run by electric power. The principal stockholder of this company is B. L. Duke, of Durham, N. C.

A charter has been granted the Weygadt Mountain Railway company for the construction of an electric and gravity railway around Weygadt mountain, a pleasure resort near Easton, Pa. The road will be two miles long, and the capital stock is $30,000. The officers of the company are: President, J. Marshall Young, of Easton; secretary and treasurer, D. W. Nevin of Easton.

Arrangements have been made, it is said, by which the Thomson Houston company will secure control of the St. Cloud, Minn. street railway system and will put in an electric line and extend it to the reformatory, or East Sauk Rapids on the north, and the Great Northern car shops on the west, provided sufficient inducements are forthcoming on the part of benefited property owners. An expenditure of $135,000 is contemplated.

The Jamestown, N. Y., street railway has been extended to Lakewood, and it is likely that it will be continued eastward to Falconer. This will make a clear stretch of twenty one miles from Falconer, and constitute one of the largest suburban electric roads in the country. It will place Jamestown, Lakewood and the Erie railroad within quick communication with Chautauqua and make a complete circle of rails around the lake.

The hardest steel at present successfully worked by the electric welding process is that used for band saws. Besides the regular work of making the joint in continuous band saws, it has been ingeniously adopted for replacing broken teeth in finished saws. Formerly it was necessary to cut down to a smaller size any saw from which one or two teeth had been broken, thus losing not only the difference in price between the two saws, but also the entire cost of the labor in cutting the original saw. Now when a tooth is broken out, they simple fit in a new tooth, which is electrically welded in place, and a drop of oil applied as the completion effectually restores the temper of the saw to a serviceable point.

The Standard electric company of Detroit invited a number of prominent citizens of that city recently to attend a test of the Logan Storage battery car. The party was taken to Mount Clemens from Milwaukee junction in one hour and fifty-five minutes. Numerous stops were made, and the actual running time for the seventeen miles was one hour and twenty minutes. There was no lack of power, the current was easily controlled, stops and starts were made without jerk or jar, and altogether the trip was an entire success. The motors on the car are the Shawan motors. They worked easily and smoothly. The speed developed was an average of about twelve miles per hour. At times fifteen and one-half miles per hour was made of short distances. The car and load weighed nearly eleven tons.

Two electric cars going in opposite directions on one track met in Lynn a few days ago. Each conductor claimed the right of way and a war of words ensued, neither being willing to concede an inch. Finally both men boarded their respective cars and gave the signal to go ahead. The motor men turned on the power in full force, and for five minutes the cars strained and tugged for supremacy, the moment one car began to lose the brakes being turned on. The passengers left the cars and expostulated with the angry conductors, but they were obstinate and the battle continued. Other cars came along and the deadlock continued for about an hour. The superintendent of the road was sent for, and he quickly decided which one of the cars should go back. His orders were completely disregarded by the enraged employes, however, and he was finally compelled to board the car and manage it himself, thus clearing the line. The battle caused great amusement to a large number of spectators. The offending participants were discharged.

ELECTRIC MINING.

In speaking of the successful introduction of electric mining machinery the McKeesport, Pa., *Times* says: "The Jeffrey Manufacturing company of Columbus, O., has recently equipped the following named mines with electric coal cutters: Helvetia mines, Helvetia, Pa., four machines; the Redstone Coal & Coke company, Grindstone, Pa., two machines; the Union Colliery company, Victoria, B. C., four machines. The Michales Electric Mining company is putting in an electric mining plant at O'Neil & Peterson's coal works at Bunola, on the Monongahela river. It will be in working order in a few days. Judging from the report of Mr. Norwood, the state mine inspector of Kentucky, some of the largest coal companies in that state are contemplating the feasibility of adopting these machines, together with the haulage system, etc., in their mines."

TELEPHONE.

The Universal Telephone company of London has recently fitted up the Royal Italian Opera House, Covent Garden, for Sir Augustus Harris with 50 telephones, all inside the theater, and is now fitting up the Theater Royal, Drury Lane, with a like number, and Sir Augustus' residence at St. John's Wood with five stations, including one to his stables. A trunk line joins his house with the Drury Lane Theater, and another joins Drury Lane to Covent Garden Theater, thus enabling Mr. Harris to communicate from either his house at St. John's Wood, Drury Lane, or Covent Garden, to any one of the remaining 104 stations. The length of wire used exceeded 50,000 feet.

TELEGRAPH.

The new submarine cable line between New York and Brazil was formally opened for business on September 1st. This provides for the first time direct telegraphic communication between the United States and the big South American republic. The new line is said to be controlled by French capitalists.

MISCELLANEOUS.

Electrically propelled life-boats are proposed in England. The difficulty of keeping the connecting cable intact in stormy passages is raised as an objection.

A press dispatch states that John Wilkinson, a lineman employed by the Swift Electric Light company, Saginaw, Mich., recently grasped a live wire carrying a current of 2,000 volts and escaped with a bad burn on his hand.

W. H. Harris, J. O. Lee, T. R. Phister and G. T. Speer have incorporated at Maysville, Ky., the Ohio Fuel company to manufacture fuel and illuminating gas, electricity and electrical appliances. The capital stock is $500,000.

The United States Corporation Bureau of Chicago, reports 263 new completed corporations in the United Statse for the week ending Aug. 28, with a total capitalization of $63,073,660. Of these 13 were light, heat, power and transportation companies, and the capital stock was $3 515 000.

By an accident occurring at an electrical station in Posen, Germany, on Aug. 27th two employes were killed, and one injured. The men were on the roof of the building making some repairs in the conductors when, by a fatal blunder, the whole current was turned on, with the result stated bove.

Some genius in Brussels, Belgium, has suggested a new system of electric light poles. He proposes "masts formed of steel rods, which would be drawn at nightfall from sheaths placed in the ground, and which would be drawn back again at daybreak, so as to in no way alter the architectural appearance of the Grand Place during the daytime. It is proposed to work these movable masts by means of hydraulic pressure."

It is stated that W. H. Chew, agent of the Columbia Water Power company of Columbia, S. C., has granted 400 horse power each to the Columbia Electric Street & Suburban Railway company and the Congaree Gas & Electric company. He has also, it is said, promised to Miller Bros. 500 horse power for the 10,000 spindle cotton mill they propose to erect on the "Heights." This power is to be transmitted by electricity.

At Grosswardein, in Hungary, a short time ago a flash of lightning struck the theatre during a performance. The audience, believing the house had taken fire, rushed to the doors, the consequence being that a number of women fainted and fell under the feet of those in the rear. Some of the more cool-minded among the audience were able to reassure the crowd, and no serious injury was done. The performance, however, could not be continued.

The Brotherhood of Electrical Mechanics has issued a neat pamphlet showing the objects sought to be attained by the organization. In the prospectus this statement is made: "Our Brotherhood is not a labor organization in the general acceptance of the term. We leave the question of wages where we thi k it properly belongs, that is, between employer and employe. We are unequivocally opposed to strikes, and to anything that will interfere between employer and employes, as we believe their interests to be identical."

A writer in *Land and Water* says that during a recent visit to Totland Bay he was told that the fishing all along that part of the Isle of Wight was very poor, and that since the setting up of the search light for the forts it had

[illegible] looked on as a certainty."

[illegible] year eighty projects for the utilization of water power were [illegible] River Doubs. Electric lighting is being gradually in- [illegible] horse power is to be obtained from the Aar, and electrically [illegible] electrical power and employ 600 workmen. The capital required for the scheme, which is to obtain 16,000 horse power from the Rhine at Rheinfelden, has been subscribed to the amount of over $3,000,000 Nearly the whole power of the streams near Winterthur is utilized electrically. Vicosoprano and Stampa are to be lighted electrically, and will utilize the water power in the neighborhood At Soluthurn a company has been formed with a capital of $150,000, to make a canal between the Emme and the Aar, and electrically transmit the power thus obtained. The great increase in the utilization of water power will have an important effect on the coal industry of the Saar district

TRADE NEWS.

An attractiveiy gotten up price list has just been issued by the Okonite company, and will be sent to any address upon application at 13 Park Row, New York.

So rapidly is the list of new devices that the Electric Merchandise company is putting on the market growing that it has been compelled to issue another supplement to its general catalogue of 1891. It contains descriptions of line, station and car equipment material.

The Ries Electric Specialty company of Baltimore has recently secured the handsome and commodious building on the northeast corner of Baltimore and Eutaw streets in that city, directly opposite the Eutaw House, and has fitted it up with the necessary machinery and appliances for manufacturing its electrical specialties. This company promises a novelty in the shape of a device that will create something of a revolution in incandescent electric lighting, inasmuch as it is said to constitute the "missing link" that will place incandescent electric lighting as an illuminating agent on a par with gas.

The Hine Eliminator company, 106 Liberty street, New York, states that the little pamphlet published by it containing Prof. R. C. Carpenter's complete report of the test of steam separators made in June last at Sibley College, Cornell University, has proven the best salesman it has ever had. This report sets forth in tabulated form the demonstrated efficiencies of the six steam separators and oil extractors. By these tables it is claimed the Hine eliminator, in this test, demonstrated an efficiency over all competitors ranging from $11\frac{1}{16}$ to $59\frac{1}{16}$ per cent. Dry steam, especially for high speed engines, is a matter of much importance, and the value of steam separators is becoming understood.

At the last session of the Missouri Legislature provision was made for the establishment of a manual training school, or industrial department, in connection with the Lincoln Institute, at Jefferson City, Mo. The necessary buildings are now nearing completion, and the power plant, tools, etc., will be installed in a short time. The board has contracted with the Pond Engineering company of St. Louis for a power plant, designed in accordance with the best principles of modern steam engineering, as the educational value of such a plant will be an important consideration. The order covers an Armington & Sims engine; horizontal tubular steam boiler, with rocking grates; Lowe feed water heater and purifier, and Blake boiler feed pump The Pond Engineering company is to deliver and erect this machinery at the institute complete, and ready for regular service.

One of the best of the catalogues that will be presented to the notice of the visitors at the Montreal convention will be that of the Electric Construction & Supply company, New York, just from the press. As everybody knows, the great specialty of this company is the manufacture of the Ward arc lamps for incandescent circuits. The handsome pamphlet referred to gives fine cuts of the different varieties of this lamp, accompanied by clear and comprehensive descriptions. Lamps for railways, theatrical uses, search lights and photo-engraving are shown as well as those designed simply for commercial utility. In many instances it is very desirable to run arc and incandescent lamps on the same circuit, as, for instance, where offices and waiting rooms are lighted with incandescent lamps, while the entrances or large areas may be brilliantly illuminated by the use of arc lights. In such cases as these and where it is desired to use a low tension circuit the Ward lamp is very useful. The many advantages of the lamp are set forth in a business-like way in the catalogue, and a number of testimonials are appended.

The Interior Conduit & Insulation company of New York will be represented at Montreal by its president, Edwin H. Johnson, General Manager E. W. Little and E. T. Greenfield, electrician. This being the first opportunity presented since the company [illegible] general electrical manufacturing [illegible] that many new and novel devices will be shown. The Johnson ampere meter, an absolutely dead beat instrument, and the Johnson vise lock switch will be found to be worthy of attention. The company also expects to show the new California arc lamp, which it is about to

place upon the market. This lamp is only fifteen inches in length, with no obstruction underneath, consequently casting no shadows, and will burn over 90 hours without trimming or change of carbons. The Garland Carbon protector is another device that is promised to be shown. This device will be found specially useful in enabling the users of the single carbon type of lamp to enjoy all the advantages of long life of carbons hitherto only accomplished by the use of double carbon lamps.

BUSINESS.

M. C. Chase, manufacturer of specialties in hard rubber, has been adding to the capacity of his factory on South Canal street, and is prepared to give estimates on any work in his line.

The Mosher Arc Lamp company is making extensive arrangements at the factory on the north side to take care of a large business during the coming fall and winter. Several important changes and improvements are underway and the popularity of the Mosher lamp is likely to be fully sustained.

The Knapp Electrical Works, Chicago, report an increased demand for Safety wire. They are general western agents for this wire. An electrical expert of national reputation writes: "Of the many attempts during the past ten years to make a reliable rubber insulated wire none has been so successful as the Safety Wire Cable company's." Only the best Para rubber and Lake Superior copper are used, and every foot of wire is guaranteed.

The Union Electric Works, Springer building, Chicago, are meeting with merited success in the new line of work mapped out, which is not only proving a source of profit directly but is encouraging inventors without sufficient capital to put their appliances before the trade. This company is carrying on a large line of experimental work and stands ready to manufacture any meritorious invention on a royalty, or purchase the patents outright if desired.

Thompson & Robertson, of New York, notify the trade that they have secured the sole right to manufacture and sell the fibrous dry battery and fibrous disque Leclanche porous cup, heretofore made by Taylor & Walsh. They will be manufactured under the personal supervision of the inventor and well-known electrician, J. Hart Robertson; and Mr. Louis Walsh, formerly with the Crosby Electric company and Taylor & Walsh, will be the manager of the sales department.

The New York Insulated Wire company will show in the exhibition hall at Montreal the Vulca Electrical Wire Ducts, together with appliances and a complete system of wiring for any lighting system. The ducts or tubes are water and fire-proof, show high insulation resistance, and are practicably indestructible. The tubes are the invention of Geo. H. Meeker, western manager of this company. The system is from the designs of A. Noll, the company's electrician, and J. W. Godfrey, general manager.

The Bloomington Electric Light company, Bloomington, Ind., is about to install a 150-horse power Ball engine, manufactured by the Ball Engine company, Erie, Pa. The Hebrew Institute, New York city, is installing an 80 horse power engine, furnished by the same company through its representative E. T. Copeland, 106 Liberty street New York city; and the Dubois Traction Passenger Railway company, Dubois, Pa., is installing a 100-horse power engine, furnished by Dravo & Black, Pittsburg, representatives of the Ball Engine company.

Thos. Wrigley, 85 and 87 Fifth avenue, Chicago, is offering for sale an ingenious little device known as a toggle bolt that is apparently coming into very general use by the telephone and electric light companies for use on hollow walls and tiling. Mr. Wrigley is also making a toggle bolt hook for fastening up chandeliers and electroliers that is also becoming popular, besides making a full line of drills and other appliances needed by electric people. How to fasten a telephone or moulding onto a hollow tile wall has long been a problem. Mr. Wrigley's inven[illegible] were fully described and illustrated in a recent number of this paper.

The Emerson Electric Manufacturing company of St. Louis has been noted since the date of the organization of the company about a year ago, for the number of novelties given to the trade, many of them becoming [illegible] operation of the leading street [illegible] companies throughout the country. Among the appliances recently brought out is the new Bagnall fuse switch, and a regulating device to [illegible] motor. The switch [illegible] replaced. The [illegible] speed of the motor in an ingenious manner, is simple in construction, and [illegible] company ha[illegible] [illegible] before [illegible]

ELECTRICAL PATENTS.

[illegible]

[illegible] New York, N. [illegible]

458,583. Electric Railway. Walter H. Knight, New York, N. Y.

This invention relates to electric railways wherein the supply conductor or conductors are inclosed in a conduit; and its object is to avoid the objections which in many instances are attendant upon a conduit placed between the track rails, as well as to provide a suitable structure for the wires for each of two parallel roads. To accomplish this desired result the conduit is place outside the rail, and when equipping a double track road a conduit for the conductors of both roads is constructed and placed between the two tracks, so as to be readily accessible for the collecting devices carried by the cars on the two roads.

458,584. Electric Motor Truck. Walter H. Knight, New York, N. Y.

458,585. Telegraphy. David Kunhardt of Aachen, Germany.

458,587. Electric Brake. John C. Lincoln, Rochester, N. Y.

458,603. Fusible Cut out. Charles S. Van Nuis of New Brunswick, N. J., Jonathan H. Vail of New York, N. Y.

458,619. Conduit for Electric Railways. Frederick E. Degenhardt, Chicago, Ill.

458,620. Electric Trolley or Contact Wheel. Frederick E. Degenhardt, Chicago, Ill.

458,625. Electro Therapeutic Apparatus. William J Herdman of Ann Arbor, Mich.

458,630. Conduit for Electric Railways. Emil E. Keller, Chicago, Ill

458,646. Electric Motor. Elihu Thomson, Lynn, Mass.

The chief object of this invention is to construct a motor which when supplied with current of constant potential will maintain a practically constant speed under varying loads, and to obtain this result with constant non-sparking points on the commutator and without the danger of causing by overloading a loss of magnetism in the field magnets of the motor.

458,652. Electro-Chemical Transformer. Turner D. Bottome, Hoosick, N. Y.

458,653. Incandescent Lamp Cut-out. Turner D. Bottome, Hoosick, N. Y.

458,656. Lightning Arrester. James. P. Freeman, Washington, D. C.

458,665. Electric Railway. Henry A. Seymour, Washington, D. C.

This invention has for its object to enable the same conductor to serve for cars running in opposite directions on two tracks. To this end the cars are provided with trolleys adapted to travel on a suitably arranged supply-conductor parallel with the double track when the said cars are on either track.

458 666. Automatic Cut-out for Dynamo Electric Machines. Sidney H. Short, Cleveland, O.

The object of this invention is to provide a device which will automatically open-circuit the shunt-coils of a compound dynamo on the breaking of the external or working circuit, whereby when the external circuit is closed through a human body, as by taking hold of the broken ends in the attempt of repairing, a greatly diminished current will be generated, and all danger to workmen will thus be avoided.

458,702. Electric Generator. John C. Henderson, New York, N. Y., Frederick Sargent, New Rochelle, N. Y.

458,716. Synchronizing Mechanism for the Second-Hands of Clocks. Homer Munson, Mendota, Ill.

458,718. Carbon Clamp for Electric Arc Lamps. Albert P. Seymour, Syracuse, N. Y.

458,719. Duplex Arc Lamp. Barton B. Ward, New York, N. Y.

The object of this invention is to provide a simple and effective means whereby the two sets of carbons may be caused to operate in the proper order, one after the other.

458,729. Electric Locomotor. Henry F. Shaw of Boston, Mass., George F. Shaw of Dedham, Mass.

458 747. Electric Railway Conduit and Contact Device. Walter H. Knight, New York, N. Y.

458 753. Protective Fuse. Hammond V. Hayes, Cambridge, Mass., Anthony C. White of Boston, Mass.

458,755. Electric Meter. Maurice Koechlin, Belfort, France.

458,778. Electric Subway. John C. Reilly, Brooklyn, N. Y.

458,844. Electric Railway. Leon O. Dion, Natick, Mass.

458 856. Armature for Electric Motors or Generators. James F. McLaughlin, Philadelphia, Pa.

458,859. Method of and Apparatus for Operating Electric Railways by Dynamic Induction. Elias E. Ries, Baltimore, Md.

The object of this invention is to overcome the difficulties of [illegible] due to the direct communication of the [illegible] of electrical energy with the traveling motor by subst[illegible] direct communication one [illegible] the alternating current generated by electro dynamic [illegible] the inventor is enabled to [illegible] the generator in the most perfect m[illegible] to utilize current of very high tension [illegible] and to employ line conductors [illegible] surface, overhead and under[illegible]

[illegible] Closed Conduit for Electric Railways. Charles [illegible] Van Depoele, Chicago, Ill.

[illegible] improvements [illegible] and improved arrange[illegible] may be place[illegible] thereby effectually [illegible] manner.

[illegible] System of Electric Railway Conductors. Charles [illegible] Van Depoele, Lynn, Mass.

[illegible] Controller for Electro Magnetic En[illegible] Van Depoele, Lynn, Mass.

458,870. System of Supplying Current to Reciprocating Electric Engines. Charles J. Van Depoele, Lynn, Mass.

This invention relates to a system of supplying current to reciprocating electric engines, and more particularly to electric engines of the type operated by two forms of current—as, for instance, by a combination of alternating currents, and according to the present system the various types of currents are secured from an ordinary supply circuit by the intervention of a current modifying device at or near the point of consumption.

458,871. Telpher System. Charles J. VanDepoele, Lynn, Mass.

This invention relates to improvements in electric telpher systems—that is to say, a system of electrically propelled vehicles in which a number of light carriages or cars are propelled along a specially constructed way from point to point, and started and stopped and otherwise controlled without direct manual intervention.

458 872. Electro Magnetic Reciprocating Engine. Charles J. Van Depoele, Lynn, Mass.

458,873. Combined Electric Engine and Pump. Charles J. Van Depoele, Lynn, Mass.

According to this invention a magnetic piston is reciprocated within a pump cylinder placed inside a motor coil or coils, and the piston itself is so constructed as to constitute the piston of a pumping engine, while the cylinder within which it is contained serves as the protecting casing interposed between the piston and the interior of the motor coils, the cylinder in this instance being diagametic metal and of correct bore without slits or other openings communicating with the coils and serving, therefore, as a cylinder, through which pass the liquids to be removed. The engine may be double acting, and therefore capable of operation in any position, or it may be single acting for vertical work In either event the reciprocations of the magnetic piston are caused by the shifting of the field of force of the motor coil or coils, which is produced by successive waves or impulses of defined rising and falling currents.

458,874. Reciprocating Electric Engine. Charles J. Van Depoele, Lynn, Mass.

458,876. Electric Arc Lamp. Barton Brewer Ward of New York, N. Y.

This invention relates to improvements in electric focusing arc lamps adapted to be used in conjunction with a parabolic reflector of a search light; and the objects of this improvement are, first, to provide an automatic focusing light in which there will be uniformity in the feed of the carbons at all angular positions, and, second, to reduce the friction of the rods carrying the carbons.

458,879. Electric Switch. Adolph Wissler of St. Louis, Mo.

458,880. Casing for Electric Switches. Adolph Wissler of St. Louis, Mo.

458,931. Electric Railway. Walter Cook Wright, Philadelphia, Pa.

The improvements in the construction of the conduit contemplate provisions for protecting the electric conductors and the contact rollers receiving current therefrom from access of drippings through the slot of the conduit by locating the conductors and rollers upon such a plane with respect to the lower edges of the two depending aprons at opposite sides of said slot that any water entering the latter shall be directed downward below the line of possible contact with said conductors and rollers.

458,932. Electric Railway. Walter Cook Wright, Philadelphia, Pa.

458,947. Annunciator. William C. Dillman, Brooklyn, N. Y.

458,952. Electric Comb. John M. Riley, Newark, N. J.

458 953 Electric Comb. John M. Riley, Newark, N. J

458,954. A System of Reciprocating Electric Engines. Charles J. Van Depoele, Lynn, Mass.

458,956. Controlling Dynamo Electric Machines for Electric Railways. Sidney H. Short, Cleveland, O.

This invention relates more particularly to automatic controlling means for preventing the overloading of the dynamo electric generators in electric railways, wherein the motors on the different electrically propelled vehicles are arranged abreast of or in multiple arc with one another.

458,961. Testing Switch for Electric Circuits. Rudolph C. Smith, Yonkers, N. Y.

458,964. Cleat for Electric Wires. Henry Price Ball, Brooklyn, N. Y.

458,976. Electric Motor. Norton P. Otis and Rudolph C. Smith, Yonkers, N. Y.

This invention relates to a method of and apparatus for starting and controlling electric motors and more especially motors which are used to transmit motion to machinery for the transportation of goods and passengers, and which are necessarily obliged to be stopped and started quite often in their operation.

458,977. Safety Device for Electric Elevators. Norton P. Otis and R. C. Smith, Yonkers, N. Y.

The object of this invention is to provide means whereby the operator in the cage of an elevator may be notified of any change of the operation of the engine, and to provide safeguards to prevent a series electric motor from using an unnecessary amount of current beyond that required for the work which it is required to do; and to these ends the cage is provided with indicators, with means for operating it upon an undue change in the speed of the engine, and in the case of an electrical engine means are provided whereby the operator in the cage can control the operating extent of the field magnet, and whereby friction is automatically applied to prevent any undue increase of motion of the engine.

458,987. Electric Arc Lamp. William A. Turbayne, Toronto, Canada.

Claim one reads:

"In an electric arc lamp the combination of main and shunt magnets or solenoids, a lever pivoted intermediate of its extremities and connected at its opposite ends with the armature or core of the respective magnets, and a ring clutch for the carbon rod provided with lateral arms extending in opposite directions, one arm carrying a roller or other anti-friction device bearing upon said lever and the other arm carrying an adjusting screw, the end of which also bears upon said lever."

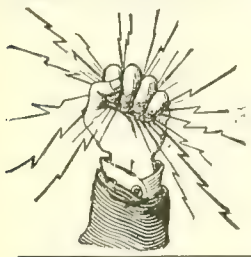
459,017. Regulator for Constant Current Dynamos. Ernest P. Clark, New York, N. Y.

[illegible] Constant Current Dynamo. Ernest P. Clark, New York, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used. Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the Boston Fire Underwriter's Union, under date of March 22, 1886, he says: "A Thoroughly Reliable and Desirable Wire in Every Respect."

The rubber used in insulating our wires and cables is specially chemically prepared, and is Guaranteed to be waterproof and will not deteriorate, oxidize or crack and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid, and to a very great extent, fire proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS.

4 LaSalle Avenue, Chicago.

Write us for Prices.

CHICAGO.

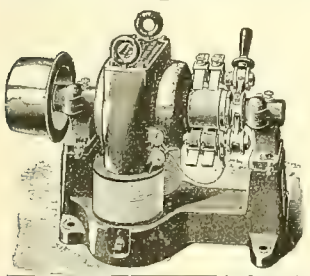
The Electrical Construction Co.

43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

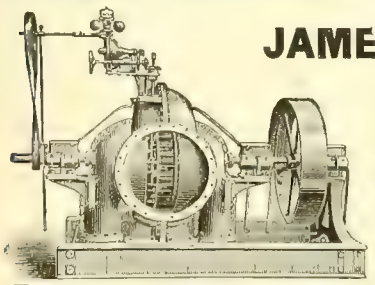
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS



BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL, FOR ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

WANTED.

An electrician, now in charge of [illegible] electric station and general electrical work in a prominent Eastern [illegible] a change. Seven years in the present business, four years in Central States. Best of reference. Thoroughly posted on [illegible] high tower and Edison [illegible] work. Address EASTERN, Care WESTERN [illegible]

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

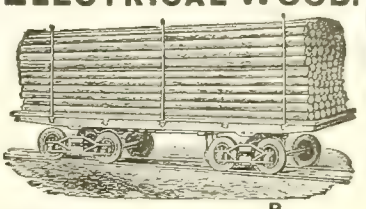
FOR SALE

At a bargain: One 1 H. P. "C. & C." Arc Motor, One 2 H. P. "C. & C." Arc Motor, in perfect condition; also two Exhaust Fans, almost new.

WINTER'S CAFE,

279 State St., Chicago.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

WANTED.

[illegible] ARC LIGHT

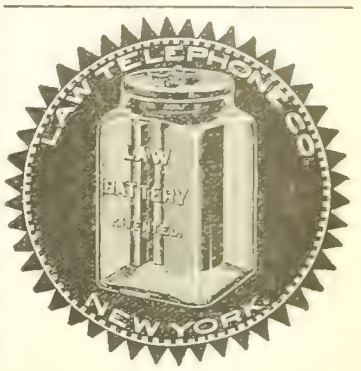
ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of [illegible] free.

T. J. MURPHY,

Electrical Engineer Bldg. 136 Liberty St., Room [illegible] NEW YORK.



The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Electrical Engineering Co.,

ROOM 603, MONON BUILDING, CHICAGO.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., Brooklyn, N.Y.

REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

"MAGNETIC VANE"

AMMETERS AND VOLTMETERS

ARE THE BEST INSTRUMENTS FOR

Central Stations, Isolated Plants,

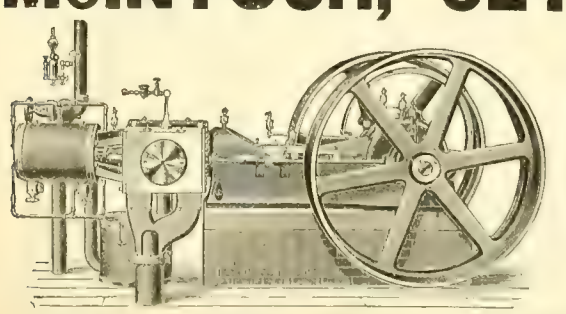
Marine Installations, Electric Railways

Correspondence Solicited.

Send for Illustrated Circular 235.

QUEEN & CO., PHILADELPHIA.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, 339 Rookery Bldg., CHICAGO.

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION
One	12½x12	80	Edison General Electric Co., Gr[illegible], N. Y.
Two	18½x17	600	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rockaway, N. J.
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 19x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Robbins & Co., Chicago, Ill.
One	15 and 21x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric [illegible], Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Long Island City, N. Y.
One	8x9	30	A. J. Wilkinson, Rhode Park, Mass.
Two	9½x10½	45	Presbyterian House, 156 West 23d St., New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T. H. Int. Elec. Co., Rockaway, N. J.
One	11 and 19x15	150	Fritz Wilen, Bethlehem, Pa.
One	16x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 26x17	400	Baltimore Electric Reliance Co., Baltimore, Md.
One	14½ and 24x22	500	Georgia Electric Light Co., Atlanta, Ga.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

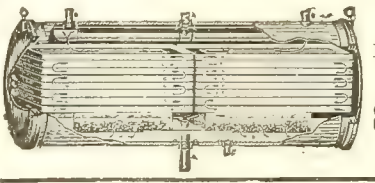
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

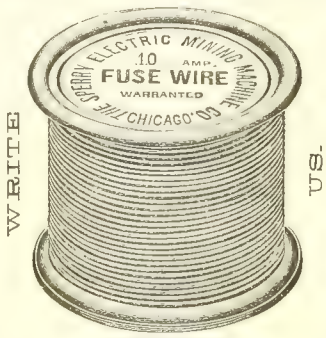
Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EVERYTHING IN

WIRE—FUSE—STRIPS.



MANUFACTURED BY

The Sperry Electric Mining Machine Co.,

39th St. and Stewart Ave., CHICAGO.

ALUMINUM

50 Cents per Pound.

THE COWLES

Electric Smelting & Aluminum Co.,

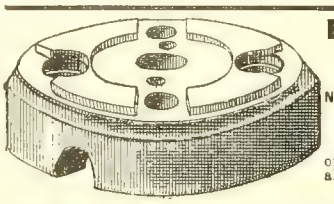
LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum at 50 cents per pound for ton lots in ingots.

Aluminum sheet, wire and castings at lowest market price.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence solicited.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

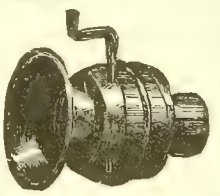
IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

THREE HARVEST EXCURSIONS.

The Burlington Route, C., B. & Q. R. R., will run Harvest Excursions, Tuesdays, August 25th and September 15th and 29th, from Chicago, Peoria, Quincy and St. Louis to St. Paul, Omaha, St. Joseph, Kansas City, Denver, Helena, Salt Lake and all other points in the Northwest, West and Southwest. Rates very low, tickets for sale at all company's ticket offices at points on and east of Mississippi River. Many connecting lines will sell through tickets for these excursions. Inquire of local agent for full information, or address P. S. EUSTIS, Gen'l Pass. and Ticket Agt., Chicago.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

BINDERS

—FOR THE—

WESTERN ELECTRICIAN,

ONE DOLLAR.

Manufacturers of

OCTAGONAL AND CEDAR

TELEPHONE & ELECTRICAL

RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

73-75 W. Jackson St.

RELIABLE

WE ARE FITTED WITH RELIABLE Machinery and Tools, And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.

THE MOSHER ARC LAMP

For Direct Incandescent Circuits

BEATS THEM ALL.

Read what a customer says:

BENICIA ELECTRIC LIGHT AND MOTOR CO.,
BENICIA, CAL., June 25, 1891.

MOSHER ARC LAMP CO., CHICAGO.

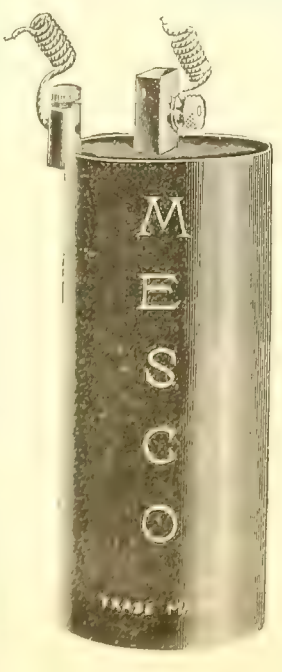
Gentlemen:—Yours of 11th inst. received. In reply we have to say the [illegible] satisfaction, and we are well pleased with it. Our superintendent says he has [illegible] other lamps of different makes [illegible] He wants you to send another [illegible] Dixon Electric Motor Co., Dixon, Cal., of which [illegible] superintendent.

Yours truly, S. C. GRAY, Pres't.

Write for Circulars, Prices and Sample Lamp to

MOSHER ARC LAMP CO.,

125 ONTARIO ST., CHICAGO, ILL.



Cut Full Size.

The "Mesco" Dry Battery.

(PATENT APPLIED FOR).

For Call Bells, Annunciators, Burglar Alarms, Telephones, Medical Apparatus, the Laboratory and all open circuit use.

Price 80 Cents.

We guarantee the Mesco Dry Battery equal to any dry battery made, in E. M. F., durability and recuperative power.

This battery is no infringement on any existing patent.

Exhausted Batteries Replaced with New Ones at a Nominal Price.

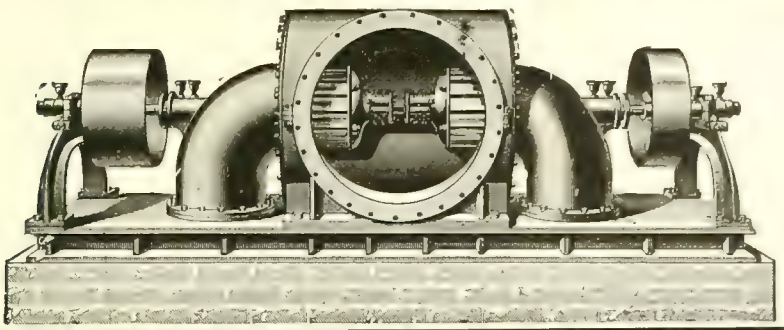
Liberal discounts to the trade.

We make a Disque Leclanche Battery which is guaranteed equal to any in the market. Our prices are reasonable on all kinds of electrical supplies.

Manhattan Electrical Supply Co.,

36 Cortlandt Street, NEW YORK.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to the **CELEBRATED WATER WHEEL** on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** being **double** the **Power** of [illegible] number of the leading electric [illegible] ical use of water it is without an [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents a pair of [illegible] **VICTOR TURBINES** arranged on a horizontal shaft and [illegible] Tubes, End Bearings for Shaft, and [illegible] a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now [illegible] Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

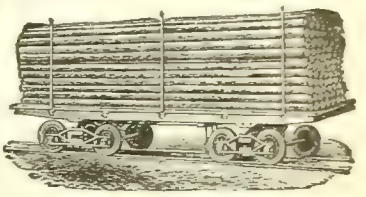
HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BOWDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

ESTABLISHED 1878.
SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

1000 HOURS LIFE.

2000 " "

3000 " "

4000 " "

5000 " "

SUNBEAM LAMPS.

WRITE US FOR PRICES AND PARTICULARS.

The Sunbeam Incandescent Lamp Co., Chicago, Ill.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

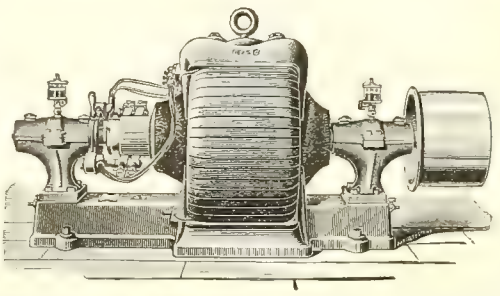
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

PERRET ELECTRIC MOTORS AND DYNAMOS.

REMOVAL NOTICE.

To Our Friends and Patrons:

To meet the increasing demand for Perret Motors and Dynamos, another increase in our facilities has been necessary, and to accomplish this we have moved our factory and general office to Springfield, Mass., where we have secured the property on State Street, formerly known as the Bullard Repeating Arms Works. This property is one of the finest in New England, and is conveniently situated for receiving and shipping goods by all the railroad lines centering in Springfield. With these enlarged and increased facilities, and with a large increase in capital, we shall be able to serve our customers better than ever.

For the convenience of our patrons in that vicinity, we have established an office, storeroom and workshop at 89 Liberty Street, New York City, in charge of Mr. Robert Watson.

Respectfully,

NEW YORK OFFICE,
89 Liberty Street.

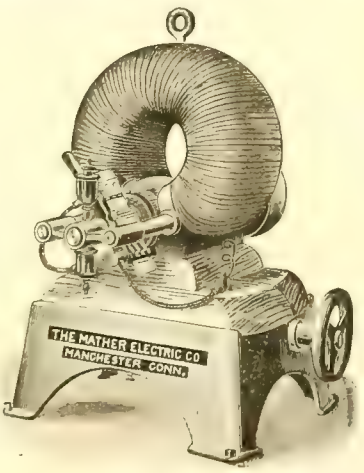
THE ELEKTRON MFG. CO., Springfield, Mass.

THE MATHER ELECTRIC CO.,

MANCHESTER, CONN.

MANUFACTURERS OF

DYNAMOS,
MOTORS,
Power Generators,
Electrical Instruments
and Appliances.



Complete Equipments for
Isolated Electric Lighting
and Power Plants,
Central Stations and
Steamship Lighting.

CHICAGO OFFICE, 161-163 RANDOLPH STREET, CHICAGO, ILL.

Sales Agents Western Department.

MILWAUKEE, WIS.
JULIUS ANDRAE, - - - - - - 225 W. Water St.

KANSAS CITY, MO.
KANSAS CITY ELECTRIC WORKS, - 903 Broadway.

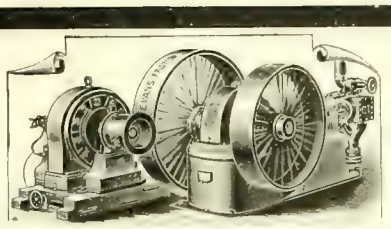
ST. PAUL, MINN.
F. S. BRYANT, - - - - - - - 128 E. Fourth St.

ST. LOUIS, MO.
BLATTNER & ADAM, - - - - 220 N. Fourth St.

MINNEAPOLIS, MINN.
T. M. MACUIRE, - - - - - 23 Syndicate Block.

OMAHA, NEB.
COWGILL, ROUTLEDGE & CO., - 39 Barker Block.

TACOMA, WASH., W. L. BRETHERTON, 1144 Pacific Ave.

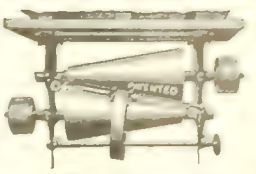


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

THOMAS STURGIS, Prest. Wm. C. LANE. Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

Western Electric Co.,

CHICAGO, NEW YORK, BERLIN, PARIS, ANTWERP, LONDON.

ELECTRIC LIGHTING APPARATUS,
Arc and Incandescent Systems,
Automatic Regulation.

S-U-P-P-L-I-E-S.

A NEW BOOK.

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

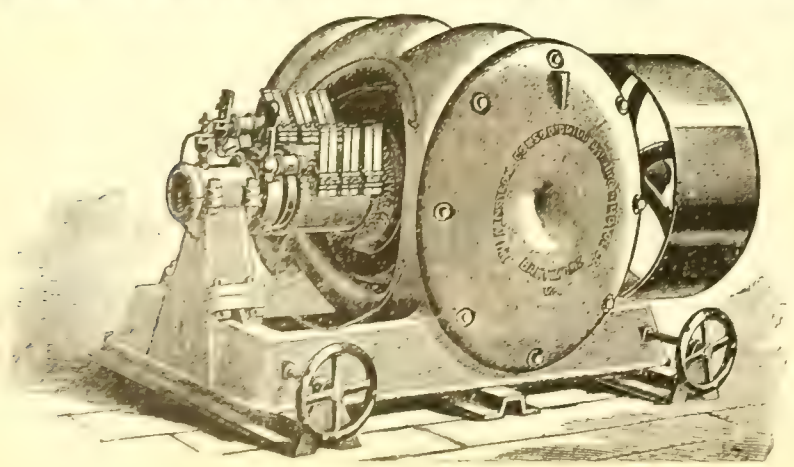
NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS
For All Work.

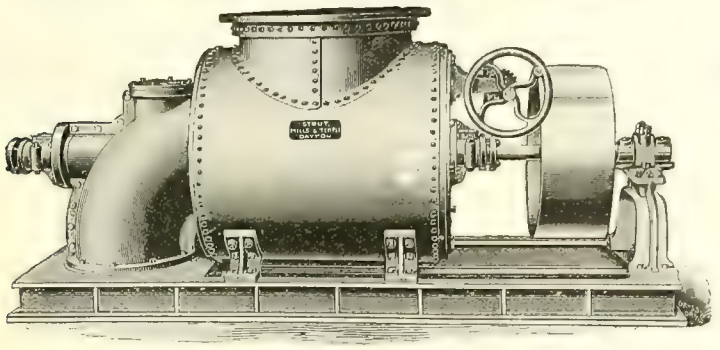
DYNAMOS
For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its High efficiency at all ranges of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,
SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

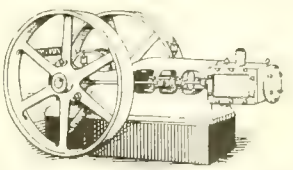
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North Street, BALTIMORE, MD.

COMPLETED TO DEADWOOD.

The Burlington Route C. B. & Q. R. R. from Chicago, Peoria and St. Louis, is now completed and daily passenger trains are running through Lincoln, Neb., and Custer, S. D., to Deadwood. Also to Newcastle, Wyoming. Sleeping cars to Deadwood.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES

A FEW PROMINENT MISCELLANEOUS USERS

(Excepting Governments and Railroads).

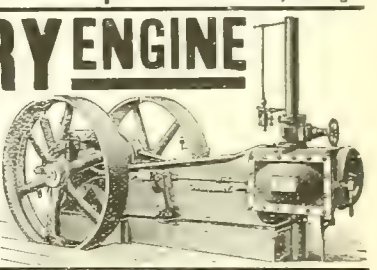
Adams Express Company; Allegheny City Light Plant; Allegheny County Light Company; Anheuser-Busch Brewing Company; Arbuckle Brothers; Ashcroft Manufacturing Company; E. Balbach & Son; Baldwin Locomotive Works; Bowers Dredging Company; Brooks Locomotive Works; Brown & Sharpe Manufacturing Company; Brush Electric Company of Baltimore; Brush Electric Light Company of Buffalo; Burlington Electric Street Railway Company; Calumet & Hecla Mining Company; Cambria Iron Company; Carnegie, Phipps & Company; Cincinnati Gas Light & Coke Company; Coxe Brothers & Company; Crescent Steel Works of Miller, Metcalf & Parkin; Cumberland & Presumpscot Mills, Denver Consolidated Electric Company; Detroit Dry Dock Company, Detroit Electric Light & Power Company; Dunnell Manufacturing Company; East End Electric Light Company of Pittsburgh; Elgin National Watch Company; Federal Street & Pleasant Valley Electric Street Railway Company of Pittsburgh and Allegheny; Forest Paper Company; Gate City Oil Mills; Glen Echo Electric Street Railway Company of Washington; Herkimer Paper Company; Howe, Brown & Company; Illinois Steel Company; Lehigh Avenue Passenger Electric Street Railway Company of Philadelphia; Lombard, Ayres & Company; McConway & Torley Company; McKeesport Electric Light Company; Metropolitan Electric Light Company of London; Missouri Electric Light & Power Company of St. Louis; Muncie Pulp & Paper Company; New England Dredging Company; Newton Paper Company; G. H. Nichols & Company; Ohio Paper Company; Oliver Oil Company; Omaha & Council Bluffs Electric Railway Company; Omaha Electric Street Railway Company; Otis Iron & Steel Company; Pacific Rolling Mill Company; Pencoyd Iron Works; Pennsylvania Steel Company; Philadelphia & Reading Coal and Iron Company; Pittsburgh Locomotive & Car Work; Robert Poole & Son Company; Quaker City Dye Works; St. Charles Car Works; Sawyer-Man Electric Company; Schenectady Locomotive Works; Williams Sellers & Company; Sherman Oil & Cotton Company; Shoenberger & Company; Southern Cotton Oil Company; Claus Spreckels' Sugar Refinery; Tacoma Light & Water Company; Terre Haute Electric Street Railway Company; Union Switch & Signal Company; United Electric Light & Power Company; Vancouver Electric Street Railway & Light Company; Wellman Iron & Steel Company; Westinghouse Air Brake Company; Westinghouse Electric & Manufacturing Company; Wilmington City Electric Street Railway Company.

Over 3000 other users.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application.



STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg.
San Francisco, 29 & 31 Spear St.

DRY STEAM
FURNISHED BY
THE POND SEPARATOR.

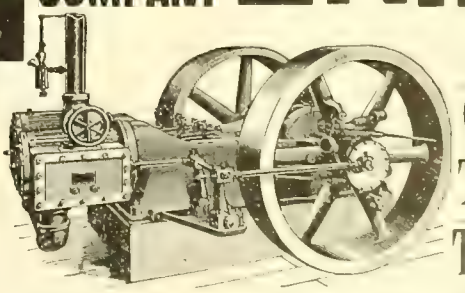
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.
ST. LOUIS. CHICAGO. KANSAS CITY.
OMAHA. DALLAS. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER & CO., 38 South Fourth Street Philadelphia, Pa.; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY Co., Tacoma, Wash.; CROOK, HORNER & CO., Baltimore, Md.; E. G. GILBERT, Atchison, Kan.
BRANCH OFFICE, Room 506 Rookery Building, CHICAGO, ILL., ALBERT FISHER, Manager.

A MARVELOUS INNOVATION

THE THOMSON-HOUSTON ELECTRIC COMPANY

HAS REVOLUTIONIZED THE ELECTRICAL EQUIPMENT OF STREET RAILWAYS.

The Intermediate Shaft, Pinion and Gear have been discarded.

The Armature Pinion and Axle Gear are now enclosed in a dust-proof case filled with oil.

Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

The construction of the Armature avoids the possibility of a burn-out, except by malicious carelessness, and when damaged, can be readily repaired by a novice.

Don't make a mistake by contracting for Railway Equipment before seeing or understanding this marvelous machine.

Prices for Repairs, Parts and Supplies materially reduced.

Information, Prices and Literature furnished on application.

THOMSON-HOUSTON ELECTRIC CO.

CHICAGO OFFICE:
148 MICHIGAN AVENUE.

BOSTON OFFICE:
620 ATLANTIC AVENUE.

Buxton's Universal Packing.

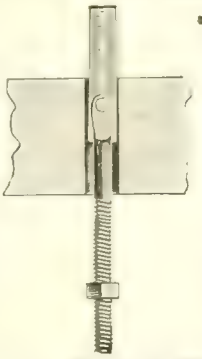
Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,
17 VIRGINIA ST., EAST SOMERVILLE, MASS.

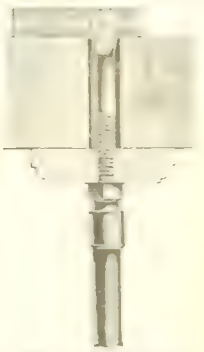


TOGGLE BOLT

Manufactured by
Thos. Wrigley
For Securing Fixtures to Stone, Brick, Wood, Hollow Tiling or Marble Slabs.

Write for Circulars and Price List.

85 and 87 5th Ave.,
CHICAGO.



Experimental Work in Anything Electrical.

FREEMAN, COLEMAN & CO.,
53 and 55 South Jefferson Street, - - CHICAGO, ILL.

ELEMENTS OF ELECTRIC LIGHTING.

BY PHILIP ATKINSON, Ph. D.

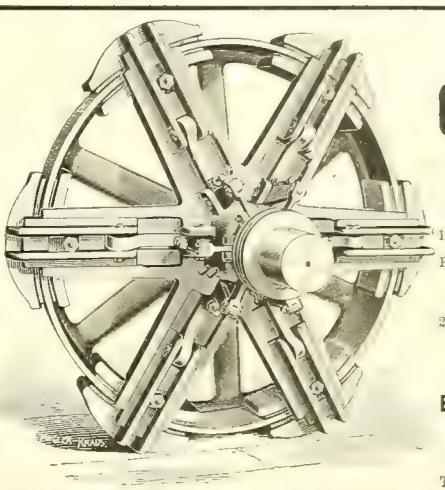
260 Pages Cloth Binding, Illustrated, Price $1.50.

This book is an elaboration and revision of the popular series of articles which have appeared in the WESTERN ELECTRICIAN under the same title. It treats of: Principles of the Dynamo; Alternate Current Dynamos; Direct Current Dynamos; Electric Terms and Units; Electric Measurements; The Arc Lamp; The Incandescent Lamp; The Storage Battery; Electric Distribution.

Sent, postage prepaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, Chicago.

BRANCHES: 164 Summer St., Boston, Mass; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa; 60 W. Monroe St. Chicago. | St. Louis, Mo.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 205 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

STANLEY ELECTRIC MFG. CO.

TRANSFORMERS.

Compare these weights with weights of other transformers:

5 light,	48 lbs.
10 light,	65 lbs.
20 light,	85 lbs.
30 light,	101 lbs.
40 light,	130 lbs.
100 light,	300 lbs.

A. C. FAN MOTORS.

SMALL,
NOISELESS,
RELIABLE.

Less than 1½ Amperes required to drive it.

Price, $20.00.

PITTSFIELD, MASS.

Chicago Agents: THE ELECRICAL SUPPLY CO., 102 Michigan Ave.

H. WARD LEONARD & CO.

ELECTRICAL ENGINEERS.

Any shunt motor operated by entirely new system, giving any desired speed with any pull in belt, within limits of motor's capacity.

Efficiency the same at any speed.

No rheostat or other power-absorbing device necessary for regulating speed or pull.

Perfect results for printing presses, elevators, hoists, pumps and any work in which the speed and pull vary.

No special apparatus required beyond standard machines of any company.

See our exhibit at Montreal Convention.

Investigate our Electrical Intelligence Business.

Consider our low rates for acting as consulting and supervising electrical engineers, purchasing agents, etc.

If you wish any construction done get a bid from us.

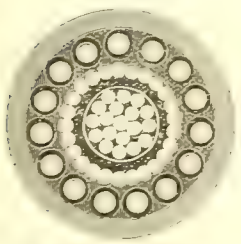
Electrical Exchange Building, - - - - New York City.

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.

THE RUBBER USED IN

HABIRSHAW INSULATION

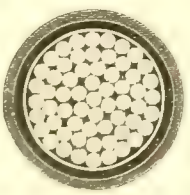
IS PURE PARA.



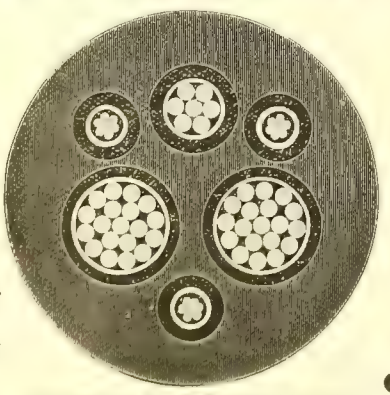
Underground Core.

Feeder Cable, Brooklyn Edison Electric Light Co.

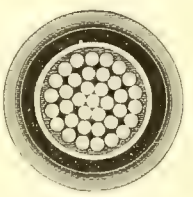
Underground Core, N. J. Central R. R.



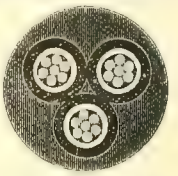
Feeder Core, Broadway Theater.



Submarine Work, Edison Electric Light Co., Easton, Pa.



Naval Core, United States S. S. "Chicago."



Portable Cable, Broadway Theater.

Marine Core, used on Government Cruisers.

Naval Marine India Rubber Covered Wires.

Naval Land India Rubber Covered Wires.

PROMINENT INSTALLATIONS.

STANDARD INDIA RUBBER COVERED WIRES.

Feeder Conductor, "Dryplex," Grand Central Depot.

Adopted by the Navy Department and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

SOLID AND STRANDED CONDUCTORS, TAPED, BRAIDED, FLAME-PROOF.

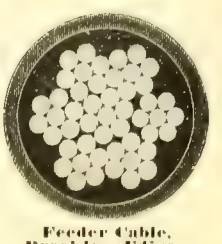
The Habirshaw Insulation fulfills all requirements in places demanding the "Best," and in that field finds no successful competitors.

Feeder Core

FACTORY: GLENWOOD, YONKERS, N. Y.

WM. M. HABIRSHAW, F.C.S.,
GENERAL MANAGER.

OFFICE:
315 Madison Ave., Cor. Forty-Second St.,
NEW YORK CITY.



Feeder Cable, Brooklyn Edison Electric Light Co.

THE ELECTRICAL SUPPLY CO., Western Agents, 171 Randolph St., Chicago, Ill.

HALT!!!!!!!!!!

AND READ.

PAISTE SWITCHES.

KNOWN THE WORLD WIDE OVER.

Lately improved by a steel (rubber covered) handle, binding posts, etc., and PRICE REDUCED.

5 AMP. STYLE.

5 AMP. STYLE.

5 AMP.

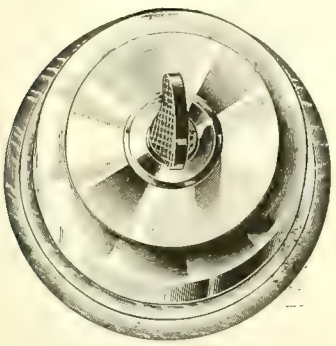
25 to 35 Cents.

10 AMP.

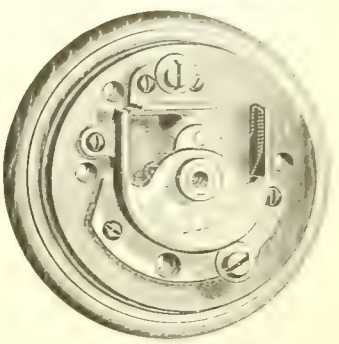
30 to 40 Cents.

According to

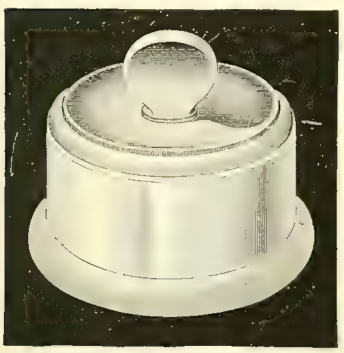
QUANTITY, QUALITY and FINISH.



10 AMP. STYLE.



10 AMP. STYLE.



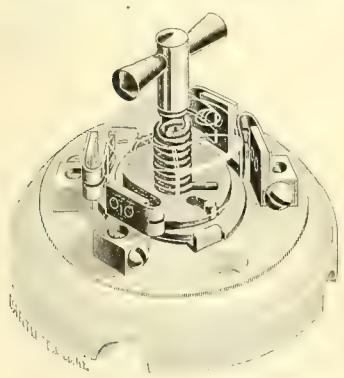
OUR CHINA SWITCH.

CHINA SWITCHES.

The neatest Switch ever designed; cannot tarnish with atmospheric changes; tinted all shades, and finished in gold. Send for samples.

Price, 5 AMP. ..... 72c to $1.00
10 " ..... 96c " 1.40
3 point—5 AMP ..... 90c " 1.25

OUR CHINA SWITCH.



OUR D. P. SWITCH.

D. P. SWITCHES.

Eccentric Movement.

A new thing—we boldly claim the movement to be the best one on the market. A sample will prove our claims.

Price, 15 AMP ..... 75c to $1.00

According to Quantity, Quality and Finish.
25, 40 and 50 Amp. in course of construction.

OUR D. P. SWITCH.

SOCKETS.

PAISTE - SWITCH - SOCKETS.

Embodies all the principles of the Switch.

Made to fit Edison, S.-M. and T.-H. Lamps.

PRICE, Key, 25 to 30 Cents. Keyless, 18 to 22 Cents.

According to Quantity, Quality and Finish.

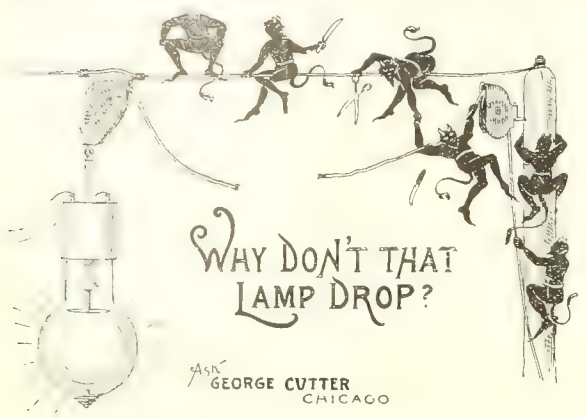
SOCKETS.

341 ROOKERY, CHICAGO, ILL.

H. T. PAISTE,

1201 Market St., PHILA., PA.

Does our JIM PIM visit you? If not, please send us your name and he will do so. Many dollars will be saved by doing this.



GEORGE CUTTER,

333 "The Rookery," CHICAGO.

SAFEGUARDS FOR ELECTRIC LIGHT CIRCUITS.

COUNT THE COST—

One falling Arc Lamp;
One ton of Coal;
One Dynamo burnt out.

THEN JOIN THE WISE USERS OF

Simplex Braided Rubber Wire,
Cutter's Lamp-Supporting Pulley.

For "that new indoor circuit," get Simplex Braided Rubber Wire.

READ THE FOLLOWING.

EDISON ELECTRIC ILLUMINATING CO. OF BROOKLYN.

BROOKLYN, August 17, 1891.

THE ELECTRIC CONSTRUCTION & SUPPLY CO., New York.

GENTLEMEN: It might perhaps interest you to know the success with which the Ward Arc Lamp is meeting in Brooklyn. We installed, eighteen months ago, two (2) of your lamps and to-day have 740 connected to our low tension circuits. To show you that they give satisfaction it is merely necessary to mention that every day we are replacing high tension lamps and for no apparent reason, except that the light is steadier and more brilliant, and that the consumer has control over each pair of lamps.

I think, from the results we are obtaining here, it would be to the advantage of every station supplying incandescent lights to add this new and profitable source of income to their system.

Yours truly, W. S. BARSTOW, Gen'l Supt.

REMEMBER WE GUARANTEE "WARD" LAMPS TO BE EXACTLY AS REPRESENTED.

THE ELECTRIC CONSTRUCTION & SUPPLY CO., Established 1881

PHENIX BUILDING, CHICAGO, ILL. TELEPHONE BUILDING, NEW YORK CITY.

WHY SPEND MONEY!

For Inferior Wire when you can get BEST which is

SAFETY

WIRE, CABLES AND CORD

For Inside, Underground and Submarine Use,

Of **US,** Or

R. B. WATSON,
DETROIT, MICH.

J. W. MASON,
KANSAS CITY, MO.

POST & CO.,
CINCINNATI, O.

PERKINS LAMPS

ARE USED BY

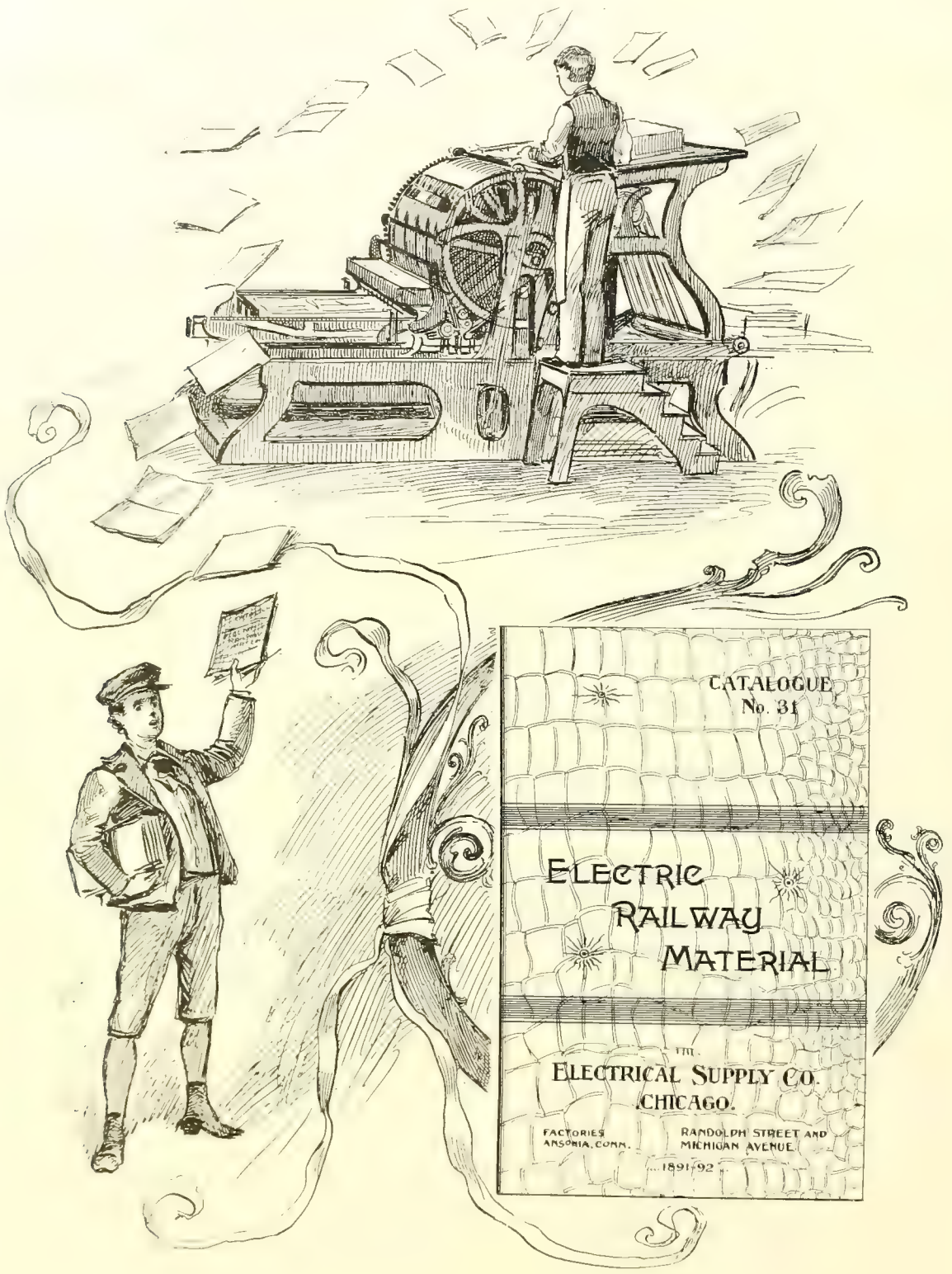
THE MILLIONS.

KNAPP ELECTRICAL WORKS,

MANUFACTURERS OF

Electrical Supplies of Every Description,

54 and 56 Franklin Street, CHICAGO, ILL.



CATALOGUES:

Electric Light and Power, No. 23.

(READY NOW.)

Electric Railway, No. 31.

(READY NOW.)

Electric House Goods, No. 44.

(READY NOW.)

TESTIMONIALS.

SUN ARC LAMP!

For Arc Circuits.

For Direct Incandescent Circuits.

ONLY Arc Lamp in the market that burns on an INCANDESCENT CIRCUIT **SUCCESSFULLY.**

SINGLY OR TWO IN SERIES.

READ THESE:

THE CHICAGO TRIBUNE,
EDITORIAL ROOMS.

CHICAGO, Sept. 2, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO.

GENTLEMEN:—We have been using your Sun Arc Lamps for photo engraving, and find them first-class in every respect. Have used several Arc Lamps, but find yours superior to all, and consider them second to none. Yours truly,

(Signed) LOUIS RASICOT,
Engraver.

THE DAILY INTER OCEAN.

CHICAGO, ILL., August 25, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO.,
195 to 207 S. Canal St., City.

GENTLEMEN:—We are using your Sun Arc Lamp, and find it the best Arc Lamp for Incandescent circuits that we know of. It is giving the most eminent satisfaction, and we take much pleasure in certifying to its merits. Yours very truly,

(Signed) THE DAILY INTER OCEAN,
Per D. LAPOINTE, Photo-engraver.

KNAPP ELECTRICAL WORKS,
54 Franklin St., Chicago.

August 27, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO., Chicago, Ill.

GENTLEMEN:—The Sun Arc Lamps which we are using on our Incandescent circuit are giving us the best results and we regard them as the best lamp of its kind in the market.

Wishing you continued success, we remain,
Yours truly,
(Signed) KNAPP ELECTRICAL WORKS,
Per M. A. KNAPP, Manager.

ROCKFORD ELECTRIC MANUFACTURING CO.,
Manufacturers of
ELECTRIC MOTORS, RAILWAY AND STATIONARY.

ROCKFORD, ILL., Sept. 2, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO., Chicago, Ill.

GENTLEMEN:—.....
..... I started up the lamp and saw it in operation for several nights, and it worked very nicely, certainly better than any lamp I have ever seen in use on Incandescent Circuits. I hope to be able to send you other orders soon.

Wishing you much success,
Yours very truly,
(Signed) GEO. A. MAYO.

(**MORE NEXT WEEK.**)

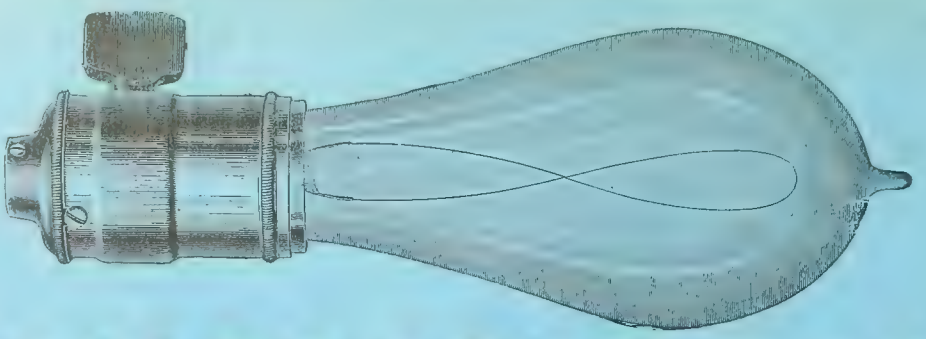
Convince Yourself by Sending an Order for One or Two to us.

Great Western Electric Supply Co.,

201, 203, 205, 207 SO. CANAL STREET,

Selling Agents. **CHICAGO, ILL.**

Special Inducements to Supply-Houses.

LONG  LIFE

INCANDESCENT LAMPS.

SEE WHAT PURCHASERS SAY:

BURLEY HOUSE,
Belle Plaine, Iowa,

State of Iowa }
Benton County } ss.

I, B. B. Burley being duly sworn upon oath depose and say, that I am a resident of Belle plaine Benton County Iowa, and proprietor of the "Burley House" in said City, — That Sept. 20th 1889, the Wm A. Hunter Electric Company, placed a 32 Candle power — 52 volt incandescent lamp, of the Thomson-Houston System, on the porch at my said Hotel — That said lamp burned continuously for 4620 Hours, burning out July 15th 1891. —

B B Burley

Subscribed in my presence and sworn to before me August 10th 1891.

Tom H. Milner
Notary Public in & for Benton Co. Iowa.

NOTARIAL SEAL IOWA

B. B. BURLEY,
Prop. BURLEY HOUSE,
Belle Plaine, Iowa.

Extract of letter from Manitou Electric Co., Manitou Springs, Colo.

DATED AUGUST 23, 1891:

"We have got T. & H. Lamps burning and giving good light that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston Lamps still burning that have burned 5,000 hours. The lamps were all I could ask. Have tried 'Sunbeam,' 'Edison' and other lamps made in Chicago, and the 'Perkins,' all of which are no good on earth."

MANITOU ELECTRIC CO.,
By C. F. TINGLEY, Manager.

THE IRON MOUNTAIN ELECTRIC CO., IRON MOUNTAIN, MICHIGAN, state that they have lost but 2 lamps in three months, with one thousand installed.

In the face of these Facts, why do you buy lamps that are of Short Life, Low Candle Power, and that quickly Blacken?

We make our own lamps and can furnish them at once

From 45 to 116 Volts,
From 6 to 150 Candle Power.

Write for Price Lists.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Avenue, BOSTON, MASS.

148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....—
Abendroth & Root Mfg. Co.. xvii
Alexander, Barney & Chapin.....i
American Electrical Works.... xvii
Andrews & Co., A. H..... xxiii
Automatic Switch Co..... xiv
Baggot, E xviii
Bain Electric Mfg. Co..... xxvii
Ball Engine Co.....xxii, xxiii
Ball & Wood Co., The... i
Baxter Electric Motor Co.....xxxii
Bernstein Electric Co..... x
Blatz, L.....xvii
Borden & Selleck Co..... xix
Braun Illustrating Co xxiii
Brownlee & Co..... xvi
Brookfield, Wm..... ... xvi
Brush Electric Co..... ... xxi
Butler Hard Rubber Co.....iv
Buxton, Geo. B .....xxv, iii
C. B. & Q. R. R.....xvii, xv ii
C. & C. Electric Motor Co.....xx
Card E. Motor & Dynamo Co.xviii
Central Electric Co..... ...vii
Chase, M. C..... xvi
Chicago Electric Mfg. Co..... xvii
Chicago Electric Motor Co.....—
Chicago Rawhide Mfg. Co..... x
Clower, Harris & Co.....i
Chicago Insulated Wire Co... xxi
Colburn Electric Mfg. Co..... xviii
Coolidge, Fuel & Supply Co ..xxvii
Consol. Elec. Mfg. Co., The i
Cowles Electric Smelting and Aluminum Co..... xviii
Crocker-Wheeler Electric Motor Co..... .....vi, xvii
Cutter, Geo..... xxviii
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co.xxiii
Eastern Electric Cable Co.....xvii
Edison General Electric Co.....viii
Edison General Electric Co., Cable and Wire Department.....ix
Eddy Electric Mfg. Co.....xi
Electric Construction & Sup. Co. xxv
Electric Merchandise Co..... xvi
Electric Secret Service Co..... xx
Electrician Pub. Co...xii, xiv, xviii
Elec. Construction Co., The....xvii
Electrical Engineering Co.....xvii
Elec. Eng. & Supply Co., The..xvii
Electrical Supply Co., The....xxx
Elektron Mfg. Co..... xx
Emerson Electric Mfg. Co....xxvii
Empire China Works..... xviii
Erie Electrical Supply Co..... i
Evans Friction Cone Co..... xxi
For Sale..... xvii
Foster, O. A..... —
Fort Wayne Electric Co xxxii
Freeman, Coleman & Co..... —
Globe Carbon Co.... xix
Great Western Elec. S. Co....x, xxxi
Greeley & Co., The E. S.....i
Hale Elevator Co..... xiv
Heisler Electric Light Co..... xxxii
Hill Clutch Works ..... —
Hine Eliminator Co.....xvi
Holmes, C. H..... xviii
Holmes, Booth & Haydens... xxi
Hood, Wm..... xiv
India Rubber & Gutta Percha Insulating Co..... —
Interior Conduit & Insulation Co. x
International Okonite Co..... i, vi
Kartavert Mfg. Co..... xviii
Keller & Degenhardt..... xvi
Knapp Electrical Works..... xxix
Law Telephone Co.....xvii
Leonard & Co., H. Ward..... —
Leffel & Co., Jas.....xvii
Loud, H. M. & Sons Lumber Co.xviii
McLaughlin, James xvii
Manhatten Elec. Supply Co... —
Mason, James H..... xvii
Mather Electric Co..... iv
Milliken Bros.....iv
Minneapolis Street Railway Co.xxvi
Monitor Electric Co.....xiv
Mosher Arc Lamp Co..... xviii
Munsell & Co., Eugene..... xvii
Murphy, T. J..... iv
N. W. T. H. Electric Co..... v
National Carbon Co.....iv
National Electric Mfg. Co..... xiii
N. Y. Belting & Packing Co... ..xvi
New York Insulated Wire Co.... ix
New York & Ohio Co.....i
N. W. Elec. Specialty Co... .xx ii
Nuttall Company, R. D.....i
Ostrander & Co., W. R..... xvi
Paiste, H. T..... xvi
Page Belting Co.....—
Partrick & Carter Co.....xiv
Payne & Co., Geo. W.....
Pearson & Co., W. B.....xxiii
Phoenix Glass Co.....—
Pond Engineering Co xxiii
Powell Co., The Wm.....xviii
Queen & Co..... xi
Rockford Electric Mfg. Co.... —
Sargent & Lundy..... i
Sawyer-Man Electric Co..... xv
Schieren & Co. Chas. A.....xvi
Schoonmaker, A. O xvi
Schuyler Electric Co..... ... x
Short Electric Railway Co.....xvi
Shultz Belting Co.....xxviii
Sperry Electric Mining Machine Co.....xviii
Standard Underground Cable Co....i
Standard Paint Co.....xvi
Stanley Electric Mfg. Co.... ..—
Star Iron Tower Co..... xxvii
Stearns Mfg. Co.....xxiii
Sterling, W. C.....xix
Stilwell & Bierce Mfg. C.. xviii, xix
Sunbeam Incand. Lamp Co xix
Taussig, S..... ... iv
Temple, J. C..... xix
Thomson-Houston Elec. Co. ill, xxiv
Turner Brass Works..... xvii
Union Electric Mfg. Co., The.. xiv
Union Electric Works.....—
Union Hardware Co..... xvi
U. S. Electric Lighting Co... —
Van Nuis C. S..... —
Vulcanized Fibre Co..... xix
Wanted xvii
Wenstrom Consolidated Dynamo & Motor Co., The xx
Western Electric Co xxvii
Westinghouse Elec and Mfg Co..xv
Westinghouse Machine Co....xxiii
Weston Electrical Instrum't Co.. ..vi
Williams Engine Works..... .xxiii
Woodbridge & Turner Engineering Co xix
Woodhouse & Rawson, Ltd....—
Worthington, Henry R.....—

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelting & Aluminum Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co.
N. W. T. H. Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Chicago Rawhide Mfg. Co.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co. The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars, Electric Railway.
Minneapolis St. Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Edison General Electric Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Keller & Degenhardt.
Leonard & Co., H. Ward.
Mather Electric Co.
McLaughlin, Jas.
N. W. T. H. Electric Co.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Automatic Switch Co.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
Mather Electric Co.
National Electric Manufacturing Co.
N. W. T. H. Electric Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrollers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Automatic Switch Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Manhatten Elec. Supply Co.
Monitor Electric Co.
Northwestern Electric Specialty Co.
N. W. T. H. Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.
Chase, M. C.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Chase, M. C.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cutter, Geo.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus Electric.
[illegible]

Motors.
[illegible]
Chicago Electric Motor Co.
[illegible]
Erie Electrical Supply Co
[illegible]
N. W. T. H. Electric Co.
[illegible]
Thomson-Houston Electric Co.
U. S. Electric Lighting Co
[illegible]
Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
Rochester Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Cutter, Geo.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

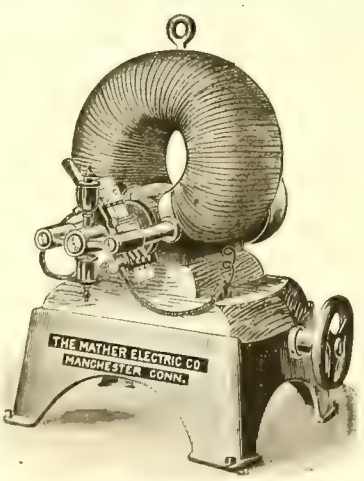
ELECTRIC SLATE
Switch-boards a Specialty.
Small samples of plain and marbleized free.
T. J. MURPHY,
Electrical Exchange Bldg. Room 215. 136 Liberty St., NEW YORK.

YOU WILL OBLIGE
Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

THE MILLIKEN PATENT POLE
For Electric Street Railways and Electric Light Work.
55 LIBERTY STREET, NEW YORK.
MANUFACTURED BY MILLIKEN BROS.
59 DEARBORN STREET, CHICAGO.
Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.
WRITE FOR CIRCULAR AND CATALOGUE.

SYNOVIAL DYNAMO OIL.
Second to None. Free from Gum or Acids.
By refiltering can be used continually. Adopted by the largest Electric Plants of the West.
Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO.

THE BUTLER HARD RUBBER CO.,
33 Mercer Street, New York,
POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF
HARD RUBBER GOODS
Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF
SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.
KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES
Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.
HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.
Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.
For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

THE MATHER ELECTRIC CO.,
MANCHESTER, CONN.
MANUFACTURERS OF
DYNAMOS,
MOTORS,
Power Generators,
Electrical Instruments
and Appliances.


Complete Equipments for
Isolated Electric Lighting
and Power Plants,
Central Stations and
Steamship Lighting.
CHICAGO OFFICE, 161-163 RANDOLPH STREET,
CHICAGO, ILL.
Sales Agents Western Department.
MILWAUKEE, WIS.
JULIUS ANDRAE, - - - - - - 225 W. Water St.
KANSAS CITY, MO.
KANSAS CITY ELECTRIC WORKS, - 903 Broadway.
ST. PAUL, MINN.
F. S. BRYANT, - - - - - - - 128 E. Fourth St.
ST. LOUIS, MO.
BLATTNER & ADAM, - - - - 220 N. Fourth St.
MINNEAPOLIS, MINN.
T. M. MACUIRE, - - - - - 23 Syndicate Block.
OMAHA, NEB.
COWGILL, ROUTLEDGE & CO., - 39 Barker Block.
TACOMA, WASH., W. L. BRETHERTON, 1144 Pacific Ave.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

—GENERAL AGENTS FOR—

ALL PRODUCTS

—OF THE—

THOMSON-HOUSTON ELECTRIC CO.,

—FOR—

Northern Wisconsin,
Minnesota,
North Dakota,
South Dakota,
Montana,
Wyoming,
Idaho,
Washington,
Oregon.

PRINCIPAL OFFICE:

403-405 Sibley Street, St. Paul, Minn.

H. M. BYLLESBY, President. HOWARD C. LEVIS, V.-P. and Treas. B. F. MEEK, Jr., Secy. and Asst. Treas.

GEO. C. DUFFIE, Asst. Secy.

BRANCH OFFICES:

Cor. A and Front Streets, PORTLAND, ORE.
H. W. COODE, Manager.

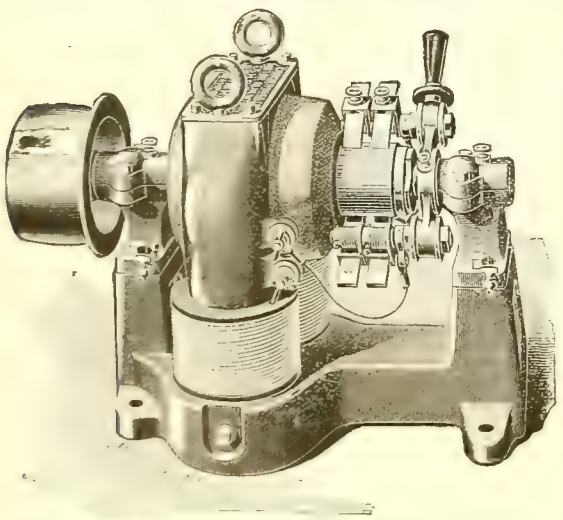
Thompson Block, HELENA, MONT.
H. W. TURNER, Manager.

RESPECTFULLY SUBMITTED TO THE MEMBERS OF THE FOR ASSOCIATION BADGE. N. E. L. ASS., U. S. A.

INTERNATIONAL OKONITE COMPANY, LIMITED.

13 PARK ROW, NEW YORK.

Largest Manufacturers of Insulated Wires and Cables in the World.



CROCKER-WHEELER

Perfected Motors.

CORRESPONDENCE INVITED.

430-432 West 14th Street,

NEW YORK CITY.

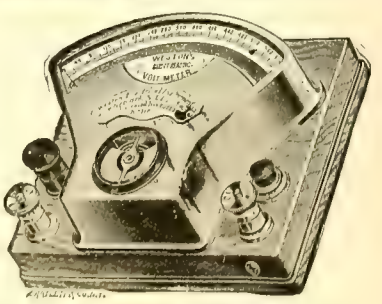
The Standard Voltmeter.

THE STANDARD AMMETER.

WESTON'S PORTABLE DIRECT-READING VOLTMETER.

Weston's Portable Direct-Reading Ammeters and Mil-Ammeters.

These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all classes of work.

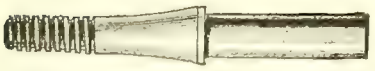


SEND FOR ILLUSTRATED CATALOGUE.

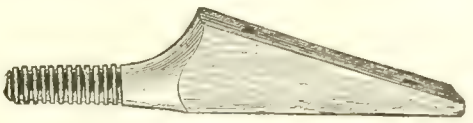
WESTON ELECTRICAL INSTRUMENT COMPANY,

Office and Factory, 114 & 116 WILLIAM STREET, NEWARK, N. J.

CONSTRUCTION MATERIAL.



STRAIGHT PINS.



BRACKETS.

CORNER PINS.

CROSS ARMS.

OUR ST. LOUIS BRANCH.

OKONITE

TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

OUR KANSAS CITY BRANCH.

OKONITE

TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OUR OMAHA BRANCH.

OKONITE

TRADE MARK.

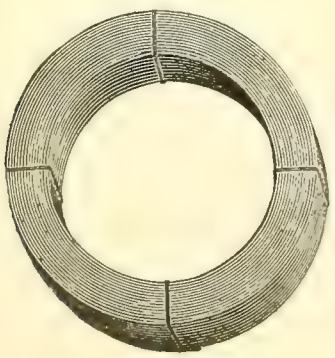
WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

OUR DENVER BRANCH.

OKONITE

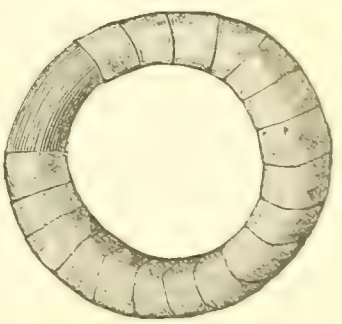
TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., Denver, Colo.



UNDERWRITERS' WIRE.

We are manufacturers of all these goods, and can quote lowest prices.



WEATHERPROOF WIRE.

CENTRAL ELECTRIC COMPANY,

116 AND 118 FRANKLIN STREET, CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE COMPANY'S SYSTEM.

Edison

General

Electric Co.

EDISON BUILDING,

BROAD STREET,

NEW YORK.

Announcement!

WE ARE NOW FURNISHING:

INCANDESCENT LAMPS,
Of any Voltage to Fit any Socket.

ARC LIGHTING SYSTEM,
Embracing many New and Valuable Features, Notably Lamps that will Burn 7 or 14 Hours.

SLOW SPEED MOTORS,
From 1-12 to 1-2 Horse-Power. Most Economical and Reliable Small Motor Manufactured.

MOTORS,
Of any Capacity, from 1-2 to 210 Horse-Power. Highest Efficiency, Lowest Price.

FIXTURES, ELECTRIC AND COMBINATION GAS,
Being the most Complete and Artistic Line now on the Market.

WIRE AND CABLES,
Including the Famous Cables of Siemens & Halske, of Berlin.

ELECTRIC RAILWAYS,
Both Single and Double Reduction Motors.

ELECTRIC MINING APPLIANCES.
Percussion Drill, Diamond Drills, Locomotives, Hoists, Pumps, Fans and Coal Cutters.

GENERAL SUPPLIES,
Carried in Stock at Each District Office.

DISTRICT OFFICES.

CANADIAN DISTRICT:
Edison Building, Toronto, Can.

CENTRAL DISTRICT:
173-175 Adams St, Chicago, Ill.

EASTERN DISTRICT:
Edison Building, Broad St., New York.

NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.

PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.

PACIFIC NORTHWEST DISTRICT:
Fleishner Building, Portland, Ore.

ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.

SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga.

CUT-OUTS, JOINTS, DISTRIBUTING BOXES, ELBOWS ETC., ETC.

CORRESPONDENCE SOLICITED.

THE NEW SAFE-DUCT AND COMPLETE METHOD OF WIRING FOR ALL ELECTRIC LIGHTING SYSTEMS.

"VULCA"

NEW YORK INSULATED WIRE CO. NEW YORK
MOISTURE-PROOF
VULCA
ELECTRICAL WIRE-DUCT
NON-INFLAMMABLE
TRADE MARK

ELECTRICAL WIRE DUCTS.

AND CHICAGO.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

THE NATION'S CHOICE.

Grimshaw White Core Wire.

B. D. WIRE, TAPES AND COMPOUNDS.

ALL SUPPLY STORES KEEP THEM.

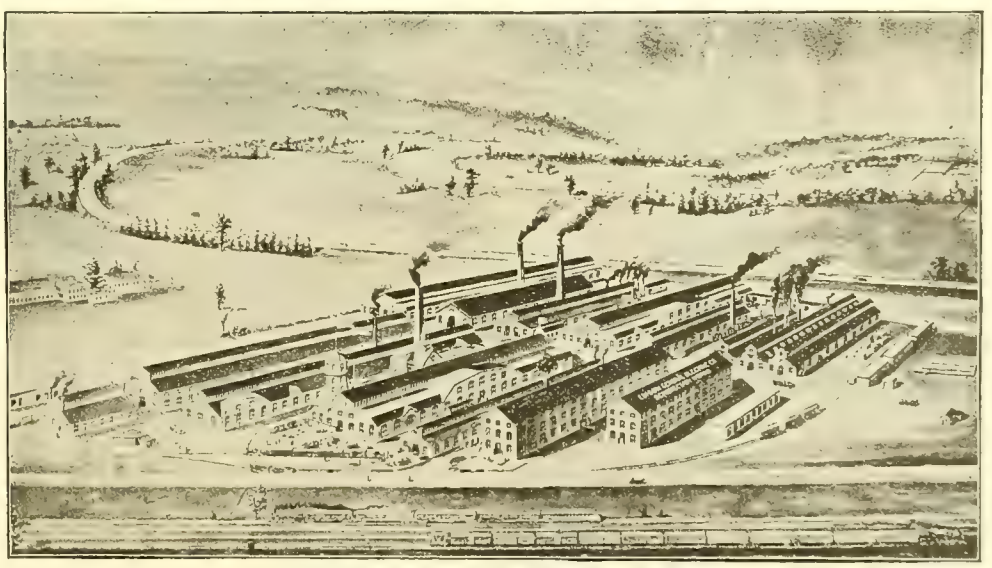
NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street, CHICAGO,

MAIN OFFICE: 649-651 Broadway, New York. GEO. H. MEEKER, Western Manager.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

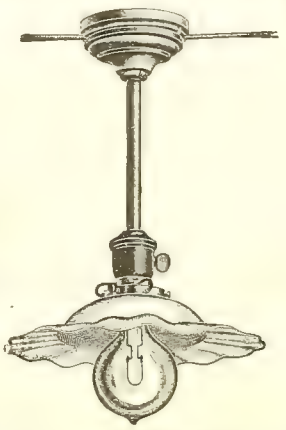
BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS

-FOR-

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

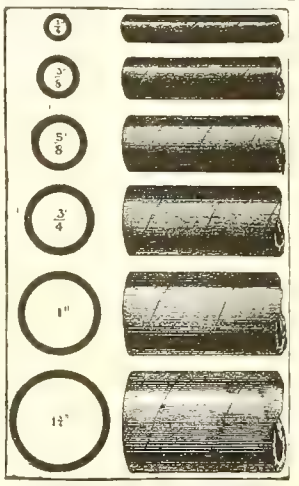


The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,

BOSTON, - MASS.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

THE INTERIOR

CONDUIT AND INSULATION CO.,

WORKS: { 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Electrical Engineering Co., 320 Dearborn St., Chicago, Ill.
Southern Electric Co., Baltimore, Md.
Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
B. Frank Johnson, Provident Bldg., Philadelphia, Pa.

RAWHIDE DYNAMO BELTING.

GREATEST ADHESIVE QUALITIES. A NON-CONDUCTOR OF ELECTRICITY. CAUSES LESS FRICTION THAN ANY OTHER BELT.

Rawhide Pinions for Electric Motors a Specialty.

LACE LEATHER ROPE AND OTHER RAWHIDES. GOODS OF ALL KINDS BY KRUEGER'S PATENT.

This Belting and Lace Leather is not affected by steam or dampness; never becomes hard; is stronger, more durable and the most economical Belting made.

The Rawhide Rope for Round Belting Transmission is superior to all others.

THE CHICAGO RAWHIDE MFG. CO., 75 Ohio Street, CHICAGO, ILL.

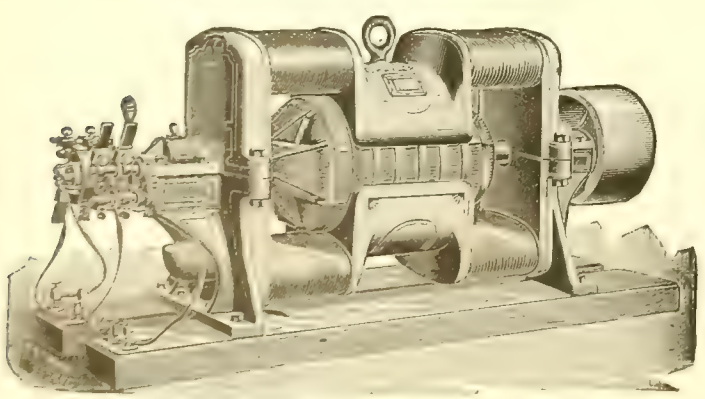
The Only Manufacturers in the Country.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

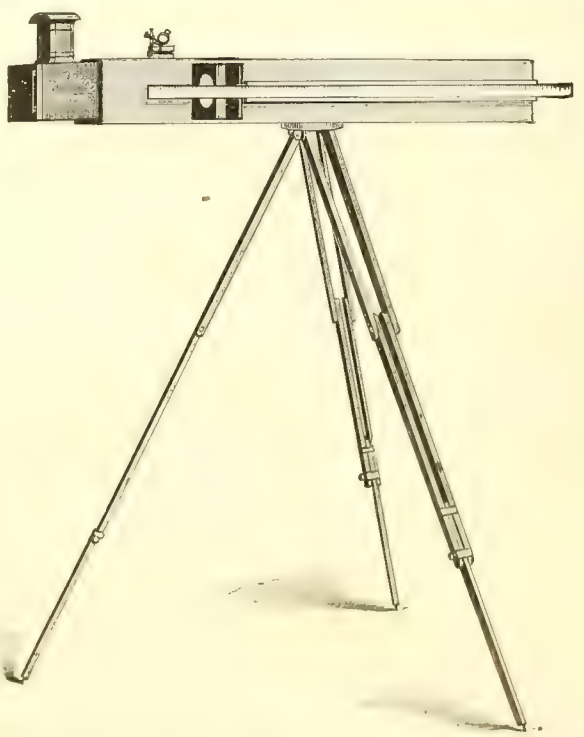
Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

FOR CENTRAL STATION USE.



Measure the candle power of your incandescent lamps with our

PORTABLE PHOTOMETER. - - - PRICE, $30.00.

CORRESPONDENCE SOLICITED.

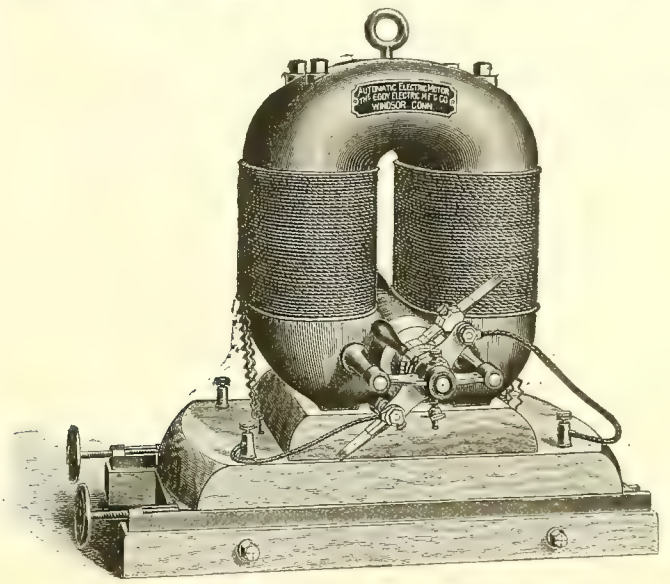
QUEEN & CO., Philadelphia.

THE

EDDY ELECTRIC MFG. COMPANY

MAKES A SPECIALTY OF THE COMPLETE EQUIPMENT
OF FACTORIES WITH

ELECTRIC POWER.



EDDY POWER GENERATORS,

ANY SIZE UP TO 300 H. P. AND ANY VOLTAGE.

THE EDDY ELECTRIC MOTOR

Is Simple, Efficient, Durable, Economical and Always Reliable.

THE EDDY ELECTRIC MFG. CO.,

WINDSOR, CONN.

136 Liberty Street, - NEW YORK.
92 Franklin Street, - - BOSTON.
506 Commerce St., PHILADELPHIA.
341 The Rookery, - - CHICAGO.
Rialto Building, - KANSAS CITY.
413 Jackson Street, - ST. PAUL.
409 West Michigan Street, DULUTH.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

THE NATIONAL TRANSFORMER SYSTEM

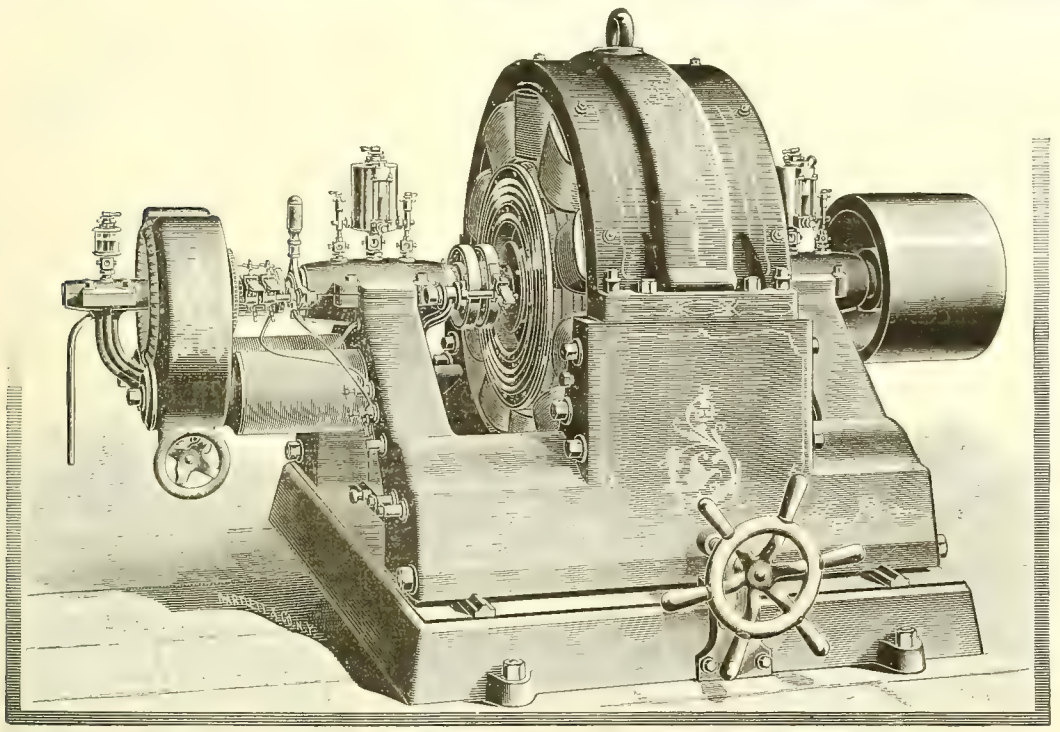
OF INCANDESCENT LIGHTING.

Florence, S. C., August 19, 1891.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.:

GENTLEMEN:—I write this to tell you of the wonderful performance of our Alternating Dynamo, which is a 750 lighter of your manufacture. Last night, while at supper, a cross got on our mains by their sagging on to a telegraph wire, and my engineer, who is a new man, ran the dynamo with the ampere meter needle clear on the end of the scale, which is about 80 amperes, or equivalent to approximately 1,600 lamps. It ran that way until it chocked down a 100 H. P. engine with 110 pounds steam, and then he sent for me. Strange to relate, the machine was not damaged a particle. The excessive current had melted all of the 4 fuses on the board, but the engineer had put in new ones and heavier ones, and had started up again. I consider that we have the only dynamo on earth that would stand such a strain and not be injured. I shall of course see to it, that a thing of this kind does not happen again.

[Signed] A. A. FORMAN, Supt. Florence Impvt. & Mfg. Co.



Self-Contained Alternator. Capacity 1,000 16 C. P. Lamps.

THIS IS THE MACHINE THAT WE BUILD.

SEND FOR CIRCULARS AND PRICES.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

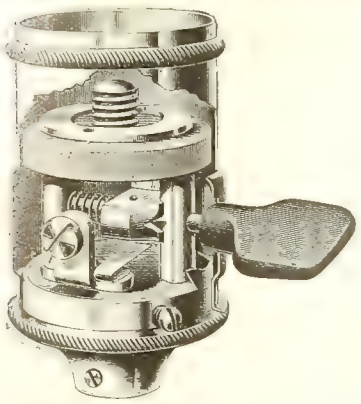
COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	DETROIT, MICH.,	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	DENVER, COLO.,	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	SAN FRANCISCO, CAL.,	National Electric Development Co.
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.	KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
SEATTLE, WASH.,	Chas. H. Baker & Co.	DULUTH, MINN.,	The Electrical Eng. & Supp'y Co.



"OF SOME THINGS ONLY THE BEST ARE WORTH HAVING."

WE GUARANTEE ALL GOODS

And will ship to central stations on approval—FREIGHT PREPAID.

The UNION ELECTRIC MFG. CO., Bridgeport, Conn.

NEW YORK: Alexander, Barney & Chapin.

BOSTON: The Eastern Electrical Supply Co.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

DYNAMO REGULATORS and RHEOSTATS

Of all descriptions in stock and manufactured to order for any special work.

MOTOR SWITCHES,

Both Hand and Automatic, of Superior Design and Construction.

Entire attention devoted to the manufacture and wiring of Rheostats.

AUTOMATIC SWITCH COMPANY,

SOLE MANUFACTURERS OF THE

Whittingham Automatic Switch,

No. 8 Keyser Building,

BALTIMORE, MARYLAND.

SEND FOR CATALOGUE AND PRICE LIST.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES!

16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

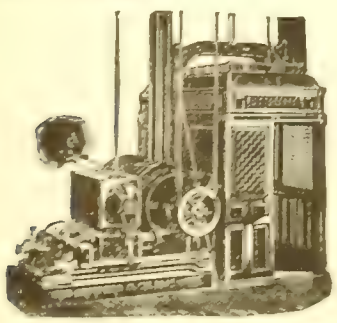
ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires, Incandescent and Battery Cords, in fact, every kind of Wire known to the Electrical Trade.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

PASSENGER AND FREIGHT

Hydraulic and Electric

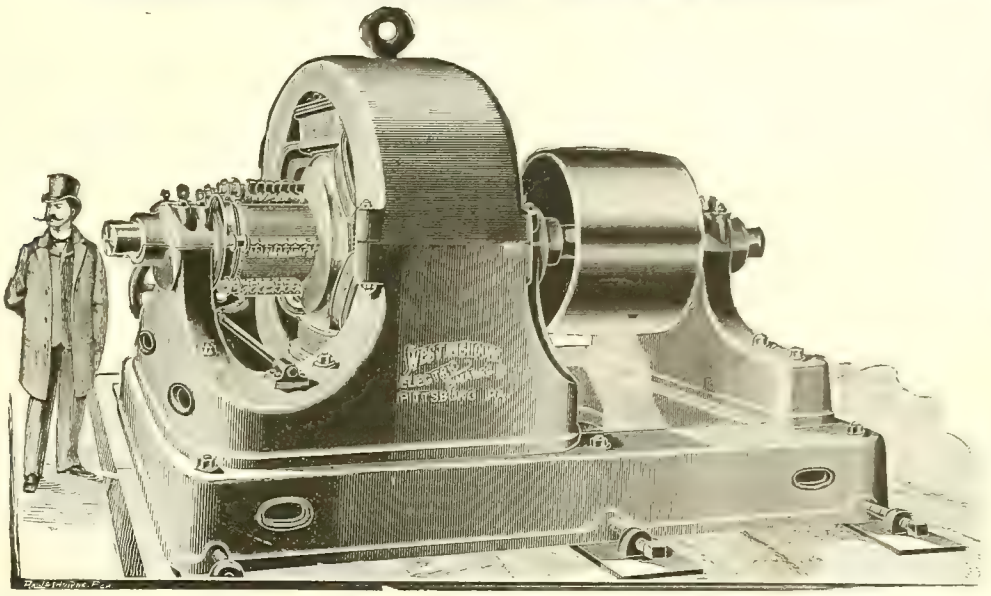
ELEVATORS.

WESTINGHOUSE
MULTIPOLAR STREET RAILWAY GENERATORS.

COMPOUND-WOUND. SELF-EXCITING.

Perfect Self-Regulation.

High Electrical Efficiency.



Slow Armature Speed.

No External Magnetism.

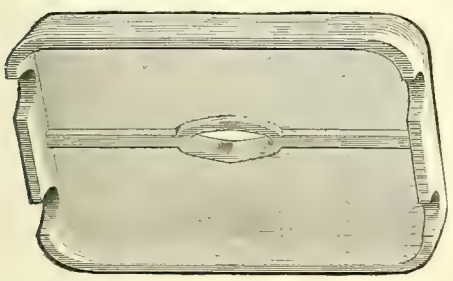
Self-Oiling Bearings.

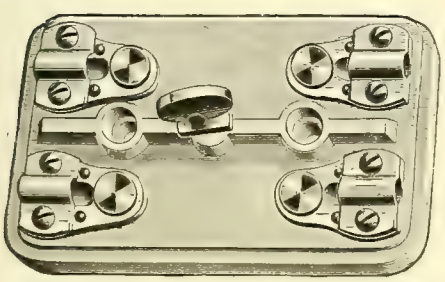
Descriptive Catalogues of Generators, Single-Reduction and Gearless Motors, and Power Station Appliances furnished upon application. Correspondence on all subjects connected with Electric Railways is solicited.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,

RAILWAY DEPARTMENT,

PULLMAN BUILDING, CHICAGO. PITTSBURGH, PA. 120 BROADWAY, NEW YORK.





CUT-OUTS,

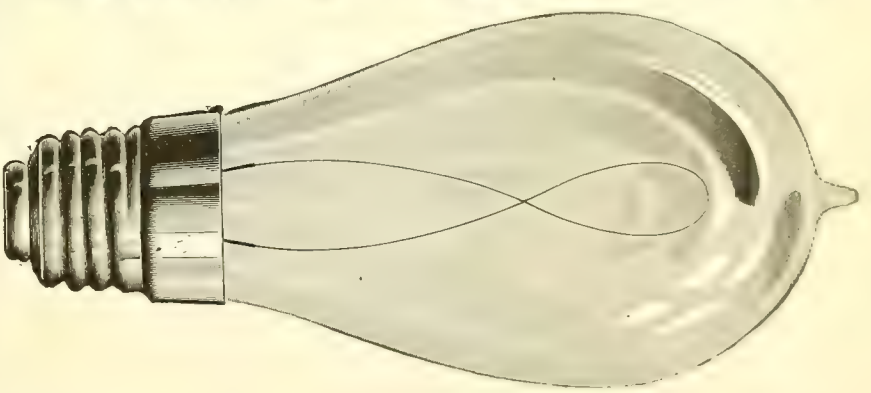
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 1201 Market St., Philadelphia, Pa.

See our full page advertisement in issue Sept. 1st for illustrations, prices, etc.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

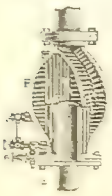
MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

KNOW WHAT YOU'RE GETTING!



HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

In a test of the best known "Separators" recently made at Cornell University this ELIMINATOR demonstrated percentages of efficiency over ALL competitors ranging from 11 to 39 per cent. The full report of test with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street. NEW YORK.

ATTENTION,

STREET RAILWAY MANAGERS.

The Jamestown (N. Y.) Street Railway Co. report that the total time lost by 10 cars from June 10th to August 29th (11 weeks) was two (2) car days.

Short System.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, O.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

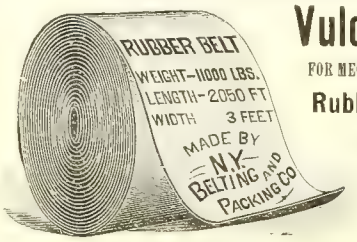
Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO. ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

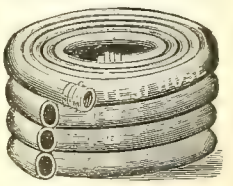
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601 1611 17th Street.
CHARLESTON, 169 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

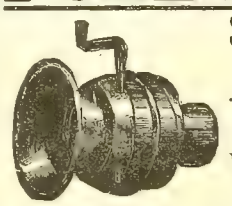
SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 1624 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

P AND B.

Armature Varnish,
Insulating Compounds,
Insulating Tapes,
Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, SEPTEMBER 19, 1891. No. 12

THE CONVENTION

Of the National Electric Light Association at Montreal.

The fourteenth convention of the National Electric Light association was held at the Windsor hotel Montreal, Sept. 7-11. The attendance was probably the largest in the history of the organization, and there were of course many ladies present.

The formal opening of the convention took place Monday afternoon at 3 o'clock. President Huntley, on assuming the chair, said: It affords me great pleasure in opening this, the fourteenth convention of the National Electric Light association, to have the honor of presenting to you the chairman of the citizens' executive committee of the City of Montreal, Professor Bovey, of McGill University.

PROFESSOR BOVEY: It devolves upon me as president of the citizens' executive committee to offer you a very hearty welcome. We sincerely hope that this convention will be full both of instruction and enjoyment. We feel sure of the instruction, as that depends upon you; as to the enjoyment we trust that the entertainments provided in the programme will prove agreeable diversions. I have now the honor of calling upon the mayor of Montreal, the Honorable James McShane, who will now address you.

MAYOR MCSHANE: I am here as the mayor of Montreal, and I have but a few words to say to you. Some months ago Mr. Corriveau, a native of the city of Montreal, called upon me one day at the city hall and asked me, as mayor of the city, if I would in my own way endeavor to give him some encouragement to ask your body to make Montreal your next place of meeting. I knew that there was opposition, and I think that St. Louis and other places in the United States had sought to take you there, but Montreal has succeeded in bringing you here, and now in the name of the citizens of Montreal I offer you a hearty and sincere welcome. I am sure that the citizens of Montreal will do what they can to make your stay while here as pleasant and agreeable as possible. I am not going to speak of the great good that your association has done and will do in the future, because there are some gentlemen upon this platform who will speak to you upon that subject. I will content myself by saying to you again that you are most welcome, and that the people of the city of Montreal will do all that they can to make your stay with us as agreeable as possible.

Sir Donald A. Smith was next introduced. He said: You have already heard words of welcome from the president of the citizens' association, and also from the mayor of Montreal, spoken in more appropriate terms than it would be possible for me to use. My own words are not required to give you a hearty welcome, but I do assure you, for my fellow citizens and for myself, that we are delighted to have you with us, and that it gives us the greatest satisfaction to find that you have honored us by coming here on this occasion. I assure you that we appreciate very highly having [illegible] can be of more benefit, nothing can tend more to induce cordiality than such conventions as we are to have here on this occasion. We hear occasionally of such things as a union, and there may be [illegible] may be beneficial or otherwise. I have no doubt there are such in the United States, and also in this country. But, be that as it may, I am one of those who believe that a meeting of the peoples of different countries, and especially those who are neighbors, as we are, and have such constant and such great relations with each other in trade and in every respect, cannot but clear away many of those cobwebs and many of those ideas which we have had each of the other, and which were entirely erroneous. And I am sure that the welcome which you will have here from the people of Montreal will be as sincere, as earnest, and as cordial as it would be possible that any welcome could be. Before sitting down I would say that we have had communications from his excellency, the governor general of the Dominion, Lord Stanley, which express very great regret at being unable to be here to-day in doing honor to you on this occasion, but he has made a point of arranging his engagements so that we shall hope for his presence at the banquet which our citizens will have the honor of tending to you on Thursday.

Professor Bovey next introduced Sir J. W. Dawson, the principal of McGill University.

SIR J. W. DAWSON: In tendering you a cordial welcome not only from McGill University, but I think I may

GENERAL VIEW OF THE EXHIBITION HALL.—NATIONAL ELECTRIC LIGHT ASSOCIATION, MONTREAL.

say from all teaching bodies in the Dominion of Canada that are interested in the practical and applied sciences, I only recognize what all of our universities and colleges are now bound to recognize—that in the presence of an association like this we are in the presence of the representatives of a great, growing and coming profession, and one which more than perhaps any other has served to bring to the notice of the world the great advantages that may arise from the prosecution of the physical sciences. Your science was prosecuted for a long time before much was known of its practical applications, but in the present day, as you know, and in the last few years, this great subject of practical and applied electricity has not only come to be something wonderful in the growth which it has presented with regard to its own special developments in telegraphy, in lighting, and in other matters of that kind, but also because it has been, young though it is, lending a hand to older scientific professions. We find now that the civil engineer, the mechanical engineer, the mining engineer, the metallurgist and the essayist, all of them, are under obligations to the electrical engineer, and it is now extending its hand—this young giant which has grown up among us—to all the older branches of our scientific professions, and it is making more than ever before, the subject of the physical sciences one which is attracting the attention of the community, and young men are endeavoring more and more to qualify themselves to enter professions of this kind. That gives us in our university a good reason, and gives all universities everywhere a good reason for recognizing such an association as this by offering it a cordial welcome, and which we in McGill University are entitled to do the more especially on this occasion because you honor our academical town with your presence. That we consider to be a great honor, and not only so, but you come at a time when we in the McGill University are expecting, at the next session, through the liberality of one of our great benefactors in Montreal, to be able to establish for the first time in a thorough and efficient manner, a course of electrical engineering, and in which we hope to have many of our young Canadians emulate the skill and success which you, on the other side of the line have so eminently shown in this great and rising profession. And so, on behalf of McGill University, and I may say in behalf of all educational interests in Canada, I have the greatest pleasure in offering you a kindly welcome, and in saying that we shall do all that we possibly can to make your stay here as pleasant and as profitable as possible.

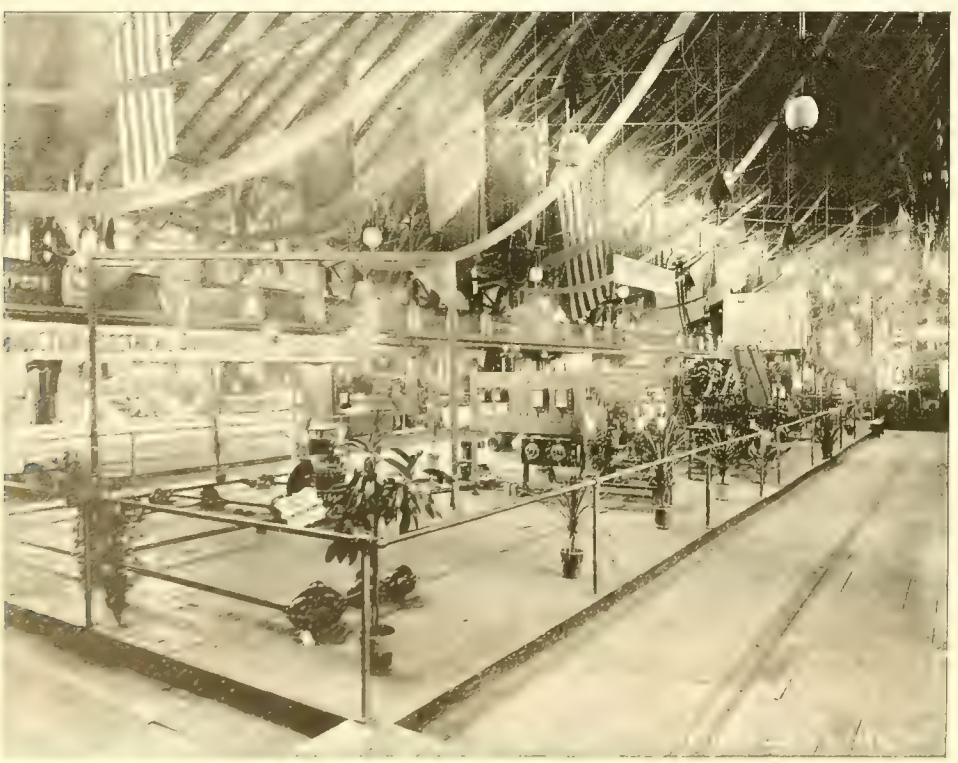
Professor Bovey called upon Alderman William Clendinning.

ALDERMAN CLENDINNING: A hearty welcome has been tendered to you by the leading men of our city, the mayor, the president of our great educational institution, and by other gentlemen, and it remains merely for me, in behalf of the aldermen, to tender you a most hearty welcome. You represent a science which has changed the entire face of the commercial world. There is probably nothing that has contributed so largely in this respect within the last century, or that has so changed the entire condition of things in the commercial world as has electricity. I think that are very instructive, and that your presence here and your visit to our city will be the occasion of giving us great pleasure, and of teaching us things that we do not know quite so well as our brothers across the water, the Americans, because they are practical men, who are applying the sciences to a to get money out of them, and their reputation is made in that way. As far as electricity is concerned there is probably no country in the world that has gone as far as you have done. I have had occasion in traveling out west for the last few years to observe this, and wherever I have gone, even away out in the Rocky Mountains, I have found your appliances there making money, lighting the people and advancing civilization. There is no doubt at the present moment that the great power of the future is electricity, and we are very happy to see here the vanguard of Americans who come to represent it in our city.

The next speaker was Alderman Cunningham:

ALDERMAN CUNNINGHAM: I am no authority on electricity, but I am pleased to know that this meeting takes place in our city, though, as an alderman, I am sorry to say that many of our streets are not in such a condition as we wish them to be. As far as I am concerned I will do all that I can in order to make your visit among us agreeable and I hope that when you return to your homes you will carry with you pleasant recollections of the city of Montreal.

ELECTRICAL EXHIBITION AT MONTREAL.—FORT WAYNE ELECTRIC COMPANY'S DISPLAY.



ELECTRICAL EXHIBITION AT MONTREAL.—EDISON COMPANY'S DISPLAY.

PRESIDENT HUNTLEY: For the first time in its history the National Electric Light association meets on other than its native soil. Yet even in so doing it but adds new evidence to the feeling in the breast of every electrician, that his art is foremost among the influences tending to promote human intercourse and break down the walls of separation. Coming, as do our members, from every state in the Union and the Dominion of Canada, and representative, as they are, of all the varied agencies and methods for the distribution of electric light and power, it affords me the greatest pleasure to acknowledge in their name the fraternal welcome with which we have all been received and the lavish hospitality that makes us at home in this noble Dominion and in its magnificent city of Montreal.

From the fact that the invitation was so cordial, and that the reception has been so warm, I can but infer that the association enjoys here an intelligent appreciation of its work, its object and its aims. Permit me to say, therefore, that the association asks for itself, during the coming week, a kindly tolerance of its technical papers and discussions, hoping that the large exhibit of electrical apparatus of the latest and most perfected character may make amends for the somewhat abstruse nature of its proceedings. If the earnest and practical quality of our dealing with the great questions of electricity shall in any wise stimulate electrical work in Canada and lead to the electrical utilization of its great water powers and coal beds in light, locomotion, power and heating, we trust it will be accepted as at least some slight acknowledgment of the manner in which we have been so generously greeted.

I have the honor of calling upon United States Consul Knapp, to say a few words to us in behalf of the United States.

GENERAL KNAPP: It affords me great pleasure to be present and participate in the exercises of this afternoon, and I am sure that you need no words from me, after those which have been uttered by the several gentlemen who reside in the city of Montreal, to assure you of a most hearty welcome, and I am certain that I can speak for the members of the Electric Light association in saying that should it ever be the lot of citizens of Montreal to visit their cities that they will give you a cordial greeting. The associations of this hour are suggestive of twofold congratulations, first congratulations to the city of Montreal that she has the privilege of having so royal a guest, and one so worthy of her hospitality as this National Electric Light association—an association which, although young in years, embraces in its membership men who have become famed in their works, men whose success in the fields of science and invention have become the proud heritage of mankind; an association which has for its purpose the development of one of the grandest sciences known in this nineteenth century, a science which, in its development and in its application is for our good, ministering to the wants of humanity, and also ministering to the wants of nations. But while I congratulate the citizens of Montreal in having so royal a guest, I may also congratulate you who come from the United States in having a host so royal as is the

city of Montreal. Let me say to you as visitors of my own nationality you will realize that it is a city justly famed, a city where mercantile and manufacturing industries tell the story of prosperity, a city made beautiful and interesting by historic spots, by noble monuments, by stately edifices, where churches of every denomination point toward heaven their spires of faith, and where institutions of learning like the McGill college rise like exhalations and shed their rays of light through this Dominion, to other nations and to the world. You will also find it a city whose citizens always have a hand of welcome, a word of greeting and a heart of friendship for the representatives and for the people of the United States. And so I say that this is an hour for mutual congratulations and felicitations, and as I join in them and in one sense bid you welcome, in another sense, if I may be permitted, I will express to the citizens of Montreal your gratitude for this royal greeting. I beg to express the hope that as your stay will be pleasant so your convention will be one of profit to you as individuals and of advantage to the great science you represent, and through it all we shall realize better than ever before that we are all citizens of two countries which are and will continue to be royal friends.

The President introduced Judge Armstrong of Camden, N. J.

JUDGE ARMSTRONG: To you, Mr. Chairman, the chief magistrate of this city, to this committee who so kindly and so cordially bid our association welcome, I am called upon to respond by the man we have learned to obey. I can promise you in advance that the response that you will receive from every one wearing the ribbons will be much more cordial, much more appreciative, much more expressive, than any words that I can use. Mine is none the less sincere, none the less hearty; and as I have listened to these cordial words that came to us I realized again and more fully I think than ever before what electricity does. It has been called the great annihilator of space—that thing that reaches its destination as soon as it starts. It is evidenced here to-day that it can annihilate state lines, that with it no peoples are known—only one people; that no communities are known—only one great family. We therefore appreciate most heartily the welcome you have given. You have asked why we should leave the cities of the states where we peculiarly belong, it is claimed, and come here. Do you know who your representatives were that you sent down to invite us to come? If you do know them as we have learned to know them, you would know that we could not help coming. They promised us well, but we have already received much more than they ventured to promise. Had they told us what you have told us here to-day we would have begun to suspect that their promises were too fair—the allurements too great—and we would have been afraid to come. In this welcome, my friends, that we have received it seemed to me that I saw the earnest expressions on the faces, and that I knew that these words came from the heart. I looked down here at this badge, and I saw two flags, distinct, but under the button bearing our name there was some sort of connection; it was completed there. The flags stand distinct, and yet they meet at a common center; they meet at a common point; they have a point of contact where all are interested. They meet around this circle, where there is no people known, no government known, only the good of mankind as mankind.

I particularly appreciate the fact that we are here assembled, and while I never mean to forget, nor do you want me to forget, that my allegiance is owed somewhere else, I am proud that upon this great continent there is a people of such enterprise, such energy and such ambition as I have been permitted to see in the few hours that I have been here.

One of the speakers congratulated us because we brought the ladies along with us. That proves conclusively that he has not been at our electrical conventions heretofore, and I am sorry to say that it proves that he does not know anything about the science of electricity. Ask any one of these bright young electrical engineers—and you will observe that most of these electrical engineers are young men—ask any of these engineers what he could do without an attachment. Ask him to tell you how necessary it is to have both positive and negative currents, and ask him also about the essential character of a switch. Ask him about any of these things, and then never again will it be noted as a matter of remark that ladies are attending electrical conventions.

THE PRESIDENT: I have the pleasure of introducing one to you, who I think is not wholly unknown to you—Erastus Wiman of Staten Island, New York.

MR. WIMAN: I could not resist the temptation to spend a few hours in Montreal, to act in a double capacity. A resident and a member of this association in New York, I wanted to come here and partake of the hospitality of the city in which I spent some of the happiest years of my life, and in which perhaps I am better known than any man that ever left it. In another capacity I come as a Canadian and to say a few words of welcome to the men with whom I have been associated in the latter years of my life in the great country on the south—to say how glad we Canadians are to see you among us. There is nothing in the world that is so productive of good as the mingling of these two races together. If they met more often, if they understood each other better, if they comprehended the great good that is in both, better conditions would prevail, and a larger charity and a better trade and a greater progress would come in everything. But I come to-day in this double capacity simply to testify, as I think no other Canadian can testify to the Canadians themselves what a marvelous brood of young fellows has sprung up in the last five years in connection with electrical engineering and electrical propulsion. I doubt if any system in the world is with it as I am, I believe I may say this, that there is a larger [illegible] greater number of messages transmitted in proportion to population in Canada than in any other country in the world. I can say this, too, that a lower rate—a cheaper price for [illegible] minion of Canada than in any other country in the world, taking distance into consideration; so that in telephony and telegraphy electricity has found, on this continent, in this Canada of ours, its greatest development. I would like to say to Canadians, though, that in certain things in the United States a greater progress has been made than here, and that [illegible] to-day, namely, that I should draw your attention to the marvelous growth in the United States of the use of electricity in the street railway. It seems to me that no one thing has grown with such rapidity as the value of real estate wherever there has been an electric railway introduced. I know that it is alleged that the United States has the power to create wealth greater than that of any other country. I know that last year we produced in that country eight millions of [illegible] price of $400,000,000—a sum greater than all the gold mines in the world produced in five years. I know we mined ten million tons of iron, and I know we produced this year an enormous crop of wheat. These are great accumulations of wealth, but they sink into insignificance compared with the increased value in real estate wherever an electric railway is promoted. There has been a greater advance in Boston in the value of real estate by the establishment of the West End railway than Boston ever made by any other influence. I saw in Minneapolis and St. Paul—those two wonderful rivals that we see struggling to get ahead of each other all the time—a greater growth in values and a more perfect system of communication than by any other means possible; so at Tacoma, so at Spokane. It is strange that in Montreal, of all cities in the world, that is only beginning to be realized.

I want to impress on my friends in Canada the advantage that the electric system has in the transmission of power. I was in Boston on Friday and stood in one station which had a capacity of [illegible] horse power. It seems to me I do my duty as a former citizen of this place and still somewhat interested in it in drawing the attention of the residents here to the fact that they possess the potentials of power almost beyond any city in the world. In the great rapids, above them and below them, are forces which, if applied by electricity, would be of the greatest advantage. I know of no city that has such enormous facilities for the creation of electricity as this city has. I know of no place in which power can be transmitted s

ELECTRICAL EXHIBITION AT MONTREAL.—THOMSON-HOUSTON ELECTRIC COMPANY'S DISPLAY.

perfectly and completely as in this city, so that a delicate wire running over a house might work a fan in a sick room and in the next block might lift a trip hammer; so that a sewing machine, or half a dozen of them, or fifty of them, or a factory, could be run from the St. Lawrence and Ottawa by the transmission of this power. An optician might grind the most delicate piece of glass in a small lathe before him, and even the running of a sewing machine and the rocking of a cradle might all be done by electricity. I think I can see in the marvelous growth of that power that the fecundity of the French race will be even increased by the facility of rocking the cradle by electricity. Perhaps when that day comes the success will tell a different tale. I hope it will. At any rate we want something to stimulate this country to grow a little faster. I have great gratification indeed in believing that you will have a most joyful time. So far as the city itself is concerned I have the belief that your presence here will stimulate and draw attention to this question of not only having every street equipped with electric railroads, but making every ripple on the rapids contribute to the wealth of the city. I cannot but think that the great progress that electricity has made and your presence here will bring popular thought and popular opinion to bear on this question of the use of this tremendous force that lies now idle, so far as its transmission is concerned. If that should occur it would all be attributable to the fact that the National Electric Light association held its meeting in the city of Montreal. Montreal has facilities for manufacturing greater than any other city in the world. It has got raw material at its hand. It has got the cheapest and the best labor. It needs only the touch of electricity to make it the greatest city and this the greatest country under the sun.

President Huntley's Address.

President Huntley delivered the following address:

My predecessors in this chair have seen the association advance in strength and worth, outliving trials and vicissitudes, to emerge on a wider, larger field of usefulness and opportunity. I do not believe that there is another industry in the world which has passed through such quick stages of evolution as ours, and become so soon established in popular favor and general prosperity. But we must not assume that because electric lighting has set its feet upon the rock and laid its deep foundations, nothing more remains to be done save pursue the policy and practice of the past. On the contrary, I deem it necessary to say here that my own responsibilities as a central station manager compel me, as never before, to be watchful of the tendency of conditions and inventions in the art, so that I may in any degree profit from my own hard won experience. If, as central station men, we are to secure adequate return on the investment committed to our care, it becomes us in every way to study closely all the ideas that will give higher efficiency of plant and higher economy in operation. There was a time when some of us expected to grow rich out of abnormal prices. To day there is not one of us who does not know that his hopes of dividends lie wholly in the skill with which the best business ability and the soundest engineering are applied to the work in hand.

I take it that it is now pretty well recognized among intelligent station managers that the day has passed when they can limit themselves to one class of service or apparatus to the exclusion of all others. To obtain the fullest measure of success and the largest return from the capital invested, they must be ready to supply any demand made upon them; as a result, the successful station, even to-day is gradually assuming a composite character. This compositeness is manifesting itself first in the variety of apparatus, as a result of the selection of the machines best adaped to a given class of work, and independent of any particular system. One cannot help seeing in this change from early practice a step toward increasing efficiency of station operation, as well as a good reactive effect upon the manufacturers of apparatus, who are thus all placed on a common basis of competition. But besides a compositeness in detail, signs are not wanting that no one method of distribution from a central station can, in the large majority of cases, be adequate to the demands that are made upon us, and that to meet them in a manner to insure a profitable business requires a flexibility and variety in methods of distribution, the full extent of which is to-day hardly recognized. To reach the full limit of its usefulness the central station should avail itself of methods which, I believe, will finally resolve themselves into what may be called the "zone system" of distribution.

[illegible] zone system can best be explained, perhaps, by taking a concrete, practical example, and for this purpose the present occasion makes the city [illegible] setting aside for the [illegible] probability of the [illegible] from the power [illegible] station erected at the water front of the harbor. It will, I believe, be granted that up to within a distance of one-third mile [illegible]

system, employimg converters to reduce or raise the potential. Perhaps some of our new school of electrical engineers will show us how to use the same circuits for both alternating and direct currents.

But, whatever system be employed, I deem it proper to record here my conviction that the most economical way to distribute the current to the consumers at the point of delivery is by low pressure conductors, in contradistinction to the plan now generally in vogue of giving each customer a converter of his own or, in the direct system, a separate motor dynamo. I need not here enlarge upon the train of reasoning which has led me to this conclusion, but I may remark that I am strengthened therein by my own experience in Buffalo, where we are now introducing gradually 200 light converters and replacing the smaller ones heretofore employed. Nor do we propose to stop there, but expect to install converters of still higher capacity, distributing the current to a number of customers by low pressure mains centering at the large converters. As addressing myself to practical men, I need not refer to the fact that it costs practically no more labor, etc., to put up a 200 light converter than it does a 10 lighter, while the initial cost per light is less in the case of the larger converter. In these conclusions I am only recommending for large American areas what, I believe, is now recognized abroad by Ferranti and others, whose work, like our own, will eventually lead to the establishment of large converter sub-stations from which low tension wires will supply the surrounding districts.

The allusion made to the motor-dynamo system for converting the direct current from high to low potential may to some appear nothing more than the citing of a possible method in view of the existence of the alternating system, well tried and ready at hand. But without wishing in the least to detract from the merits of this system, which has probably done more to popularize electricity than any other, I cannot, as a practical man, conceal from myself the fact that, taking everything into consideration, the low tension direct current system of distribution is the most flexible within its area, and serves the greatest variety of purposes. I do not think that any one can successfully contradict the assertion that to say no other system can, with equal efficiency, take care of arc and incandescent lamps, motors, large and small, storage batteries, electric heaters, etc.

In making this statement I desire to be understood as referring to the present condition of the art, the only condition which, as practical men, we ought to consider in matters of this kind; but I hope the time will soon come when the same can be said of the alternating system. There are still other methods which suggest themselves, by which the "zone" system could be effectually carried out, but those indicated are sufficient to demonstrate the idea I have endeavored to convey.

After the intelligent station manager has decided upon the nature of his apparatus and the initial capacity of his station, his most important consideration is the allowance to be made for future growth. Look back, some of you, and recall the mistakes made, but which were brought about by the enormously rapid growth of the industry. I need not go out of my own experience for such an example. Less than two and a half years ago we erected in Buffalo a new station considered far too large for even the most extended future growth. Some of my colleagues shook their heads. Yet even to day it is being worked to its fullest capacity, and provision will soon have to be made for more facilities.

What, then, may be asked, shall we determine upon as the unit time limit of growth for which provision should be made? Shall we build our stations sufficiently large to take care of the demands of five, or ten, or twenty years hence? This is a most serious question, and one to my mind as important as the selection of the proper station apparatus itself. I note the erection of several stations abroad, and some here, designed to supply the demands of 15 or 20 years hence. Without wishing in any way to detract from the laudable enterprise and faith exhibited by the promoters of these stations, a calm survey of the past, present and probably future condition of the art leads me to believe that the setting of so long a time limit as 15 or 20 years is inadvisable. I need not remind you in detail of the changes in methods and apparatus which have been effected during the last five years, by which the efficiency and output of our stations have been increased. And if to this we add the fact that already new methods, such as those pointed out by Mr. Tesla, may at any time increase the present lamp capacity of our stations five and tenfold, I think we may be justified in placing five years as the limit of time, to make provision beyond which may involve expenditures, the benefit of which may not be realized.

These are matters we are endeavoring to settle for ourselves. It is to our interest to settle them. So, too, with the underground question; but there we have gratuitous advice, assistance and abuse to such an extent that less progress is made than in any other part of the work. We all want to put our wires underground where the number is so great as to make them unsightly or unwieldy, and not a few of us have been parties to experiments now written off to profit and loss. As soon as the time arrives when every house has its wiring as a matter of course, just as now it has piping for water and gas, it will be a comparatively easy matter to lay down comprehensive underground systems. But at the present time the customers for current are scattered and not continuous. The man with enterprise enough to take electric light and power soon moves into a larger store. His successor does not want the service, but gropes along with kerosene or spoils his goods with gas. Cutting out disused underground [illegible] an added risk and expense, and ten lights could be installed on overhead circuits for ten dollars, where with underground the cost would be fifty. [illegible] that in any city—Buffalo, for example—we shall not make one underground connection, where with overhead wires we should have made twenty. Now, are the public or are we the greater losers? The public, I think. It is as unreasonable in most instances to demand underground wires as it is to expect every railroad to make every crossing above or below grade. But for our overhead wires, America would not be to-day the great land that it is of electrical triumphs; and, while I hail with delight every advance in the solution of the underground problem, I hope long to gladden my eyes with the sight of a pole well set and a wire well strung.

Another stirring question of the hour is that of municipal ownership. Now, it has been taken for granted that electric light men are against this plan, tooth and nail. How absurd that notion is! Because we represent the latest development of invention and industry, we certainly do not forfeit our pride as citizens, nor lose our interest in the advance of social science. It would, in fact, be difficult to find a more progressive, well known body of men in America to day than they who have put their money and energies into electric lighting. They are neither crusty nor cranky. But when any movement has been started for the betterment of the communities in which they live, some of them have been at its head. Now, is it strange that such men should object to the confiscation of the properties they have built up and that are beginning to pay? Is it strange that they should ask for these new theories in social economy to be tried on something else first? Many of them have grave doubts as to the accuracy of the figures that are supposed to prove that municipal plants pay. Others of us have great objection to any taxation, the proceeds of which are to set the municipality up in a commercial business; others again believe that the best results are reached in any industry when it is freest from political influences and is left to the uplifting and perfecting impulses of individual enterprise.

I believe that the most conclusive answer we can make to the sophisticated arguments of an ill-disguised socialism, presenting itself in this municipal ownership scheme, is to give the very best service possible at the lowest rates compatible with fair profit. Some of the prices we now obtain are so low as to exclude any profit at all, especially when repairs and reconstruction are considered. But here again we may help ourselves out by native wit. Every company in the ranks of this association ought to ascertain for itself at regular intervals just how it stands as an industry. A good deal of apparatus in use is decidedly inefficient. Overhaul it. If necessary, throw it out and put in better. Above all, adopt a good system of bookkeeping. Electric light securities are to day far from enjoying the esteem in financial circles that they deserve. This is due in a measure to speculative investment and to over capitalization in the past. But it is also attributable very often to the poor system of accounts employed, and I am glad to see the subject thus receiving attention. If we know what our current costs, we know what we can sell it for, and unless that information is obtainable from our office books, engineering will go for naught, and capital required for new work will stand aloof.

In conclusion, I would urge that the association determine upon meeting only once a year. Even if it were not impossible to recover in six months from such overwhelming hospitality as we are now the recipients of, I believe that the time has gone by when half-yearly meetings were necessary. Once in twelve months is often enough for us to come together for the comparison of our experiences and the report of further refinements in the detail of the industry. The mere fact that frequent reunions are no longer necessary is in itself a hopeful sign, for it tells of stable and settled conditions and of activities that now require our presence at home pretty much the year around.

Gentlemen, I thank you for your attention, and I trust that your deliberations in the coming week will be characterized by the same earnestness which has marked them in the past.

The president then read an invitation from McGill University to the members to visit the library, museum and buildings of the university; an invitation from the Art association of Montreal to visit its gallery; an invitation from the Quebec & Levis Electric Light company to visit its works at Montmorency Falls; an invitation for a trip up the Richelieu river, and an invitation from the harbor commissioners to join them in a trip up the Lachine Rapids. The president added that there were also several garden parties which had been announced and which were set forth in the souvenir. The invitations were received and filed, a vote of thanks extended.

The President: When the invitations were sent out, knowing that we would come to Montreal, the executive committee instructed its secretary to invite as a body the American Institute of Electrical Engineers, the New York Electrical Society and the Society of Electrical Engineers of Brooklyn. I have their response, here and the invitation has been accepted. We are also in receipt of a letter from the director-general of the World's Fair authorizing Mr. Hornsby to represent the commission here. I believe he will be here to-morrow and will present the subject to you when the matter of the World's Fair comes up.

The convention then adjourned until September 8th, at 10 A. M.

The following is a complete list of delegates and visitors:

MEMBERS AND GUESTS.

Abell, C. L., wife and son	Buffalo, N. Y.
Abell, Miss M.	Buffalo, N. Y.
Ackerman, P. C.	New York, N. Y.
Adams, Milton F.	New York, N. Y.
Aidall, J. E.	New York, N. Y.
Alexander, P. H.	New York, N. Y.
Anderson, J. C.	Toronto, Can.
Armstrong, E. A.	Camden, N. J.
Armstrong, Miss E. W.	Camden, N. J.
Austin, G. L. and wife	Boston, Mass.
Ayer, Jas. I.	St. Louis, Mo.
Babcock, W. R.	New York, N. Y.
Babcock, E. L.	Cuyahoga Falls, O.
Bailey, E. P. and wife	Chicago, Ill.
Bailey, G. C.	Chicago, Ill.

Baird, M. E. ..... Boston, Mass.
Baker, C. O. Jr., and wife. ..... New York, N. Y.
Baker, J. L. ..... Chicago, Ill.
Ball, G. M. ..... Pittsburg, Pa.
Barberie, E. T. ..... New York, N. Y.
Barker, F. E., and wife ..... Boston, Mass.
Barker T. ..... Manchester, N. H.
Barnes, C. R. ..... Rochester, N. Y.
Barney, C. H., wife and daughter. ..... New York, N. Y.
Barr, M. D. ..... Toronto, Ont
Bartlett, E. E. and wife. ..... New York, N. Y.
Beane, J. W. ..... Syracuse, N. Y.
Beardsley, Chas. S and wife. ..... New York, N. Y.
Beggs, J. I. ..... Chicago, Ill.
Belknap, C. ..... Boston, Mass.
Bell, Dr. Louis. ..... New York, N. Y.
Bibber, C. E. and wife ..... Boston, Mass.
Bigelow, C. H. ..... Boston, Mass.
Billings, Miss Harriet. ..... New York, N. Y.
Bishop, G. W. and wife. ..... Boston, Mass.
Blaxter, G. H. ..... Pittsburg, Pa.
Blackwell E. D. ..... Montpelier, Vt.
Bottomley, H. ..... Boston, Mass.
Boulton, W. H. ..... Buffalo, N. Y.
Bournonville, A. ..... Philadelphia, Pa.
Boutwell, Mrs. G. S. ..... Worcester, Mass.
Bovey, H. T. ..... Montreal, Can
Bowman, F. A. ..... New York, N. Y.
Braddell, Alfred E. ..... Philadelphia, Pa.
Bradley, W. G. ..... Ottawa, Ont.
Brophy, William. ..... Boston, Mass.
Brown, M. W. and wife. ..... Boston, Mass.
Browlowe, J. and wife. ..... Tuxedo, N. Y.
Bruns, P. C. ..... Peru, Ind.
Bryant, W. C. ..... Hartford, Conn.
Buell, A. A. ..... Burlington, Vt.
Burdick, J. R. ..... New York, N. Y.
Burghardt, G. H. ..... Boston, Mass
Burleigh, J. J. ..... Camden, N. J.
Caldwell, E. ..... New York, N. Y.
Candee, John N. ..... Poughkeepsie, N. Y.
Candee, W. L. and wife. ..... New York, N. Y.
Carroll, John. ..... Montreal, Que.
Carruthers, J. ..... Rutland, Vt.
Castle, W. W. and wife. ..... Boston, Mass.
Cavell, E. V. ..... New York, N. Y.
Chase, Samuel A. ..... New York, N. Y.
Cheever, H. D. ..... New York, N. Y.
Chenowith, A. C., and wife. ..... New York, N. Y.
Childs, A. E. ..... Montreal, Can.
Chinnock, F. R. ..... Brooklyn, N. Y.
Christie, W. E. ..... Montreal, Can.
Christie, A. J. ..... St. Johns, N. B.
Church, J. H. C. ..... Barrington, Vt.
Churchill, W. H. ..... New York, N. Y.
Clark, A. T. ..... Boston, Mass.
Clark C. A. ..... Boston, Mass.
Clark, Miss E. ..... Buffalo, N. Y.
Cleveland W. B. ..... Cleveland, O.
Cleverly, H. A. ..... Philadelphia, Pa.
Close, A. I. ..... Boston, Mass.
Clower, D. M. ..... Dallas, Tex.
Coggeshall, H. S. ..... Fitchburg, Mass.
Colbeer, John. ..... San Francisco Cal
Coleman, S. G. ..... Milwaukee, Wis.
Coles, Stephen L. ..... New York, N. Y.
Colvin, F. R. ..... New York, N. Y.
Corbett, M. W. ..... Montreal, Que.
Corriveau, A. J. ..... Montreal, Que.
Corry, R. B. ..... New York, N. Y.
Craig, J. H. ..... Boston, Mass.
Cram, H. B. ..... Boston, Mass.
Crandall, A. B. ..... Boston, Mass.
Crandall, C. D. ..... Chicago, Ill.
Crane, W. F. D. ..... New York, N. Y.
Crosby, E. H. ..... Boston, Mass.
Crouse, J. B. ..... Cleveland, O.
Cullen, Wm. F. ..... New York, N. Y.
Currier, C. W. ..... Boston, Mass.
Cutter, Geo. and wife. ..... Chicago, Ill.

Daggett, H. M. and wife. ..... Boston, Mass.
Daggett, H. M., Jr., ... Attleboro, Mass.
Dallon, F. L. and wife. ..... Brooklyn, N. Y.
Davenport, G. W. ..... Boston, Mass.
Davenport, W. ..... Providence, R. I.
Davis, A. E. ..... New York, N. Y.
Davis, C. J. ..... New York, N. Y.
Davis, E. T. ..... New York, N. Y.
Davis, F. W. ..... Hartford, Conn.
Dean, D. B. ..... Chicago, Ill.
Dee, J. R. ..... Houghton, Mich.
De Land, F. ..... Chicago, Ill.
De Ronde, F. S. ..... New York, N. Y.
Dickerson, J. W. ..... Chicago, Ill.
Dillont, J. F. ..... New York, N. Y.
Dolbeer, Miss Bertha. ..... San Francisco, Cal.
Dolbeer, Miss Susan. ..... Short Falls, N. Y.
Donnelly, W. T. ..... Taunton, Mass.
Donohue, F. E., wife and daughter. ..... Boston, Mass.
Doty, Fred. V. ..... Buffalo, N. Y.
Dow, C. T. ..... Somerville, Mass.
Dowse, W. F. ..... Boston, Mass.
Doying, W. C. E. ..... Summit, N. J.
Dreyfuss, T. G. ..... New York, N. Y.
Dunham, S. E. ..... New York, N. Y.
Dunn, G. M. ..... Washington, D. C.
Dwight, H. P. ..... Toronto, Ont.

Eaton, L. W. ..... Bridgeport, Conn.
English, E. L. ..... Brantford, Ont.
Estabrook, R. I. ..... Cambridge, Mass.
Evarts, O. ..... New York, N. Y.

Fairbanks, H. H. and wife. ..... Boston, Mass.
Faunce, A. B. ..... Quincy, Ill.
Ferguson, C. G. ..... New York, N. Y.
Ferguson, Jas. ..... Brooklyn, N. Y.
Field, A. B. ..... Boston, Mass.
Field, C. J. ..... New York, N. Y.
Findley, F. H. ..... Ogden, Utah
Fish, H. C. ..... St. Paul, Minn.
Foote, Allen R. ..... Washington, D. C.
Ford, A. W. ..... Brooklyn, N. Y.
Foster, Horatio A. ..... New York, N. Y.
Francisco, I. H. ..... Rutland, Vt.
Francisco, M. J., wife and son ..... Rutland, Vt.
Freet, A. W. ..... New York, N. Y.
French, H. M. and wife. ..... Boston, Mass.
Frey, C. P. ..... New York, N. Y.

Gard, T. W. and wife. ..... N. London, Conn.
Gisborne, F. N. ..... Ottawa, Ont.
Godfrey, J. W. ..... New York, N. Y.
Gordon, W. H. ..... New York, N. Y.
Greene, S. D. ..... New York, N. Y.
Greenfelder, Lewis L. ..... Baltimore, Md.
Guild, C. T. ..... North Attleboro, Mass.
Gulick, J. I. ..... New York, N. Y.
Guy, G. H. ..... New York, N. Y.
Griffin, Eugene. ..... Boston, Mass.

Hale, J. V., and wife. ..... Boston, Mass.
Hall, C. S. and wife. ..... Short Falls, N. Y.
Halle, W. S. ..... New York, N. Y.
Hamblet, G. H. ..... Boston, Mass.
Hamilton, B. F. and wife. ..... New York, N. Y.
Hammell, Miss E. ..... Philadelphia, Penn.
Hammer, Wm J. ..... New York, N. Y.
Hanley, A. T. ..... Boston, Mass.
Harrington, F. W. ..... New York, N. Y.
Hart, Gerald W. ..... Hartford, Conn.
Hart, L. H. ..... New York, N. Y.
Hatch, E. B. ..... Hartford, Conn.
Haveland, J. W. ..... Brooklyn, N. Y.
Hawkins, F. M. ..... Syracuse, N. Y.
Hays, Henry. ..... Newark, N. J.
Haywood, Miss L. ..... New York, N. Y.
Hazeltine, C. W. ..... St. Louis, Mo.
Herman, J. F. and wife. ..... Boston, Mass.
Herman, H. N. ..... Boston, Mass.
Hermann, O. ..... Philadelphia, Pa.
Hills, C. L. ..... Manchester, Conn.
Hill, F. T. G. ..... Boston, Mass.
Hinds, J. L. ..... Syracuse, N. Y.
Horn, John. ..... Montreal, Que.
Honrsby, J. A. ..... Chicago, Ill.
Hunt, W. T., wife and child. ..... New York, N. Y.
Hunter, D., Jr. ..... Allegheny, Pa.
Hunter, R. J. ..... New York, N. Y.
Huntley, C. R., and wife. ..... Buffalo, N. Y.
Hutchinson, G. W. and wife. ..... New Haven, Conn.

Insull Samuel J. ..... New York, N. Y.
Issertel, Henry G. ..... New York, N. Y.

Johnson, P. ..... Toronto, Can.
Johnston, Albert E. ..... New York, N. Y.
Johnston, Master Franklin Allen. ..... New York, N. Y.
Johnston, W. J., wife, child and maid. ..... New York, N. Y.
Jones, A. I. ..... New York, N. Y.

Keefer, E. S. ..... New York, N. Y.
Kellogg, Chas P. F. ..... Boston, Mass.
Kelly, James F. ..... New York, N. Y.
Kimball, R. J. ..... New York, N. Y.
Kirkland, J. W. ..... Boston, Mass.
Knapp, Chas. L. ..... Montreal, Que.
Knight, J. C. ..... New York, N. Y.
Knight, J. C. ..... Fort Wayne, Ind.
Knudson, A. A. ..... St. John, N. B.
Kreidler, W. A. ..... Chicago, Ill.

LaBoiteaux, J. M. ..... Cincinnati, O.
LaRue, G. W. and wife. ..... New York, N. Y.
Law, M. D. ..... Schenectady, N. Y.
Lean, G. R. ..... Boston, Mass.
Leonard, F. H., Jr., ... Syracuse, N. Y.
Leonard, H. Ward. ..... New York, N. Y.
Lesage, L. I. ..... Montreal, Can.
Lewis, E. N. ..... New York, N. Y.
Linnill, H. M. ..... Canton, O.
Little, E. W. and wife ..... New York, N. Y.
Lockwood, T. D. ..... Boston, Mass.
Long, J. A. ..... Cuyahoga, Falls, O.
Lowrie, S. N. ..... Canton, O.
Lufkin, H. L. and wife. ..... New York, N. Y.
Luncy, C. F. and wife. ..... Chicago, Ill.
Lynch, Wm A. and wife. ..... Canton, O.

Magee, F. A. ..... Boston, Mass.
Maher, E. W. and wife. ..... Albany, N. Y.
Mainwaring, A. H. ..... Philadelphia, Pa.
Mann, H. T. ..... Washington, D. C.
Manson, Geo. T. and wife. ..... New York, N. Y.
Marsh, J. W. and wife. ..... Pittsburg, Pa.
Martin, T. C. ..... New York, N. Y.
Mason, A. F. and wife. ..... Boston, Mass.
Mason, F. C. and wife ..... Brooklyn, N. Y.
MacMullen, R. H. ..... La Fayette, Ind.
McDavitt, Wm. ..... Philadelphia, Pa.
McDonald, Mrs. S. B. ..... Montreal, Que.
McFarlane, L. B. ..... Montreal, Que.
McIntire, C. H. ..... Newark, N. J.
McIntyre, J. D., and Wife ..... Syracuse, N. Y.
McLaren, D. W. ..... Syracuse, N. Y.
McLaughlin, J. R. ..... Detroit, Mich.
McLaughlin, W. R. ..... New York, N. Y.
McQuaide, J. P. ..... New York, N. Y.
McShane, James and wife. ..... Montreal, Que.
Meeker, G. H. ..... Chicago, Ill.
Medbury, Charles F. ..... Toronto, Ont.
Merrill, J. E. and wife. ..... Boston, Mass.
Meyers, J. L. ..... New York, N. Y.
Middleditch, Rev. R. H. ..... Brooklyn, N. Y.
Middleditch, Miss M. ..... Brooklyn, N. Y.
Mignery, J. H. ..... Great Barrington, Mass.
Miller, Henry J. ..... New York, N. Y.
Miller, J. C. ..... Buffalo, N. Y.
Miles, B. F. ..... Cleveland, O.
[illegible] H. ..... [illegible]
[illegible] H. M. ..... [illegible]
[illegible] ..... [illegible]
Moore, W. H. and wife. ..... Plainfield, N. J.
Morrison, W. J. ..... Toronto, Ont.
Mortimer, J. B. ..... Toronto, Ont.
Muir, John. ..... New York, N. Y.
[illegible] ..... [illegible]
Myerson, E. ..... New York, N. Y.
[illegible] ..... [illegible]
Ness, T. W. ..... Montreal, Que.
[illegible] ..... [illegible]
[illegible] ..... [illegible]
Nichols, C. M. ..... Providence, R. I.
Nichols, F., wife and son ..... Toronto Can.
[illegible] ..... [illegible]

O'Day, Chas. ..... Buffalo, N. Y.
[illegible] ..... [illegible]
Ogden, S. R. ..... Elizabeth, N. J.
Ogle, G. H. ..... Syracuse, N. Y.
O'Hara, John B. ..... Chicago, Ill.
O'Neil, Wm. G. ..... Montreal, Que.
Orford, J. M. and wife. ..... Bridgeport, Conn.
[illegible] ..... [illegible]
Outcault, R. F. ..... New York, N. Y.

Paine, C. McL. ..... New York, N. Y.
Palmer, F. S. ..... Ellsworth, Me.
Parker, C. A. ..... Boston, Mass.
Parker, G. W. ..... [illegible]
Partridge, James. ..... Sandusky, O.
Pass, James and wife. ..... Syracuse, N. Y.
Patterson, A. H. and wife. ..... New York, N. Y.
Pearce, Frederick and wife. ..... New York, N. Y.
Pearson, W. B. ..... Chicago, Ill.
Peck, E. F. and wife ..... Brooklyn, N. Y.
Peck, E. H. ..... New York, N. Y.
Perrine, F. A. C. ..... Trenton, N. J.
Phelps, G. M. ..... New York, N. Y.
Phillips, E. R. ..... Providence, R. I.
Phillips, Eugene F., and Wife ..... Providence, R. I.
Phillips, J. R. ..... North East, Pa.
Pierrez, J. C. ..... New York, N. Y.
Platt, J. B. ..... Augusta, Ga.
Porter, G. F. ..... Philadelphia, Pa.
Possons, N. S. ..... Cleveland, O
Price, C. V. ..... Boston, Mass.
Price, C. W. and wife. ..... New York, N. Y.

Reade, R. P. ..... Rome, Mich.
Redman, G. A. and wife. ..... Rochester, N. Y.
Richards, H. T. ..... New York, N. Y.
Richmond, C. T. and wife. ..... Fremont, O.
Ridell, J. E. ..... Pittsburg, Pa.
Ries, Elias E. ..... Baltimore, Md.
Roach, M. C. ..... New York, N. Y.
Rodman, Chas. L. ..... Cleveland, O.
Rosentengel, W. R. ..... Toronto, Ont.
Rosenstamm, S. ..... New York, N. Y.
Royce, F. W. ..... Washington, D. C.
Russell, J. L. ..... Great Barrington, Vt.
Ryan, R. W. ..... New York, N. Y.
Ryckman, J. W. ..... New York, N. Y.

Sanderson, M. ..... Montreal, Can.
Schieren, C. A., Jr., ... New York, N. Y.
Scott, C. E. ..... Bristol, Pa.
Seely, J. A. and wife. ..... New York, N. Y.
Seller, H. W. ..... New York, N. Y.
Seymour, A. P. ..... Syracuse, N. Y.
Shain, Chas. D. ..... New York, N. Y.
Shainwald, Ralph L. ..... New York, N. Y.
Shaw, A. C. ..... Boston, Mass.
Shaw, W. B. S. ..... Montreal, Que.
Sheehy, R. J. ..... New York, N. Y.
Shippy, H. L. ..... New York, N. Y.
Slater, C. E. ..... New York, N. Y.
Smiley, H. G. ..... Chicago, Ill.
Smith, C. D. ..... Cleveland, O.
Smith, F. F. ..... Bridgeton, N. J.
Smith, Fred. F. ..... Bridgeton, N. J.
Smith, H. J. ..... New York, N. Y.
Smith, J. K. and wife. ..... Waterbury, Conn.
Smith, Master A. H. ..... New York, N. Y.
Smith, Miss Emily. ..... Washington, D. C.
Smith, T. J. and wife. ..... New York, N. Y.
Smith, T. Carpenter. ..... Philadelphia, Pa.
Smith, W. D. ..... Cleveland, O.
Stanley, H. D. ..... Bridgeport, Conn.
Stannard, G. C. ..... Toronto, Ont.
Steinberger, Jos. ..... New York, N. Y.
Stieringer, L. ..... New York, N. Y.
Stillwell, L. B. ..... Pittsburg, Pa.
Stanhope, W. H. ..... Wilmington, Del.
Stephen, E. W. ..... New York, N. Y.
Stiness, S. G. and wife. ..... Pawtucket, R. I.
Stuart, O. K. and wife. ..... Boston, Mass.
Stump C. E. and wife. ..... New York, N. Y.
Sullivan, M. J. ..... New York, N. Y.
Sullivan, M. C. ..... New York, N. Y.
Sunderlin, L. ..... Rochester, N. Y.
Swain, F. D. and wife ..... [illegible]
Sweeton, F. D. ..... Wilmington, Del.
Swetland, H. M. and wife ..... New York, N. Y.

Taltavall, J. B. ..... New York, N. Y.
Taltavall, T. R. ..... New York, N. Y.
Taylor, J. W. ..... Peterborough, Ont.
Taylor, S. F. ..... New York, N. Y.
Taylor, William. ..... Chicago, Ill.
Thornberry, H. S. ..... [illegible]
Tolles, C. L. ..... Hartford, Conn.
Toms, J. W. ..... [illegible]
Tudor, H. C. ..... Baltimore, Md.
Tyson, F. C. ..... Wilmington, Del.
Urquhart, D. I. ..... [illegible]
Valler, G. A. ..... [illegible]
Vance, A. S. ..... New York, N. Y.

Vanderwyde, Fred H.	New York, N. Y.
Voorhees, P. Dev.	New York, N. Y.
Vose, Ralph	Boston, Mass.
Walsh, C. C.	New York, N. Y.
Walsh, Louis	New York, N. Y.
Warner, C. D., and Wife	New Haven, Conn
Washington, I.	Chicago, Ill.
Waterman, J. A.	Boston, Mass.
Watson, W. B.	Bay State, N. Y.
Watters, W. R.	Chicago, Ill.
Webb, J. W.	Chicago, Ill.
Western, Benj. R. and wife	New York, N. Y.
Western, Percy	New York, N. Y.
Wetmore, Jean A.	New York, N. Y.
Wetzler, Jos.	New York, N. Y.
Wheeler, Dr. S. S. and wife	New York, N. Y.
Whittier, R. H.	Providence, R. I.
Whitney, C. C.	New Britain, Conn.
Wigganton, J. F.	Danbury, Conn.
Wiley, George L.	New York, N. Y.
Wilhelmi, E. A.	New York, N. Y.
Willcox, W. R. B.	Chicago, Ill.
Willyoung, E. G.	Philadelphia, Pa.
Wilmerding, C. H.	Chicago, Ill.
Wilson, J. S.	Boston, Mass.
Wilson, L. S.	Boston, Mass.
Wiman, Erastus	New York, N. Y.
Winston, H. S.	Chicago, Ill.
Wisner, F. P.	New Brunswick, N. J.
Woodward, W.	Boston, Mass.
Wood, E. E.	New York, N. Y.
Worhan, W. R.	Montreal, Que.
Wright, A. A.	Renfrew, Ont.
Wright, C. H.	Renfrew, Ont.
Young, A. M. and wife	Waterbury, Conn.
Young, E. P.	Sewicklev, Pa.

Tuesday's Proceedings.

The convention was called to order at 10 A. M. by the president, who announced that the first thing in order was the reading of the reports of the committee on relations between manufacturing companies and central stations. Mr. Armstrong, the chairman of the committee first read the following letter from Geo. B. Shaw of Eau Claire, Wis., chairman of the special committee on constitution, of which Mr Armstrong was also a member.

[illegible] existence a sufficient length of time to give it a fair trial, it is our opinion, that any changes amendments or modifications at this time [illegible] constitution be submitted at the forthcoming convention.

MR. WEEKS: I second that motion, and with the permission of the chair in so doing I want to say that I am very glad that this committee has reached this wise conclusion. I take it that that state, that corporation, that association that is continually tinkering with its organic law is in a bad way, and that our constitution should be allowed to stand, at any rate until it has had that seasoning of time which will enable us to determine wherein changes are necessary. When the constitution of the United States of America was adopted you may remember of having read in history that various objections were raised to it. It was held even by some that under that constitution there would be nothing but ruin ahead of the states. But those croakers were not listened to, the constitution was given the seasoning of time that it required, and it was found that it needed but comparatively few simple amendments.

The report was received.

The committee on relations betweeen manufacturing companies and central stations presented the following

[illegible]

The committee on relations of parent and sub companies [illegible] at the last convention so it [illegible] brought to its attention [illegible] presented. "What excuse [illegible] for its existance?" We have all realized the possibility of great good [illegible] to utilize it. Unless something is to be accomplished in this field that demands the most thoughtful care and [illegible]

Bell, Edison and others in telegraphy and telephony did much to pave the way for the introduction of the electric light. Such was the attitude of the public mind that companies were readily organized for central station work, and the extravagant statements of parent companies as to the performance of machinery, of their apparatus and of their manufacture, were received with a cordiality not very complimentary to the wits of investors. Manufacturers of apparatus claimed for it a high efficiency, in one case even as high as 105 per cent. Declarations were made that with the exception of brushes and commutators, which might need renewing every two years, it was practically indestructible, nay, it was even held that it would improve with use, and they set their price so high that these qualities seemed assured. They guaranteed to purchasers: First, high efficiency; second, patent protections, and, third, exclusive rights in their respective territories. They assured investors that the new light could be produced cheaper than gas, and in order to compete with gas, and increase the demand for the apparatus, they advised continual reductions in rates of service. Companies speedily organized in the larger cities, and capital smiled on electric light investments. It was soon found, however, that various so-called systems of electric lighting were extremely crowded, and the apparatus was so short lived that investments must be increased to meet the demands for improvement and for renewals, for which the parent companies made little if any discounts. Still, so confident were the local companies of success during future years and so blindly credulous in the good faith of manufacturers, that the additional capital flowed in and the parent companies were enabled to enlarge their producing powers and to increase their dividends. In the course of time it began to appear that the second claim of the parent companies, in consideration of which local companies had paid such high prices, could not be maintained. Patent protection was not given. The pioneer enterprises saw their field invaded by apparatus employing the very devices for which they had paid so liberally upon the assurance that those devices were controlled by the grantors. Meantime capital was beginning to discover that electric light investments were often bottomless abysses. The crude and imperfect apparatus, itself short lived, necessitated constant renewals, its extreme delicacy necessitated frequent costly repairs, and the cut-throat competition, instigated and supported by rival manufacturers using practically the identical apparatus, affected public confidence. Most of the profitable fields had been occupied, and although the electric light had demonstrated its desirability and superiority over gas, the rate of service was necessarily much higher, owing to the greater cost of plant, operation and maintenance. As the parent companies found themselves with immense producing powers, and without sufficient demand to employ them, the very powerful ones began to purchase the business and factories of the weaker, presumably to clear the field of competitors, and the temptation to violate their contracts with pioneer local companies proved to be strong. It was observed with a few of these systems that their purchasers had placed them in charge of their most experienced men, and after fortifying the weak points by the use of their own special devices, intending to sell this apparatus at greatly reduced prices in fields already fully occupied by their own apparatus, which had been bought at high prices by companies to whom they had promised protection of all kinds. What treachery can be more abominable for those who have borne the brunt of the new industry, struggling for a foothold, who had literally enriched parent companies by their own pleading, who had created the demand for apparatus that the parent companies had to sell and who through their own experience had shown inventors and manufacturers wherein their apparatus could be improved and cheapened. But worse treachery followed. The most outspoken enemy of the electric light has always been gas. The gas companies were heavy corporations who had fully occupied the field of lighting for many years and had fattened upon the profits yielded by the industry of which they had a monopoly and which required a plant comparatively simple in construction, easily and cheaply operated and maintained and employing raw material, the residual products of which were made to yield a handsome revenue. When the electric light entered the field it labored under the enormous disadvantages of costly, complicated and imperfect apparatus, unknown operating expenses and depreciation and no by-products. Yet the gas interests, recognizing the new light as a formidable rival, fought it in every way available to a long established powerful and wealthy monopoly. The parent electric companies were bitter in their denunciation of the methods employed by the gas interests in their efforts to prevent the establishment of the new industry, and until their revenues from local companies began to fail, assisted the latter in the struggle in every way which did not seriously affect their pockets. At the present time, Mr. President, the condition of affairs is changed. The gas interests are still opposed to the electric light. But as this has shown that it has come to stay, gas companies all over the world are preparing for a new effort. They will wage war with our weapons—with cheap apparatus furnished them by our parent companies. They will endeavor to demoralize the field of electric lighting so that legitimate business cannot stand the strain. [illegible] are selling to the gas interests—and they have the effrontery in their advertisements to boast of their success—apparatus that employs the very devices whose exclusive control had been guaranteed to the interests that the new purchasers are straining every nerve to kill. And [illegible] at a most critical period, when depreciation is becoming known at its full value, when, owing to [illegible] are at [illegible] there is a strong tendency on the [illegible] of the central station to [illegible] and reduce their rights. The manufacturing companies are indirectly and directly promoting this tendency and are [illegible]

local companies of that profitable service which they themselves have created. To the one hundred thousand stockholders in the local companies of America is chiefly due the establishment of the new industry. They have produced the sinews of war, and by them the battle has been fought and won. From them parent companies have derived support which has made them what they are. For this veteran service and this timely support what return do parent companies make? Having possessed themselves of many millions of our hard earned money, they are now violating their most sacred obligation and betraying us to the enemy. You, Mr. President, like Agricola Senex in the fables have nurtured a viper in your bosom. You have created a Frankenstein monster, who now turns his hand against you, and I warn you, central station men of America, that if you would save your millions you must prepare to carry the war into Africa with respect both to the gas and to the parent companies. These two interests, with their pronounced porcine proclivities in common, must both be considered in this connection. The gas companies have, not without a certain assurance, fought well to concede to us the period of experimentation, believing that through the treachery of the parent companies they could easily step in and capture the business when its permanent value became known. But, if to them we seem vulnerable on account of the prices which we have paid for apparatus, let us not forget that they too have their undipped heel. Their plants also can be duplicated at much less than their original cost and by improved processes their rates can generally be greatly reduced and still leave a larger margin of profit than most of us enjoy. Indeed the gas field is a most attractive one. For while gas is fast losing its place as the leading illuminant, it is certain to be the fuel of the future, and fuel will always be more generally and largely used than light. Fuel is everywhere a necessity, while light is largely a luxury. I therefore advise everyone interested in electrical central stations to investigate the gas business, subscribe for the gas journals and let slip no opportunity to gather information regarding this great industry.

With regard to the parent companies I will say that you central station men, who have created these companies, have the power to check their rapacity, and if need be to destroy it. Your interests are identical. You have a peculiar element of strength in that you do not seek to serve the same customers and can therefore never be brought into conflict with each other. Your investments now aggregate upward of one hundred millions, with stockholders among the best business men, the leading men of affairs in America. You have the power to inaugurate a movement and carry it forward, which will be irresistible. Why should this army of producers, with its one hundred millions of active and productive property, and its inexhaustible resources submit to the extortions and treacherous attacks of a few syndicates who are little more than brokers in material, whose bona fide investments aggregate about twenty-five millions, and whose factories can be duplicated, yes and generally improved upon, for one-half that sum. Let us enter into a compact whereby we will pledge ourselves to purchase apparatus only of those companies who will treat us fairly, and in case we cannot get such fair treatment, in case we are met by a combination, a trust or a pool on the other side, let us pledge our united support to a new manufacturing enterprise which will enter the field with this guaranteed business to rest upon, and, Mr. President, if, as a last resource, if the worst come to the worst, let us with our upward of one hundred millions of investment call into a common fund from one to five, ten or even twenty per cent. on our investments, and standardize our apparatus and do our own manufacturing. You well know that there is already upward of twelve millions pledged in writing to this movement.

JUDGE ARMSTRONG: I have listened with a great deal of interest to what has publicly been expressed and so ably presented by Mr. Weeks. Since I have been a member of this association this one question has been discussed with more vigor outside the meetings of the aasociation than any other question, and indeed it should be discussed not only outside but inside, because these very evils are the most dangerous things that we have to encounter in this business in which we are engaged. Now, there should be no conflict of interests, there should be no throat-cutting in this, because it is absolutely essential that we establish firmly this industry. Now, it is not a desirable thing that any of these methods that Mr. Weeks suggests should be engaged in by us as corporations or individuals. As I understand it, when this committee was first appointed at Kansas City, it was with the idea of formulating some plan, doing something, only, however, because it was supposed that central station men would come to them with suggestions and explanations and experiences, so that we might, before this, have gone on to prepare against this day that seems now upon us. I am heartily in favor of taking the most vigorous method, using the strongest possible means that we can, firmly to establish our business, and I am more in favor of that from the reason that any such act cannot by any possibility hurt any legitimate enterprise. If that be so, no man can condemn what we suggest doing to-day.

C. H. WILMERDING: I do not think that any central station man can differ with Mr. Weeks and Judge Armstrong on this point. We all know what experience some of us have had. Personally, I cannot say that we have suffered very much, and a combination such as has been suggested would take care of the future.

M. J. FRANCISCO: I am rather peculiarly situated on this question. I have been hauled over the coals for the last two years for this very thing. I have been furnishing light at about one-third of the cost of producing it on account of this kind of guerilla warfare. So that I know something about it from actual experience. This movement is not, as I look at it, a warfare. It is simply self-protection. We want them to comply with the agreement they made with us and we want the power, if they do not do it, to compel them to do it. I have, unfortunately, been drawn into this controversy about municipal lighting.

The same principle is involved there that is involved here. A city gets the idea that it can produce light for about half the price it pays corporations. Some parent company goes to the officers of the city and proposes to put in a plant—not only to furnish the city lighting, but to do commercial business in direct opposition to the local company, whose capital is invested and whose rights the city has guaranteed by contract. Now after the company has invested millions of dollars in property, this parent company tells the city that it can produce its lights for half of what the local company is charging for them.

Mr. Wilmerding speaks of Chicago. I saw there was a bill introduced in the Illinois legislature allowing the city of Chicago not only to produce its own lights but to furnish commercial lighting all over the city in direct competition with the local companies there. Everybody knows that if the city can tax you and me to make up the deficiency that it can wipe out any local company no matter how large its capital.

T. CARPENTER SMITH: I have listened with a great deal of interest to Mr. Weeks Judge Armstrong and Mr. Francisco's remarks. I was very much interested in the proposition of Mr. Weeks to form a company for the manufacture of apparatus. I think that in that suggestion there is a weapon that lies ready to the hand of every central station man. We know that there is enough machinery on which the patents have entirely run out which can be used for nine-tenths of the lighting in an electric light station, referring more particularly to arc apparatus. The principal feature in an arc machine which has been used to sell apparatus more than any other is that of a good regulator I have had some little experience in arc lighting, and I have found that the best regulator of an arc machine is a good big load. Now I think that there is not a central station in the country but that has bought and paid for enough patent regulators to take care of all their small circuits, and I think if this committee put in the hands of every central station information that would enable it to buy machines which would run its full circuits, and let it keep those for which it has already paid heavy prices, to run its cut circuits, that you have got a weapon to bring the parent companies to a sense of what it means to lose nine-tenths of their business at once.

MR. WEEKS: I move that the committee on relations between parent and sub-companies be instructed to formulate a definite plan of procedure for the protection of the central station companies, and prepare the necessary articles of agreement, and report the same to the association in executive session at its next convention.

The motion was adopted. It was also decided upon motion of Mr. Nichols that the report of the committee and the discussion should be printed and distributed at the earliest moment.

H. M. SWEETLAND: In the absence of Mr. De Camp I have been requested to submit the following report relative to the comparison of economy in the generation of power.

REPORT OF THE COMMITTEE ON DATA.—COMPARISON OF ECONOMY IN THE GENERATION OF POWER.

BY A. J. DE CAMP.

Your committee finds almost a universal opinion among managers of electric light stations that it is impossible to record actual expense in generating power for this service, owing to the fact of frequent changes of load and short, irregular runs. The aggregate coal bills from week to week may be compared with the charges made for lights delivered, but whether this aggregate compares favorably with the coal actually necessary to perform this work or whether it be twice the amount necessary is often considered an unanswerable question. In most instances where records are kept, the date begins and ends with the number of pounds of coal burned and the number of lights delivered, no attempt having been made to record the performance of boilers and engines separately, and while the data furnished might prove the economical operation of the aggregate plant, they often show a wide margin for waste, which may be either in the boiler, engine or dynamo room.

The committee is therefore confronted with this fact: A large majority of the stations do not make records of the performance of their machinery in sufficient detail to be of service in a matter of comparison, and while many reports have been received covering fully the work contemplated, sufficient data have not been received to form a complete report that can be submitted at this meeting. The work of the committee must therefore be directed to the encouragement of simple duty tests, and if we may suggest it, to plain directions for such tests. Until it shall have been made a part of the routine work of a central station to keep these records, the duty tests will continue to be the "mole hill mountain" of the management, and the difficulty in making these records will be over-estimated. Once entered upon, the simplicity of the work is apparent, and the management finds this report as indispensable as the others.

In this respect the work of the committee has been misunderstood. We do not advocate a brake and engine indicator on every piece of machinery, or a corps of clerks and experts to make instantaneous comparisons of coal with power developed, but we urge that every piece of machinery should be frequently tested, and records of performances made. When we remember that the entire paraphernalia for a test of evaporation of boilers consists of a barrel, a pair of scales, a thermometer and an intelligent engineer, the simplicity of the work becomes apparent, and when the test once made develops the fact that we are only evaporating six pounds of water where the boiler manufacturers guarantee eleven, the advantage of the test is plainly seen in dollars and cents. Many errors creep into the boiler room that are not observed until the test of evaporation stirs up a careful search. Then the boiler settings may be found incorrect, the draft imperfect or not properly regulated, or the firing may be done in such a manner that the coal wasted exceeds the coal used. If this fact and the simple test of the amount of steam used in the engine can become more general, the work of this committee can be made more comprehensive and individual benefits can be derived, fully compensating for the work involved.

That our report is not completed and our work finished is partially the fault of the committee. Our circulars asked plain questions, which have received careful attention at the hands of the central station men and replies have been prompt and co-operation all that the committee could desire, but we have failed to show a sufficiently definite object, to sufficiently urge the making of a few simple tests where no records are kept, and to prove conclusively the advantages of the tests to every manager independent of any organization.

We suggest a continued effort. A growing interest in this work has been awakened and it is only necessary to make persistent effort to secure the results hoped for when this work was undertaken.

When the National Electric Light association shall have recorded two thousand water tube boilers in use in this service, five per cent. of which are evaporating ten pounds of water per pound of combustible, ten per cent. evaporating eight pounds and eighty five per cent. averaging only six or seven pounds, the importance of this work will be apparent, and when the records of this association show four thousand automatic, high-speed engines in use, guaranteed to deliver one horse power for one hour with eighteen pounds of water or steam, when running condensing, using from this amount to twenty-five or thirty pounds for this service, the manager will include among the reports from his assistants the data necessary to this work. The time will come when this association will make these tests for the benefit of its members.

One electric company has found it advantageous to make a thorough test of all the leading steam engines and boilers offered for this service. Our organization offers great advantages over individual or corporate enterprises in this direction. We have almost every type of equipment in use, and it only remains to record the performances to make the advantage of membership in this organization as apparent from a purely financial basis as it now is on the basis of education and social enjoyment.

The report was adopted and the committee continued.

WORLD'S COLUMBIAN EXPOSITION.

THE PRESIDENT: The report of the committee on World's Fair is the next order. If there is no report from that committee, Director-General Davis has sent here as a representative of the World's Fair the secretary of the Department of Electricity, Mr. Hornsby.

MR. HORNSBY: The World's Columbian Exposition was very much pleased at the action taken some time ago by your association in the appointment of a committee on World's Fair. That courtesy is responsible for my presence here to-day as the commissioned officer of the World's Fair representing especially the electrical department. I had intended reading a paper on the subject of the World's Fair as a whole. You are, however, technical people, and instead of reading a paper I will try to explain to you what is contemplated for the fair generally and the electrical department.

Mr. Hornsby here produced a map of the grounds, pointed out the sites of the several buildings, described their principal features and then gave a detailed account of the plans of the electrical building. Continuing he said:

The building for the electric power plant occupies a larger scope than it did. An electric intermural railway will traverse the entire length of the ground—about a mile and three-quarters. The road will be about three miles long. Electrically propelled elevators will be in all of the buildings. Everything that is done in the shape of power will be by electrical transmission. This will be an expensive plant. The companies engaged in the supply of power and light will be asked to build modern lighting and power stations of their own, after their own plans, to be approved only by the exposition management. The distribution will be in three directions. One tunnel will pass through the mines building, the transportation building and its annex, the Horticultural building and the woman's building; these will be supplied from one source. Another tunnel will strike the corner of the mines building, and pass through to the electricity building, and from it over the bridge crossing the canal, down through the manufactures building, the government building, the fisheries building, and the pier on which will be casinos, statues, fountains, etc. A short tunnel will be built from the power house, going first through machinery hall, crossing the bridge, entering through the agricultural building and annex, the sawmills, which will be run entirely by electrically transmitted power, the Forestry building and the dairy. From this plant will be served 8,000 arc lamps, 85,000 incandescent lamps and 4,000 horse power for the operation of the machinery belonging to exhibitors.

All of the grounds and buildings will be lighted by electricity. In our own building I have recently finished the plan. We will require in that building, and have arranged for, 800 horse power for the running of exhibits, aside from the operation of exhibits from the exhibitors' own plants, which will be located here as well. There will be one 2,000 candle power lamp to 1,000 square feet of space. In addition to that, in the center of the building we will have some spectacular effects and in all of the corners. I believe 700 arc lamps will be placed in that building.

A good deal has been said in regard to the finances of

[redacted]

been subscribed by foreign governments for the maintenance of their exhibits. The South American states alone have subscribed $2,700,000 for their share.

The following named nations have already replied to the invitation sent by the United States Government: Great Britain, France, Germany, Spain, Japan, China, Mexico, Peru, Honduras, Salvador, Costa Rica, Columbia, Cuba, Guatamala, Jamaica, Nicaragua, Chili, San Domingo, Turkey, Ecuador, Denmark, Russia, Egypt, Morocco, Venezuela, Brazil, Hayti and the Argentine Republic. These are almost all we may expect. It is now eighteen months before our exposition opens. We have almost the entire world to draw from already. It is impossible to say how far we may have to go. Since the inauguration of the movement to make an exposition at Chicago it has so developed that the amounts of money already set apart up to a year ago have been found inadequate. Therefore an extra $5,000,000 is being provided by subscription in Chicago, and a loan of $5,000,000 is being arranged for with the United States Government, increasing the resources of the World's Fair to $42,000,000.

So far as we are concerned ourselves, the electrical department has been divided, the service being absolutely separated from the exhibition department. All of the exhibition will be under the superintendence of the chief of the department of electricity. Everything electrical in the exposition will be on exhibition. It was contemplated originally to install a power plant proportioned to the good will of the electrical people. The management of the exposition thought it would be impossible on account of the interest taken in the exposition to have the electrical people donate for the use of the exposition enough apparatus and enough talent to serve the purposes contemplated. By the hardest work and the closest application of the electrical department we have made it appear advantageously and certainly for the benefit of the electrical people that that course would not be in accord with their wishes. Their interest would be dampened if such a procedure were to be inaugurated. Therefore we have been successful in having this plant installed purely as a business proposition, the idea being to demonstrate the economy of an electrical service over that which was contemplated before—steam and gas. To that extent we have been successful, and after the Columbian Exposition I think that we will be able to demonstrate fully all that has been claimed for electricity on the score of economy, comfort and luxury, if you please.

On motion of Mr. Francisco a vote of thanks was tendered to the secretary of the Columbian Exposition for the full, interesting and explicit explanation and description of the plans for the Columbian Fair.

MR. HORNSBY: There is one other matter I contemplated speaking about, but neglected. I have been in correspondence for six months or thereabouts with electrical people in all parts of the world relative to the holding in Chicago in 1893 of an International Electrical Congress. I have arrived at a point in our correspondence and negotiation at which I can say that the project is in the way of being successful beyond our highest hopes. We look for the presence in Chicago at that time of the ablest men in the greatest profession now in existence. The Europeans have promised to have their very highest authorities with us. The best of the electrical people of this country are heart and soul with us. The representatives of the societies in this country and in Europe have signified their intention of taking active hold of the matter of holding this International Electrical Congress. The question has come up whether this should be done through the World's Columbian Exposition or whether it should be done by the various societies. As the representative of the electrical department, as its accredited commissioner to this convention, I will say that the exposition management stands ready now and at all times to aid such a movement in any way. A provision has been made in the report of the presiding officer of the exposition management, which will be read before Congress next winter, with a view to having the government of the United States take official notice of the contemplated electrical congress. The management of the exposition has already acquiesced in the proposition to build a hall for the holding of this congress on the exposition grounds. No money will be spared by the management to make the congress in every way a successful one, and I hope that at this meeting of this association—strong, powerful, prominent, representative as it is—some action will be taken.

T. C. MARTIN: Mr. Hornsby in his remarks has made reference to the work of the American Institute of Electrical Engineers in connection with [redacted] think I may briefly state what has been done, and then, if you will allow me, suggest that this [redacted] somewhat similar lines.

Two and a half years [redacted] was known that the World's [redacted] when some of us [redacted] American Institute of Electrical Engineers, taking time by the forelock, appointed a committee to secure the holding of an electrical congress [redacted] congress was then [redacted]

Exposition, and we sent delegates to that congress. Those delegates—some of our most prominent electrical engineers and inventors, among them being Mr. Edison, Prof. Elihu Thomson and others of that rank—extended in the name of the institute to the delegates to that electrical congress an invitation to attend such a congress in this country during the Columbian Fair year. The invitation was received and accepted. During the present year another congress of like nature is being held at Frankfort in Germany. That congress in France was held under the auspices, first, of the French government and of the exposition authorities, and secondly, under the auspices of the French society. A similar procedure prevails at the present time in Germany with regard to the conference there and it is being held under the auspices of the government and with the direct support and aid of the German society. Now I think that Mr. Hornsby has outlined to us just such a line of action for work in this country. It is proposed on the part of the institute to work, as far as lies in our power, with the World's Fair authorities, and we think that with the assistance and co operation of such powerful bodies as this the congress in Chicago in 1893 will not only be the most memorable but the most useful of all the congresses that have been held up to date. I suggest that a committee be appointed that will commit this association unreservedly to the support of the World's Fair and make the movement in Chicago and the congress a success.

The committee on World's Fair was discharged, and the chair appointed a committee consisting of B. E. Sunny of Chicago, S. G. Coleman of Milwaukee, Mr. Hart of New Orleans, F. W. Royce of Washington, D. C., and C. W. Price, New York.

Data on Electric Lighting.

Mr. Weeks: My attention has been called to a clipping from one of the Kansas City papers regarding the price of street lighting in various cities of the country, and I take it that if data are to have any value whatever they should be accurate, and I am very sorry to see that the data that are given by the Census Department in Census Bulletin No. 100 are not accurate. For instance the statement is made that in San Francisco the price is $440.67 for one arc lamp for one year and in Denver $58.46. Those statements are made simply without any qualification whatever. I happen to be familiar with the facts in both cases, and I know that there is absolutely no foundation for those statements, and I think that it is but just to our good friends Rollins of Denver and Roe of San Francisco, that that statement be corrected. The facts are that in San Francisco, where, it should be remembered, coal is $7.00 a ton, the highest price paid for any one lamp per year is $361.90, and that is a four thousand candle power lamp maintained at a point remote from the central station with a considerable mileage of circuit in order to reach that point of course; and instead of being so generous as one would infer Brother Rollins has been in Denver to give them an arc lamp for $58.46 his good business sense has led him to do quite otherwise. The rate that he gets there is $150 within a certain radius and $216 outside and for tower lighting—two very different propositions.

I have had occasion to look into the question of distribution quite extensively of late, and I find that the distribution of municipal light ranges all the way from eight and six-tenths lamps per mile of line down to one lamp per mile of line.

Mr. Francisco: In the information which has been disseminated through the country for the use of municipalities important facts have not been mentioned. In one article which I read I saw the statement published that Boston had to pay $180 per year, while Ypsilanti only paid $13. That would carry the idea that the citizens of Boston were being outrageously swindled, whereas the fact is that Ypsilanti uses water power, while Boston uses steam power. You cannot make a good comparison without such facts before you.

A. [illegible] Some of you may think it strange, but the fact is that a great many central station companies do not know anything about the mileage of the circuit. Knowing how difficult these things were to reach, and knowing the necessity, the supreme importance of having these figures correct when published, I have induced the superintendent of the census to appoint Mr. Foster as a special agent to visit central stations in the state of New York, go over the schedules with them, correct and verify their statements, and lend his assistance to them in filling out those schedules, so that I may feel when I have the [illegible] I have something which is bona fide, something which is reliable and which can be accepted as an authority by the people of this country on that question. That work will be pushed to completion as [illegible] I hope that every man that Mr. Foster may call upon will see the importance of laying [illegible] giving Mr. Foster the [illegible] but let [illegible] possible. Mr. Tiffany, [illegible] the theory that [illegible]

[illegible]

the chairman of the committee so that it could be formulated and submitted here. In my own state the legislature was so busy with political matters, fortunately as to leave us almost entirely alone; and I think that is about all that we need to ask in the way of legislation.

Mr. Wilmerding: In Illinois, at the last session of the legislature, there were a great many bills introduced with a view to knocking out our interests. One bill was the one referred to by Mr. Francisco, by which the city and towns were authorized to carry on a commercial lighting business, not only with electricity, but with gas. That bill died in the committee. There was another bill introduced to the effect that no wire should be operated in the state carrying a voltage of more than one thousand volts. That also died in the committee. We were fortunate in having one or two friends in the legislature who had influence enough to knock out those things.

Mr. Francisco read the following report:

Underground Conduits.

BY M. J. FRANCISCO.

In behalf of the committee on underground conduits, I have to say that we found the subject of underground conduits was one that was liable to involve much study. We have collected a good deal of information, but the time has been so short that we confess it has been impossible to get all the matter that we had prepared the report on, ready at this meeting. I have been in correspondence with parties in London with regard to the entire underground conduit business of London, but the report that I expected to have here to-day has not yet arrived on account of the time being so short in which to get the correspondence back and forth. The same statement is true with regard to several places in the United States. Therefore we did not feel like making a report which contained merely a partial statement of facts, because several central station companies had stated to me that they do not want anything but facts, and that they want to base their calculations upon what we find to be facts. The position that the committee has taken is, that if there is a system of underground wiring that is practicable and proper, we want to find out what is the best system and then leave those that want to adopt it, upon the information which we may obtain, to decide as to that which is the best, the most practicable and the most serviceable.

The committee were continued, and requested to report at the next meeting.

The committee on safe wiring presented a report, which was referred to the executive session.

Mr. Law: As I was instrumental in preparing those rules for safe wiring I wish to call the attention of the convention to the fact that it is divided into three sections. I have found some misunderstanding with regard to that. One section says what you shall do, another section says what you shall not do, and another section says what you should do. Perhaps some of these sections that may look a little bit obnoxious to you may be those that would recommend you to do so and so, instead of saying that you shall or shall not do it.

Mr. Ayer: This is a matter of such importance that we ought not to pass upon it without having the paper before us so that we may have exact knowledge of what there is in it. As it is read before us none of us can fully understand it or take it all in. We may possibly misjudge it if we have not afforded us an opportunity to read it carefully.

Mr. Hammer: I have seen many of those reports, both across the water and on this side, and I can indorse that report as being the most complete thing of the kind that I have ever seen. It is concise. It goes right to the point. Undoubtedly there are in it some things that can be criticised by supply manufacturers, by wire men and by contractors, but an electrical engineer who has had considerable experience in applying such things from the incipient stages of electric lighting, I emphatically indorse that as being the best report of the kind I have ever seen.

The motion as amended providing that the report of the committee on safe wiring be received, and that the secretary be authorized to have it printed and copies presented to the members of the association, and that it come up for discussion "as soon as practical," was adopted.

The association adjourned to Wednesday, at 10 A. M.

Wednesday's Proceedings.

The convention was called to order at 10:20 A. M. President Huntley read a letter from the Canadian Pacific Railway company, extending to the members free telegraph privileges for social messages during their stay in Canada, over the Canadian Pacific Railway company's telegraph lines and similar privileges over the Postal Telegraph company's system.

Sir Donald A. Smith extended an invitation to the members of the association and their friends to visit him Thursday afternoon at his home from 4 until 6:30 P. M. The citizens' committee, it was announced, had arranged a trip down the Lachine Rapids. In the original programme it was designed to stop at the Indian village on the opposite side, but that was abandoned. The thanks of the association were tendered the telegraph companies and Sir Donald A. Smith.

Distribution and Care of Alternating Currents.

The President: The first regular business is the discussion on the distribution and care of alternating currents, the subject of the paper read by T. Carpenter Smith at [illegible].

Mr. L[illegible]: I most heartily indorse what Mr. Smith [illegible] of the [illegible] policy of the majority of electric [illegible] putting up street insulation, in other [illegible] part of [illegible] alternating work [illegible] for on alternat[illegible] as a rule, a [illegible] I find that in the most of cases [illegible] of renewing the fuses at the

generator and will put in a 160 or 200 ampere fuse on a machine that is only adapted to carry 130 amperes. I find that the better plan is on a 130 ampere machine to put in a 135 to 140 ampere fuse and then change it often, not waiting for it to burn out, but change it and put in a new one.

Not only should alternating lines be of good insulation, but the primaries should in all cases be fused where they branch from the main lines to the converters. It is a very common practice to bring these branches directly from the mains to the converters without any protection other than the insulation on the wire to prevent contact where one of these wires must cross the primary wires. I have seen a No. 8 wire burn off a No. 0 wire at the point where the primary loops cross the main lines. If proper fuses are placed where the branch joins the main line, it is not only a protection to your machines and converters but to life also.

When taking charge of a very large station a year and a half ago, I found a great many primary fuses removed from the converters and No. 14 copper substituted, simply because they sometimes blew out.

There is the greatest of danger in not having the primary wire fused before reaching the converter. All converters are so built that a contact between primary and secondary coils is almost impossible, but if by a short circuit in the primary, it receives a current of from 50 to 100 amperes, when it is only adapted to carry from one to five amperes, it will overheat to such an extent that it will burn any insulation which may be used. This is very liable to cross the primary and secondary wires and you have all the dangers of a high electro motive force clear to your lamp socket. Properly fusing the primary wires will obviate all this danger.

One weak point I find in alternating central station construction is the double throw switches, they are never large enough to break the arc which they are sometimes required to do, for it is not only to break the usual load of from 50 to 75 amperes on each circuit, but in case of a short circuit or ground it may reach three or four times that amount and the fire and noise produced in a break of that kind is only realized by those who actually perform the operation.

Likewise the fuses are not one-half large enough to break radially. These fuses are generally placed on the back of a wooden switch board and are a great source of danger from fire.

Mr. Francisco: Mr. Smith refers to underground and overhead wires. Now in the work in which I have been engaged for the last six months relating to underground construction I have had a chance to meet this point of overhead and underground work very generally, and my experience is that one-half of the trouble we have had in regard to both has been from the loose, miserable manner in which the overhead wires were put up. If the electric light companies themselves had thoroughly installed their plants and run their wires in a proper manner, spending perhaps what they have for underground work, we would not have had one-half of the trouble we have at the present time. In several cities I have visited the officials themselves have said, "Why, if you people would put your wires overhead in proper shape we would not have commenced this raid. But here are these wires strung in a slip-shod, haphazard manner without any system or care, and in many cases without any real insulation, and of course we have to protect the public. We are here as officials to protect the public, and naturally if you will not take the initiatory steps to protect it we have got to compel you to."

There is one other point here that Mr. Smith speaks of in regard to lights running on contract and meter. On one occasion I walked into a man's establishment and the lights were burning. He had the whole place illuminated. "Is anything the matter?" he said. I replied, "No, nothing at all, I wanted to see how these lights were burning. They seem to be running very fine." He looked at me and he happened to think that perhaps it was after the time that they should be burning. "Well," he said, "I happened to step in here to-night to turn them off." The next night I passed there at the same hour and he happened to step in and turn them off. I followed that up for about a week and I noticed he happened in there every night and he remained there until 12 o'clock. Of course if you charged that man for extra hours you would have trouble at once. But with this meter on you can tell the man distinctly, "You may burn as many hours as you please; you simply pay for what you use;" and that is all there is of it. That is the true basis of all electric light business, I think—to have a meter and control your business absolutely in that way.

Mr. Law: I will relate a circumstance respecting one of the methods of keeping the meters. A customer once pried up the cover of the meter sufficiently to introduce three or four spiders. A few spider webs in there were all that was necessary to retard the meter. I traced this matter down and found that he actually pried up the cover and introduced the spiders.

Mr. Francisco: Mr. Law's remark on that reminds me of a thing that occurred in my experience. I found that this plan of prying up the meter was adopted. I applied a small wire so that when he pried up the meter and had a short circuit he never repeated it.

Mr. Ayer: In Mr. Smith's paper I see no allusion to a thing that seems to me a question as to the location of the cut-out on the fuse. Some of the manufacturers take the position that those things should be separate and independent of the converter and left on the outside and should not be incorporated in the converter box. We know that the practice with others is to put them in.

T. Carpenter Smith: I would say in regard to the placing of fuses in converters that our experience has been that, as a rule, there is little trouble with the primary fuse in the converter except when you want to replace it, and then it is usually a very ugly job. We have for some time left the secondary fuse out and we have always followed the practice of putting a cut out immediately at the con-

verter, but on the outside of the converter, and we found that we had a great deal of trouble with the secondary fuses from the fact that it is a heavy fuse and the contacts not large enough. It is difficult to get contacts that will last three or four months without being corroded. We therefore put copper in those fuses and depended entirely on the cut-out which is immediately outside the converter. On the primary, in some cases, for large buildings, we put cut-outs on the pole and still kept the fuses in the primary end. But we had very little trouble with the primary fuse except in the case of short circuits, in which case the primary fuse always went. We never had any trouble with a short circuit from the blowing of the primary fuse, but I believe others have had that trouble. There are converters now made in which the primary fuses are put on a separate plug and that plug is pushed in and can be taken out and the fuses replaced without touching any high tension wires or connections with the current on. That has another value, which is that the fuses, if required, can be soldered into the plug, and spare plugs can be kept on hand, while a lineman can go around once a week or a month, or as often as is thought necessary, and by working the plugs keep the contact clean and free of corrosion, keeping a great deal of heat out of the fuses. If the light merely winks on the changing of a switch, he looks up, thinks the light is steady again, and he is convinced perhaps he was mistaken, and he does not take any further notice of it. But in a large house where large quantities of goods are handled, it is very awkward to have the light stop four or five seconds.

MR. AYER: The point that I wanted to get at is leaving the cut-out and fuse outside the converter box. It perhaps has some value in a short circuit coming on the loop. Bringing about a short circuit will only blow the fuse which is placed in the cut-out of the pole, where, in the event of the cut-out being incorporated in the converter box, the primary fuse, in that case, would undoubtedly blow a fuse in the main feeder, and also leave a dangerous condition of affairs on the wires. The cost of construction is very much greater where the separate box is used, and it is a question whether it is desirable, to obviate this danger of short circuiting on the loop. The converters may be placed on the, pole and there would, in that case, be room for cut-outs. That would place the fuse at the point where it would protect the public as well as the feeders. But I do not see the utility of separating the devices. It seems to me that the one box should contain both, and they could be arranged to do it properly. Different manufacturers take different views—some favor incorporating them in the converter box with the converter, while others believe in leaving them out.

MR. SCOTT: There are troubles about converter fuses even when they are carefully watched. About two years ago we had one converter that was persistently blowing its fuse. I told the lineman to bring it to the station. The base under the screw head of the fuse connection showed a mark indicating that the fuse had melted there. The screw had become loose either by the swaying of the pole or the humming of the converter, I have never been able to determine which. The vibration of the screw had formed an arc which had melted that fuse. The brass had become red hot, and the switch-board below it was completely charred for about half an inch behind it, so that the screw and its base were ready to fall through. After that we made our linemen examine our fuses every thirty days. With secondary fuses I never have known of an accident to one blowing during a thunderstorm. Sometimes a whole loop of 18 or 20 converters will have its primaries blown. People are tempted to get small sizes on account of economy, and place them on a line where they have three or four lights to supply. For instance, a five-light converter will be put up. The lineman comes along and finds that the fuse wants attention. He has a ten ampere fuse in his pocket and he puts it in. During a thunderstorm, the lightning or the static electricity on that line attacks that converter, and it finds it easier to burn out that No. 20 or 22 wire than to burn the ten ampere fuse. Consequently the primary coil is gone and the converter has to be taken down. These troubles with the coil are generally six inches or a foot from the beginning of the coil. I never found an instance where the lightning traversed the complete circuit. If the coil is attacked it will be broken before it has taken the complete circle, and by just taking off the tape and paper that can be taken out the converter will work just as well. I do not see the use of buying a primary coil, to work after the old coil is broken. About a month ago my attention was called to a new lightning arrester. I took my lineman to the place in Philadelphia where a company had equipped its line with the lightning arresters, and I found that after equipping the line with them, they had forty-seven 20-light converters go after the 21st of July. I did not buy those arresters. I looked at the inside of those arresters and found what you might call a puddle of brass around the bottom of the connections. There are transformers which have the primary and secondary fuse connections both on a wooden block inside a sort of box. If the primary fuse is attacked the secondary is bound to go. The short circuit is so complete that it burns the wooden block, and the whole inside seems to fall down. But by sending a man around at least once a month to tighten up the screws under the fuses, or to replace the fuses where they show any oxidization, and keep them in good order, I do not think there is any trouble with them. I do not feel inclined to pay for a twenty light converter when I have three lamps to install on account of the lightning.

T. CARPENTER SMITH: I know of one case where a house was wired for 127 lamps, but they actually used not more than ten lamps, and those only for a few hours in the evening. When the installation was first put in, the customer was very anxious to have the lights arranged so that he could turn them all on if he wanted to, and three 40 light converters were installed for him. At the opening the whole house was lit up, and his meter for the first month was a sight to bring joy to the heart of the company. But in about two months his bill got off so much that one day when a lineman wanted a 40 light converter for another customer he thought it would be safe to take out one of those converters, and he did so. A few weeks after that a second converter, and then a third was taken out, and he put in in their place a 20 light converter, and I do not think that the fuse in that converter has ever been blown since. He changed the meter from an 80 light meter to a 20 light meter, and the customers' bills are just about the same right straight along. Some time I suppose that he will give a party, and may then be left in darkness, but that is his fault.

MR. LEONARD: Was it in multiple arc?

MR. SMITH: It was not in multiple arc. The owner of the house was willing to pay a very good price for his wiring, and he had his house wired in three circuits—that is, all the side lights in a room were on one circuit, all the chandelier lights were on another circuit, and all his hall lights and the lights that were used at odd times were on the third circuit, and these were coupled up to the three separate converters. Of course when the lineman commenced to rob him of the converters he put a couple of circuits together, and the three circuits are now run on the one converter.

THE PRESIDENT: If there be no further discussion on that subject we will take up the paper by George A. Redman of Rochester, N. Y., entitled "Central Stations Operated by Water Power."

CENTRAL STATIONS OPERATED BY WATER POWER.

BY GEO. A. REDMAN.

The purpose of my paper is more to give a description of what is being done with water power for electrical purposes in the city of Rochester by the three different electric light companies doing business in that city, and some of my own experience with water power, than to take up your valuable time with the technical description of turbines, which can be gleaned from any of the numerous catalogues of turbine manufacturers, which contain full descriptions of turbines and their construction.

The adaptation of water power for electrical purposes has grown very rapidly within the past few years. There are several causes operating to enhance the value of water power, none more so than that of electricity.

Streams that have had no pecuniary value heretofore are now being utilized for the purpose of running electrical machinery, yet at the same time the supply of water is diminishing, caused by the destruction of forests, and water right owners in various parts of the country are devising means of storing water during the rainy seasons to furnish a supply during the dry season, also storing it in the daytime for night use. One large water right owner in Western New York, during the months of July and August, places flash boards two and one-half feet high on top of his dam, at an expense of $100, and stores up for night use the water which it is not necessary for him to use in the daytime, thereby saving in the two months an amount equivalent to a coal bill of $1,100.

The Johnstown, N. Y., Electric Light company has improved its water power at the Cuyadota Falls by erecting a dam 34 feet high on top of the falls, giving a total head of 75 feet and nearly doubling the amount of power. A survey of the upper Genessee river, between Mount Morris, N. Y., and the celebrated Portage Falls, has been made during the past year for the purpose of establishing a reservoir that will furnish the city of Rochester 30,000 horse power more daily during the entire year than it has at present.

The earliest forms of water wheels were the paddle and flutter wheels that only utilized the impulsive action of the water; these were followed by simpler wheels of the reaction type and others. We now have the improved forms of the Leffel, Victor, Lesner, Success and many others. There is a demand for the best and most economical turbine that can be manufactured.

Turbines should be built to secure the delivery of the water upon the turbine without checking the velocity of the water more than one-third, and permit the free discharge of same after passing through the turbine, and to work with as good efficiency under part gate as under full gate, and to be made of the best phosphor bronze, to stand the wear and tear under high heads. It is essential in locating central stations to be run by water power, to locate them where there is no great danger of a flood, or so protected by a breakwater as to make it perfectly safe, and also to avoid trouble with backwater upon the turbines. Where a station is situated on the bank of a river it is best to take the water from the river by means of a raceway, with the headgates parallel with the flow of the water, and at times of a freshet or running of anchor ice it will more than pay any expense incurred by so doing. The raceway should be of sufficient depth and width to permit the water to flow not more than 90 feet per minute, and a waste gate should be placed in the side or end of the race to be used in case of emergency; and when cleaning out the raceway a rack should be built across the race to prevent driftwood and other rubbish from passing into the turbines. For that purpose I would recommend a rack built of iron slats two inches wide, one-eighth of an inch thick, and placed five-eighths of an inch apart on seven eighth inch iron rods, at an angle of 45 degrees. Particular attention should be taken to keep the rack clean by raking. A trough or platform should be placed over and immediately back of the rack to rake the rubbish and anchor ice into, and so arranged that a current of water from the race will pass through the trough and carry off all the rubbish, etc. For any station that is using 100 horse power or over, it will be a great saving in labor, and pay well for the extra expense. For winter service a boom should be placed in front of the headgates, and the current will carry off a large portion of the anchor ice and other floating objects. The headgates should be built to work with a rack and pinion; also a roller should be placed back of each gate stem to facilitate the handling of the gate. The gates should have a protection built over them, to protect the gearing from storms. In a cold climate, where the gates are apt to be frozen in, salt is essential in freeing them from ice; all

[illegible] to three feet of dead water when the wheels are not in motion. [illegible] floor of that material will soon pay for itself.

[illegible] very high heads, or to conform to location, it becomes necessary [illegible] water away from the turbines, through a draft tube; the same depth of pit and area of discharge is required where a draft tube is used, as would be when the turbines are set at the bottom of the fall; the mouth of the draft tube [illegible] tail water. It is claimed that draft tubes can be used 30 feet in length, [illegible] feet in length should be used on account of the difficulty in keeping the tube air-tight, for if the tube leaks the vacuum is imperfect and there will be a great loss of power, and where steps are used they will be apt to be burned out. When possible, I would advise horizontal turbines to be used, as they are [illegible] are used without any steps. The burning out of steps is an expense and annoyance. One of the greatest advantages in the horizontal turbine is that the dynamo can be belted direct to the turbine shafting, and is in some cases coupled direct to turbine, making a good percentage in economy in power and avoiding the use of gearing. I deem it advisable to put in a number of small turbines, instead of one large one; in case of a break down, they are more easily repaired and cause less delay to customers. In the old station of the Brush Electric Light company of Rochester the vertical turbines caused considerable annoyance in the burning out of steps and stripping of the gears; so much so, that it became necessary to support the vertical shafting with water cushions. For wooden steps we have had the best success with lignum vitæ.

In my opinion, governors for the turbines are necessary and will govern any slight variation of load under high head, but where one-third or over of the load is thrown off or on suddenly, it is necessary to handle the gate by hand, as under the above circumstances the turbine is apt to slack down or run far above the normal speed, as the case may be; in the latter case causing the burning out of lamps and armatures. The governors should be placed as near the turbines as possible to save lost motion in the gate shafting and avoid the use of gearing as much as possible. We have two governors in use in our office building under a low head of 16 feet, and they govern the turbines under all circumstances in quite a satisfactory manner.

The decided advantage of a water power station over one run by steam power is not only one of economy in the saving of the expense of coal, but the station and apparatus can be kept cleaner and cooler, thereby saving considerable in expense of repairs, and it is also far more pleasant for the employes.

The Brush Electric Light company of Rochester purchased the entire lower falls of the Genessee river, which are about two miles from the business center of the city, some nine years ago. At that time it was looked upon by many as a piece of folly, to think of running dynamos there, on account of the distance from the business center of the city and the dampness around the falls. Notwithstanding the adverse opinions, the company erected two buildings on the west side of the river above and near the brink of the falls, and put in two 30½ inch Leffel, two 20 inch Victors and one 40 inch Leffel turbine, the first four mentioned turbines, under 94 feet head, and the latter under 28 feet head, with a total of 2,500 horse power. After running this power for five years it built a new station, and leased the old power to different parties for pulp and flour mill purposes.

The new station is a three story stone building, 45 feet wide and 90 feet long with a two story brick addition 42 feet wide and 80 feet long, and located at the foot of the falls on the east side of the river. The turbine capacity consists of 15 double 15 inch horizontal Lesner turbines under 90 foot head, with 14 foot draft tubes, a total of 3,360 horse power, using 6.95 cubic feet of water per minute per horse power; have had but one turbine damaged to any extent in four years. The turbine casings are placed on iron girders with the ends of the girders resting on solid rock.

The amount of floor space occupied by all of the turbines is 4 feet by 38 feet; the weight of each turbine is 196 lbs., less than one pound to a horse power; each turbine is placed in a separate division of the casings, and the shaftings extend through the shafting room, upon iron bridgetrees, with seven feet and six inches between journals, and the dynamos are belted direct to the turbine shafting; the shafting runs at 800 revolutions per minute, with 25 inch pulleys on the turbine shafting, and 24 inch on the dynamos. We use untried beef tallow for lubricating, and are well satisfied with its results. The turbine gate shafts and governors are placed in the dynamo room at an average distance of 14 feet from the turbines, where they are easily handled by the attendants.[1] A tell-tale is placed in the shafting room, connected to a float in the race above the falls, which shows the height of water in the race at all times.

The water is taken into the raceway, about 80 feet above the falls; the race is 32 feet wide, and five feet six inches deep, and cut through the solid rock. There are four headgates, with a house built over them; a wooden diagonal rack is placed in the race near the spillway to assist in freeing the race from anchor ice, the [illegible] deep and 32 feet long. The waste gates are [illegible] the spillway, and are three feet six inches [illegible] two of them. In front of and near the top of the [illegible]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, Editor and Publisher.
J. B. O'HARA, F. L. PERRY, W. E. KEILY, Associate Editors.
J. L. BAKER, Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK.
W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING. THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

	PAGE.
Formal Opening	157
[illegible] Address	157
Mayor [illegible] Address of Welcome	157
Sir [illegible] Address	157
[illegible] Address	157, 158
Ex-Mayor [illegible] Address	158
[illegible] Knapp's Address	158, 159
Judge Armstrong's Address	159
[illegible] Address	159, 160
President Huntley's Address	160
[illegible]	160, 161, 162
[illegible] Committee on Constitution	162
[illegible] Committee on Relations of Manufacturing and Central Station Companies, and Discussion	162, 163
[illegible] Committee on Data, Comparison of Economy in the Generation of Power, by A. J. DeCamp	163
World's Columbian Exposition—Address by J. Allan Hornsby, [illegible]	163, 164
[illegible] Lighting	164
[illegible] Currents, by M. J. Francisco	164
[illegible] T. Carpenter Smith, on the Distribution and Care of Alternating Currents, read before the [illegible]	164, 165
Central Stations Operated by Water Power, by George A. Redman, [illegible]	165, 167, 168
[illegible]	169
[illegible] Advantages of both the Con[illegible] Current Systems, by H. Ward Leonard [illegible]	169, 170
[illegible] Keeping Central Station Accounts, by [illegible]	170, 171
Three Years' Development of Electric Railways, by Eugene [illegible]	[illegible], 174
[illegible]	174, [illegible]
[illegible]	175, 176, 177
Electric Railway Construction and Operation, and a Consideration of their Connection with Central Station Interests, by [illegible]	177, [illegible]
[illegible]	[illegible]

DEPARTMENTS.

[illegible]

related to the electric railway. A complete report will appear in the WESTERN ELECTRICIAN of next week.

IN this issue is presented a stenographic report of the proceedings of the National Electric Light association convention at Montreal, embracing the papers presented and the discussion.

TO THE people of Montreal the members of the National Electric Light association are under great obligations for the hospitable reception extended. The entertainments provided were thoroughly appreciated and will always be remembered by those who enjoyed the hospitality of our Canadian neighbors.

PRESIDENT HUNTLEY'S suggestion that the midsummer conventions be abolished should receive careful consideration. The association is now firmly established, a thorough organization of central station interests has been secured, and in the minds of many the necessity for frequent meetings is no longer felt. It is quite probable that this subject will he given considerable attention at the Buffalo meeting.

THE papers presented at the Montreal convention were eminently practical, and will no doubt be read with much interest by all engaged in lighting and power station work. It is to be regretted that many of the most important papers were presented toward the close of the convention and the time at the disposal of the members would not permit as full a discussion as the papers deserved. Attention was called to this fact during the closing hours of the convention, and it was urged that hereafter more time be allotted the sessions and less devoted to entertainments and excursions. The suggestion will bear consideration.

BUFFALO has been selected as the city at which the February meeting of the association will be held. This is in keeping with the policy of the association to hold the last convention presided over by the out-going president at his home. The city is certainly well qualified to entertain the delegates, and the ability and energy that have characterized all of President Huntley's actions leave no room for doubting the success of the coming meeting. Many of the members believed that some other city farther west should be selected, but all will now be ready to assist in making the Buffalo meeting a great success.

REFERENCE has been made to the proposition to light the boulevards of Chicago by electricity. The city fathers no doubt are beginning to realize the importance of this proposed measure, for they are now endeavoring to devise means for extending the city lighting system. Provision has been made for lighting Jackson boulevard by electricity, and an ordinance will be introduced in the next meeting of the council providing for the lighting of the South Side system of boulevards by electric lights. It is proposed to pay for the improvement by local assessment, and it is expected the work will be completed within a year.

THE subject of wiring buildings free of charge for incandescent lighting was fully discussed at the Montreal convention. It was generally agreed that this practice should be discouraged and that consumers be required to assume the cost of wiring. If this latter policy were strictly adhered to, it was argued the companies would not be called upon to discontinue the supply of current for trivial causes. If the consumers were required to pay for the wiring, they would not be so ready to allow a costly plant installed at their own expense to remain idle. The representatives of companies that had been obliged to adopt the policy of free wiring to introduce electric lighting where the competition from gas companies had been particularly strong gave testimony to the trouble they had experienced in changing their policy after securing a foothold. It was generally agreed that when possible, the superiority of the electric light over gas should be relied upon to secure patronage.

ONE of the most practical and valuable of the papers read at the convention was that by George A. Redman of [illegible], who gave the assembled delegates the benefit of his experience [illegible] power in the Flower City. Mr. [illegible] to speak on this subject, and his [illegible] and suggestions that deserve the [illegible] station managers who are [illegible] water power to drive their dynamo[s].

Where power of this description is available, its advantages, both on the score of economy and desirability, are ordinarily so apparent that it is unnecessary to point them out. It is important, therefore, to possess a knowledge of the means of realizing the greatest percentage of power available and of the most economical methods of conveying it to the generators. Mr. Redman gives many practical hints bearing on both these points. Incidentally he shows that Rochester, with its three electric lighting companies, is one of the best lighted cities in the country.

ONE of the most important actions of the Montreal convention was the adoption of wiring rules prepared by the association committee after much labor and investigation. The rules embrace the provisions generally accepted by the insurance companies and when enforced no doubt will do much toward raising the standard of work in this department. There is no question that much poor work was done by the pioneers in the electric light business, but this was due as much to a lack of knowledge of the requirements of the new system of illumination as carelessness, though it must be admitted that those engaged in electrical construction work in its early days evidently did not appreciate the necessity of first-class workmanship. With experience came the knowledge that if the electrical companies hoped to continue in business they would be compelled to adopt improved methods of construction, and use only first-class material. This idea has been growing in public estimation, and to-day the electric light companies are found preparing rules in their association which guarantee an improved line of work. The action of the convention is commendable.

FOR the last two weeks the daily papers throughout the country have contained long articles in relation to the old suit of the Western Union Telegraph company against the American Bell Telephone company for an accounting on the contract which the two companies entered into in 1879, when, according to the claim of the plaintiff, the Bell company agreed to pay the Western Union a royalty of 20 per cent. in consideration of concessions in the way of patents and rights of exclusive operation. It is asserted that the referee, ex-Judge Lowell of Newton, Mass., is about to present a report in favor of the defendant and that the plaintiff will contest it on the ground that relatives of Mr. Lowell are interested in the Bell company. Dr. Norvin Green, in an interview, alleges that the Western Union company has been aggrieved by the manner in which the Bell company has violated the contract in allowing its wires to be used for telegraphic purposes and for stock quotations, and also that the plaintiff has not received the amount due it under the contract by something like $3,000,000. He disclaims, however, any intention of attempting to crush the Bell company. Further developments are expected when the report of the referee is presented. Meanwhile the average daily newspaper is prepared to rejoice and be glad which ever side is beaten.

THE lack of reliable statistics of the operations of the central power and lighting stations of the United States has often been deplored. Those engaged in the business could not fail to be greatly benefited by compilations of figures that would give the averages of expense, item by item, together with statistics of operation and returns. By comparing data collected for this purpose many managers would undoubtedly discover that, in one or more items, they were operating at a greater cost than necessary, and could take steps to reduce the expense. That statistics of this character are not available is almost entirely due to the indifference and negligence of the central station men themselves. Mr. Burleigh, in his paper on "Uniformity in Method of Keeping Central Station Accounts," read before the Montreal convention, presents an excellent method for collecting the desired information, and his plan is worthy of careful consideration by all who are not confident that they have one as good or better and this number, it can not be doubted, will embrace the great majority of central station managers. While the comparisons that could be made up, were Mr. Burleigh's plan to be generally adopted, would be largely confidential, intended primarily for the men in the business, still tables of statistics could be prepared that would be of great general interest as showing the extent of the electric lighting industry in the United States. There are no accurate compilations of this kind in existence, and the data thus collected would be both practical and interesting.

[*Continued from page 165.*]

stocks an iron rack is built according to dimensions given also a rubbish trough. There are three iron penstocks six feet in diameter and 80 feet high, built of three-eighth inch boiler iron, with a gate to each penstock. There are five elbows to each penstock leading to as many turbines, with an iron slide gate to each elbow; in addition, each turbine has a register gate, thereby permitting the repairing of any one turbine without interfering with the running of the others. A turbine can be taken out and another put in its place in 25 minutes. Cement floors are laid in the shafting and turbine rooms. There are three tail races, extending under the entire length of the main building; each race is nine feet wide and six feet and six inches deep.

As a reserve power, when making repairs and cleaning the raceway, we have a 600 horse power Cooper Corliss engine; in the past year it has been necessary to use it but a few days. For fire protection, two-inch iron pipes are run from the penstocks through both buildings, with four lines of hose attached at all times; the hose is tested once a week; in addition to the hose, a dozen fire pails filled with water and placed in different parts of the station are kept in readiness, and are not permitted to be used for any other purpose. A record is kept of the time of starting and stopping of each turbine, also the speed and load on same, and any variation in height of water and all repairs that are made. In addition to the above records, the day and night wheelmen report the condition of the power at the time they are relieved.

There are nine men employed at the station, five of them in the dynamo department and four in the water power department. We have in service 30 dynamos; three of them are run without any stoppage, and the balance of them on an average of 13 hours per diem. A record book is kept in the dynamo room, in which entries are made of the time of starting, stopping, speed and load of each dynamo, also all repairs of every description, all accidents to either machinery or circuits, nature, time and cause of same.

All the circuits are tested five times daily, and the tests and time of same entered in record book.

By the means of water power the company is enabled to furnish cheap and satisfactory light and power at the following rates: City arc lights, all night and every night, 27 cents per night; commercial arc lights, all night and every night, 40 cents per night; commercial arc lights, evening, 25 cents per night; commercial arc lights, evening and all day, 40 cents; 1/8 horse power motor, $18 per annum; 1/2 horse power motor, $48 per annum; 1 horse power motor current, $72 per annum; 2, 4 and 6 horse power motor current, $50 per annum per horse power; 8, 10 and 15 horse power motor current, $40 per annum per horse power; 1/8 horse power fan motors, $15 per season, from June 1st to October 1st; 16 candle power incandescent lamps, $5 to $12 per annum; 25 candle power Bernstein lamps, $12 per annum; 50 candle power Bernstein lamps, $24 per annum; 100 candle power Bernstein lamps, $48 per annum. The rates I have mentioned are for arc circuits; our rates for current on 500 volt constant potential circuits are as follows: One horse power, $48 per annum; 2 horse power, $96 per annum; 5 horse power, $180 per annum; 8 horse power, $240 per annum; 10 horse power, $300 per annum; 15 horse power, $450 per annum; 20 horse power, $600 per annum. We operate a total of 832 motors, of which 196 are fan motors, 1,396 arc, 135 Bernstein and 200 Swan incandescent lamps. One motor circuit contains 26 miles of outside wire and 394 1/8 horse power "C. & C.," one 2 horse power and one 4 horse power Brush motors, and is run with a No. 8 Brush arc dynamo. We have one 40 kilowatt 500 volt "C. & C." generator in service, on an eight mile circuit, with 48 horse power in motors in use; the ammeter averages 29 amperes. We experience no difficulty in running same with our power.[1] The rebate for poor service during the year ending December 31, 1890, was one-hundredth of one per cent. of the gross receipts, and the uncollected accounts for the same period was one-tenth of one per cent. of the gross receipts.

The Edison Electric Light company has recently erected a three-story stone station at the foot of the upper Genesee Falls, on the west side of the river, and have at present two double discharge Leffel mining wheels under about 90 feet head giving 600 horse power, and are placing two more of 400 horse power each. In addition this company has a fine steam station in the center of the business district. Incandescent 16 candle power lamps are furnished at one cent per lamp hour; arc lamps for city use, 28½ cents per night; municipal incandescents at six cents per night. The last named are being partially replaced by arc lamps. The company has in circuit 105 arc, 805 municipal and about 13,500 16 candle power incandescent lamps.

The Rochester Electric Light company's plant is situated at the upper Genesee Falls, on the east side of the Genesee river, near the business center of the city. The station is three stories in height from the top of the falls, with the wheel pit underneath, blasted out of solid rock 95 feet in depth. The company has five Leffel horizontal turbines; four are 23 inches, and the other 30½ inches in diameter, with a total of 1,500 horse power, under a head of 86 feet and eight inches. The penstock is a steel pipe seven feet in diameter; the power is transmitted to five shafts 80 feet above by belts 173 feet in length, running at a speed of 7,200 feet per minute. The dynamo room is directly over the shafting, from which all of the dynamos are belted through the floor. The dynamos are of the United States system. The company has in service 325 city arc and 140 commercial arc lamps; also 1,500 incandescent lamps and two 10 horse power motors. It has just placed one 85 horse power generator and one 1,500 light Westinghouse alternating dynamo. As a reserve power it is putting in a 100 horse power engine. The city lights are being furnished at 27 cents per light.

In addition to those I have mentioned, there are five incandescent plants and one arc isolated plant run by water power in Rochester, some 500 incandescent and 25 arc lamps, making a grand total of 1,991 arcs and 16,640 incandescents. The population of Rochester is 140,000, making a very high average per capita.

DISCUSSION.

MR. REDMAN: I would like to call the attention of the members to the prices. They vary undoubtedly from the prices of some other cities, but you want to bear in mind that we use water power entirely. It has only been necessary during the last year to shovel coal for half a day, and that necessity was occasioned by the cleaning out of the race-way. Another thing that I would call particular attention to is the development of the motor service. We have two motor services—one running in the northern portion of the city, and the other in the northwestern, where, with very few exceptions, the motors are placed in dwellings or in small shops built in the rear of dwellings. Heretofore the small manufacturers resident there have done business in the center of the city, and on the fifth or sixth floors of buildings, but now they do their manufacturing at home, either in their dwellings or in small shops.

MR. ARMSTRONG: How much money do you make?

MR. REDMAN: That is rather a leading question. We pay a dividend.

MR. ARMSTRONG: What I mean by that of course is. Do you make unusual dividends from these rates or can you carry a large sum as surplus, or are you making only fair dividends?

MR. REDMAN: We are making some money. Of course in addition to our electric light business we are renting water power for other purposes. We are renting 2,500 horse power of water power.

MR. FOOTE: Which branch of your business do you consider the more prosperous, the power or the light?

MR. REDMAN: We are now developing the power, and making special efforts with it. The incandescent light we hardly bother with.

MR. ARMSTRONG: My question was asked more particularly with a view of securing an explanation of the data which would enable us to use it practically. I presume there is no company here that has not had Rochester and other cities thrown at it by members of city governments and boards, whenever propositions have been made by electric light companies for municipal lighting. Now we get 39 cents for 2,000 candle power lights every night, and all night while here the price is stated by Mr. Redman as 27 cents for city arc lights. I see that for commercial lighting, all night and every night, forty cents per night is obtained by this company, which only has to use coal for half a day during the whole year. The facts shown by these figures ought to be strongly emphasized; that nothing but water power is used by this company; that in addition to the fact the water power costs nothing so far as the electric light is concerned, 2,500 horse power is sold. The incidental expenses, as I apprehend, and possibly the investment itself, are paid for by the sale of water power in addition to the sale of electric lights. Rochester, therefore, is doing a great thing when it is so far underselling us who have to pay high prices for coal, and who have to watch our boilers and our coal fires very carefully. Our general manager, as he has met the lighting committee of the city council, has had the figures of this city, and the figures of other cities using water power, as well as the figures of cities that burn coal—getting it for nothing and objecting to pay for the carting—has had all these things urged upon him.

MR. REDMAN: You will notice that two other companies charge the same price. There are three companies doing business in Rochester.

MR. ARMSTRONG: And practically you get the same price. Are they also using water power?

MR. REDMAN: Both water and steam.

MR. ARMSTRONG: Let us be very careful in giving all the facts connected with the production of power when we give out the figures that we receive. It may be that a company getting 70 cents—or possibly I am rather too high—but getting a large percentage above our own company, is not making the same amount of money, because the cost of fuel and other conditions may be much more serious for it than for us. We may be making less money than a company getting considerably less than we are getting, simply because its conditions are much more favorable than others, but if we can get statistics and get information in such a way that all the conditions are always given, we will be doing well. I am glad that in this paper the conditions are given so plainly as they are.

MR. FRANCISCO: I am running at the present time a 30 horse power motor; running an entire factory with that motor. In that factory they have a Daniels planer, and that takes 44 amperes. They are running the whole factory with a 30 horse power motor. When they first started I could not understand what was going on down there. They would throw on the 44 amperes of current, while their motor was not intended for such an arrangement.

MR. REDMAN: We are running some Daniels planers, and I find in our experience that those planers are the worst machines to handle.

MR. FRANCISCO: I investigated the matter and found that it all depended upon the way they were running the planer. They would set it for a quarter inch strip and put on the 44 amperes, whereas if they would set it for an ordinary strip, it would take only 40 amperes, with a 500 volt current. We were running a 500 volt current on that machine. The point was just here: That in doing their planing, if they took only a thin shaving, they have got to run the board through twice, whereas if they take a thick shaving they run it through but once, and it takes but half the time. The result was that human nature developed itself at once.

[illegible] elevator service. But I have never found that any of these [illegible] more than one-third of what our contract price would give us. I have also found that our customers are more surprised than we are at the small price that they have to pay for the service. For that reason I have concluded recently that we will not furnish any elevator service on the meter. We do not want to surprise them in that way.

MR. F[illegible]: What is the [illegible]

MR. W[illegible] we are using compound [illegible] dicated coal consumption is not more than two pounds per horse power hour.

MR. AYER: There has been nothing said here with reference to constant current rates, and it may perhaps be of some value to some of us to know what the charges are in that way. We are running an excess of two hundred horse power of constant current on arc lights, and we make a charge of $10.50 for a single horse power for ten hours' service, regardless of the character of the service. Wherever we happen to have a variable load, that indicates that the load on those motors is the maximum load, and we insist on their making a contract based on that maximum load.

MR. WILMERDING: I do not want to be understood as saying that we do not make a five dollar per month rate straight through, but that is on elevator service. Our lowest contract price for the intermittent service is $6.25, and our lowest price on constant power is $9 per month.

T. CARPENTER SMITH: I would say that there is one advantage that a constant current motor has over a constant potential motor, and that is, that a constant potential current will slow down if it is overloaded.

C. DUNHAM: What Mr Smith says with regard to the motor is correct, as I have found in my experience that if a constant current motor is overloaded it will slow down. We run on an average from forty to fifty candle horse power two and a half miles from the station. The maximum is fifty-six horse power, and it runs down to thirty-eight.

MR. SCOTT: I thought that this was a discussion of the paper relating to the operation of central stations by water power, and the point that interests me is to know the relative cost of production by water and by steam. As to the charges to customers, although very interesting facts, still they can be got from the schedules. The charges to customers have been, according to my experience, regulated in accordance with what the customers were willing to pay for the service. What we central station men want to know is how we can produce a good article at the least possible cost. We come together for the purpose of deliberating upon what are the best methods for us to pursue under different circumstances. From what I have seen in my own section of the country I judge that water power has not superseded steam. The companies there can run on high pressure engines, and furnish sixteen candle lamp per hour at an expenditure of half a pound of coal, whereas water will cost them as much as a six tenths the cost of a pound of coal, and when water costs them that much, they gain nothing by discarding steam for water. I do not find in this paper a statement of that element of cost. The paper speaks of the rebates costing only one one-hundredth of one per cent. The rebates do not cost us that, as we only give rebates back to men who kick so outrageously that we cannot get rid of them. It costs this man something to keep up his race way, and it costs something to repair dams. There are floods. There is no water power that is proof against damages by floods. Then there is the expense of cleaning out the pond. If those repairs, and the wages of the men who are delegate to make those repairs, cost as much as buying a load of coal, why should we not buy the coal? I want to get at the facts which will show me whether it will pay us to throw out the coal and take in water.

MR. LEONARD: I have had some experience in connection with the running of stations by water power, and I think that the remarks of the last speaker are very pertinent and correct and that the cost of water power although it is apparently cheaper than steam is frequently higher than it would have been for a first class steam plant. I think, further, that water power is really not sufficiently constant to entirely eliminate the steam plant. With the exception of a few plants where the water power is peculiarly favorable, the water power has to be assisted by a steam plant, and the ultimate expense is frequently [illegible] than it would have been if they had entirely disregarded the water power and built the steam plant at the best possible location. In my own experience I find that the best use to make of water power is not that of operating a full load, but of taking care of that portion of the load which is quite light, and which operates between, I will say, 11 o'clock at night and dawn of the next day, for the load is fairly constant during those hours, and the economy of the water power is then more marked because it enables the services of an engineer to be dispensed with. The use of the water power has proved to be very [illegible] in certain places where a not very [illegible] water power existed, but where perhaps fifty or one hundred horse power could be obtained at almost any period of the year, and which would answer to carry a light load during certain hours of the day and late at night.

T. CARPENTER SMITH: I would say that this question of the relative cost of steam power and water power has been very fully considered in some papers which were [illegible]

---

1. The twenty six mile motor circuit is the most popular circuit that we have, and is run through the northeast suburban portion of the city. All the motors on this circuit, with a few exceptions, are placed in tailor shops that are either in the dwellings or in shops built in the rear of the dwellings.

[illegible] the American Society of Mechanical Engineers and notably in a paper read last year by Mr. Manning of the Amoskeag Mills at Manchester. He states that his experience has led him to the conclusion that, all things considered, steam will under almost any conditions, if properly handled, be produced as cheeply as water power. I think that at most central light stations the best use to make of the water power is to use it in condensing. Steam has an enormous advantage over water power in that with steam you can state almost to a certainty just what your power will cost you. There has been such an enormous experience in steam, and so many statistics have been collected, that the cost per annum per horse power of steam has been determined within very small limits for all the types of engines in use. If a steam engine has really to be installed anyhow as a relay to the water power, you might as well run with steam all the time, for you have got to keep your engineer there, and you have got to keep your fires ready for lighting. And further, a steam engine possesses the ability to be driven beyond its rated capacity, whereas your water wheel is absolutely limited to the power contained in the head, and in case any sudden call is made upon you for increase of power you must either shut down, or start your engine. And if you have to keep your engine ready to start up it is better to keep it going the whole time. I wish to say that I would strongly recommend all members of this association to secure those papers. They can be had by applying to the secretary of the Society of Mechanical Engineers. Another paper, which was read some years ago by Louis F. Lyon, on the use of headlight oil for keeping boilers clean, is also worthy your attention. I read that paper and tried the oil, and had such success with it that we have used it ever since. But of course the oil must be used intelligently, and I have found the method given by Mr. Lyon to be the best. Those two papers I think are well worthy the attention of the members of this association.

THE PRESIDENT: The next paper is that of H. Ward Leonard, of New York, entitled "A Central Station Combining the Advantages of both the Continuous and Alternating Current Systems." Following is the paper:

A Central Station Combining the Advantages of Both the Continuous and Alternating Systems.

BY H. WARD LEONARD.

We are all well aware of the fact that the greatest strength of the three-wire system is due to features, the lack of which constitutes the greatest weakness of the alternating system, and that the reverse of this statement is equally as true.

The high efficiency, reliability, safety and adaptability to supply almost any requirements for electric energy, which are the features of strength of the three-wire system, are the very points upon which the alternating system suffers by comparison, for its efficiency is much lower, its reliability is less, due to the fact that its machines are not practically operated in multiple arc, its safety is necessarily less, due to the existence of the high primary pressure, and its current is not adaptable to commercial use for motors, charging storage batteries, electro deposition, and so forth.

On the other hand, the low first cost of an alternating system, the simplicity of its circuits and of the operation of the central station and its ability to reach, with moderate expenditure of capital, lighting at any practical distance, make it the only possible pioneer in new and untried territory without great risk and almost the certainty of expending capital which will never be remunerative.

Hence, it is that we find the three-wire system in possession of the densely settled centers of cities and towns, and not extending to the outskirts because of the uncertainty of a sufficient return upon the necessary capital, and both the central station manager and the distant would-be consumers are anxiously awaiting the development of improvements which will enable the three-wire central station to supply such distant consumers. And hence it is that the manager and consumers of an alternating system anxiously await the day when motors can be operated and a more economical, safe and reliable current than the present alternating current can be furnished by such a station to supply the imperative wants of the heart of a busy city.

If the above statement of the present existing conditions be a fair one, it will be evident that if we could only in some way secure the advantages of both systems in a common distribution, we should greatly improve matters. The object of this paper is to point out what appears to the writer to be a step forward in that direction.

The following conditions seem to be necessary:

1. We must supply a continuous current for the central [illegible] when power is required.

2. We must supply the outlying districts with an alter[illegible]

[illegible]

sumer's place.

[illegible]

mary wires and alternating current converters, with a three-[illegible]

is eight o'clock in the evening. The switches which serve to connect the central and outlying sections are open, and our three-wire plant is supplying the full load of the central portion of the city. The alternating plant in the same central station is supplying the converters of the outlying section, which convert from 1,000 volts primary to 220 volts in the secondary, and the secondary coil has a connection at the center which is led off to supply the central wire of the three-wire system of the outlying section, the outside terminals of the secondary being connected to the outside wires of the three-wire system. It will be noticed that both plants are being operated at full load.

Now, suppose it to be eleven o'clock. The load has gone off rapidly so that the alternating plant is now operating under the worst possible conditions, and these conditions will continue for the outlying district until dusk the next day—that is, for probably 18 hours. An operator is now sent out who goes to each section supplied by a converter and by throwing a switch transfers the secondary wiring from the alternating system to the three-wire mains. In this way the small remaining load is gradually transferred to the three-wire plant and then the alternating plant is shut down. The three-wire plant continues in operation all night and all the next day, supplying all devices with a continuous current. Motors can be operated in all portions of the system, even for domestic purposes in the distant residences, and all consumers get the opportunity of the use of the continuous current for any purpose desired for 18 hours out of the 24.

Dusk now arrives and soon the heavy lighting load will rapidly come on, and in such case the outlying section could not be supplied by the small wires feeding the distant three-wire section during the day, which are only about one-tenth the size which would be necessary to supply the full load.

The operator again goes round the circuit, and now transfers the load of the outlying section from the three-wire plant to the alternating plant, and this condition prevails again until eleven o'clock arrives, when the operation is repeated, as before described.

The switches for transferring the load of the outlying section from one system to the other can readily be controlled by simple means from the central station itself, if desired.

Now, let us look at some of the advantages we have gained.

All of our inside wiring is done on the three wire systems for use of a lamp of 110 volts. This means that for the same distances and loss in conductors, we will save eleven-twelfths of the cost of copper which would be required by a secondary using 55-volt lamps upon a two-wire system; or, to put it another way, we can supply 110-volt lamps upon a three-wire system with the same cost of copper and the same percentage of loss in conductors at three and a half times the distance which would be permissible for 55-volt lamps on a two wire circuit.

We all know the great desirability of using large converters, on account of their cheaper first cost per lamp and their higher efficiency, and also because a far more perfect regulation of pressure can be obtained upon a lot of lamps scattered in different kinds of stores throughout a block, if they be supplied from one converter, than can ever be obtained by supplying these lamps by a lot of small converters loaded differently in almost every case, and consequently supplying a different pressure at the secondary terminals of each converter.

Under the system proposed by me one converter would ordinarily supply the entire lighting of a block, resulting in less first cost, higher efficiency of conversion, longer life of lamps, greater reliability and greater simplicity of plant. A point worthy of notice is that for 18 hours out of the 24 an absolutely safe pressure is in use throughout the entire system, and that during all daylight hours, when the greatest liability to accident from contact with high pressure wires exists, no high pressure is in use. With such a system no consumer need be turned away. The consumer who wants to charge storage batteries and also make electric welds by electricity can do so upon the same day and from the same wires that supply his incandescent lamps. The factory upon the outskirts of the town, which runs its isolated plant, and must to day either use storage batteries or run machinery all night to supply a few watchmen's lights, can now switch on to the central station at six o'clock, and operate the few lamps it may need until dusk next day, when heretofore the alternating system, which was the only one which could reach it, did not run after midnight, or possibly after daybreak, because of the loss of money in so doing.

With this system the outlying districts can be pioneered with the least first cost and least risk. Any outlying section in which, for any cause, the demand increases greatly beyond that originally anticipated, can be supplied permanently by the three-wire system by merely running the necessary feeders to supply the already existing mains, and in such case the switches and converters would be moved out farther or transferred to some new section ready for pioneer work.

The combination of a storage battery system and an alternating system also presents peculiar advantages. The storage battery is at its best when supplying a small steady load, such as we have for at least 16 hours out of the 24. The alternating is at its best when supplying the full load possible only during the remaining eight hours. The average [illegible] load on a general system is only about 12 per cent. of the maximum, consequently we are entirely safe in the statement that the greatest load during the 16 hours of light load is not more than 10 per cent. of the [illegible] for the 24 hours.

If we were to attempt to operate the heavy load by storage batteries, we must either make an enormous investment, or, what is even worse, operate storage batteries [illegible]. On the other hand, if we try to operate the 16 hours' light load with converters, our [illegible] 10 per cent. of our converter [illegible]. But reverse the case and everything works at its maximum efficiency. During the eight hours of possible heavy load we operate all devices by the alternating system. At the same time a continuous current dynamo charges our storage batteries located either in the central station, or, if more desirable, at different centers in the system of distribution. At the end of the eight hours' run we shut down the plant, lock up the station and leave it for 16 hours, the storage batteries meantime supplying all devices.

If, for extraordinary reasons, we have not capacity sufficient in the storage batteries to supply the demand, we run the continuous current plant to assist it; and if that should fail or prove insufficient, we start up our alternating and supply all or a disconnected part of the system with it.

With this plant distances are of no consequence; we can use 1,000 volts for the continuous current plant as well as for the alternating, and the single two-wire distribution is all that is necessary for perfect results.

The weak spots of this latter arrangement will, no doubt, be thought to be the storage battery, but my experience with this device is that if you use it properly, under suitable conditions, and do not attempt to squeeze impossible results out of it, economical and satisfactory service can be obtained from it, and certainly no better condtions could be obtained for it than those described above.

Up to this time a bitter fight has waged between those believing that the alternating, the direct, or the storage battery system, respectively, was the only suitable one.

I believe in them all, each operated so as to be used under the best conditions for its use, and I trust that the suggestions given above may lead to our being better able to meet and overcome our common enemies, high first cost, low efficiency, danger, unreliability and the inflexible conditions of the existing demand.

Discussion.

T. CARPENTER SMITH: We have been accustomed to speak of the efficiency, the reliability, the safety, the easy adaptability of any of the various systems in use, only with reference to the relation that these features bear to the currents themselves. The consequence has been that all currents using high tension have almost without exception in the first years of the business been installed in such a manner as to be a serious menace to life and property, and therefore have been universally condemned by the uninitiated public. I wish therefore to say that whatever remarks I may make are based upon the relation of electric lighting to the public, and not its relation to the central station. With that statement as a starting point I wish to join issue at once with Mr. Leonard in his statement that the alternating system suffers by comparision with the three wire system, "for its efficiency is much lower, its reliability is less due to the fact that its machines are not practically operated in multiple arc, its safety is necessarily less due to the existence of the high primary pressure, and its current is not adaptable to commercial use for motors, charging storage batteries, electro deposition, and so forth." I will start out at once with the first of these—as to its efficiency being much lower, and will say that the efficiency from the standpoint of electrical engineering, the average efficiency during the twenty-four hours' load, the converter system as at present installed may be lower than that of the three-wire system. But with regard to the satisfaction of the public, I think that the efficiency of the alternating system is considerably higher. I have been operating now for nearly four years an alternating system, and we supply three thousand lights in a district of the area of six city squares. We cannot go any further because we cannot get a franchise. Our district is honeycombed by the three wire system. Their central station is within a block of us. Their wires run down every block on which ours are found, and on some blocks where ours are not. They have connections in nearly every building in that district, and yet they have never succeeded in taking a single light from us. On the contrary, we have taken several customers from them, simply on the ground that their customers could not stand the poor regulation. The sudden changes in the light annoyed customers so much that they preferred to come to us. We have never lost a customer from bad service. We have thrown several off but we have never lost one. Mr. Leonard says that "its reliability is less, due to the fact that its machines are not practically operated in multiple arc." I do not think that that amounts to anything, and for this reason, that while their machines are not generally operated in multiple arc, still they can be, and if there were any necessity for it, they would be so operated. I do not think there is any necessity for it, and I prefer not to do it, because I think that in case of accident to any one machine there is far less danger of accident to others. Any one machine being broken down does not give you the risk of breaking down other machines running on the same circuit. The time required to throw in the switch of a relay machine is not more than the time which is required to throw in the switches which Mr. Leonard uses for transferring from one system to the other. In actual practice that simply amounts to the winking of the lights for one instant. Another advantage and one in which safety is also concerned, lies in the fact that the alternating system has its road divided up into small units. That is to say, no matter how badly the wiring may have been done in any one building it does not affect any other building, and one customer cannot threaten the safety of every other customer of that station by having his apparatus or the wiring in bad condition. The failure of one group does not affect any of the others. The alternating current in itself, from the mere fact of its being an alternating current, has an immense added safety in the fact that it will not strike an arc. It is difficult to follow an arc with it except under very high pressure. We have had that illustrated over and over again in lamps under conditions where a fifty volt direct current would cause the blowing of the fuse. A very serious question which was brought before the committee on safe wiring is one that we have got to face before very long and to consider seriously, and that is the grounding of the neutral wire. There have been seve-

ral arguments brought forward why this should be allowed. It practically came down to this that the insurance agents and inspectors have preferred to ground the neutral wire, and practically make a return to the one wire system of installing electric lights, to avoid the much greater danger of the 220 volt arc between outside wires, and the consequent damage in buildings where combination fixtures are used. Now I do not know whether it is not a good thing to go back to the one wire system of wiring. That is an engineering question that we shall have to determine by years of experience. But I do know that if the grounding of the neutral wire is permitted you must also permit the grounding of the transformer. You cannot make fish of one and flesh of the other. And more than that, I do not believe that is the real reason of the desire for the grounding of the neutral wire, but that it is rather due to the fact that any failure of the third wire would cause the blowing out of the lamps one side or the other according as the load may be placed. That objection would equally apply to Mr. Leonard's plan of wiring up all lights on the three wire system. I think that the inherent defects of the three wire system are enough to forbid its use. The two wire system will meet these conditions. You can do your wiring on that system, if you please, on one hundred volts, although I think myself that the lower voltage we get and the larger the conductors we get, the better safety we get, and the slightly additional cost in installation is generally borne by the consumer. The statement that with large converters we get cheaper first cost, higher efficiency and better regulation of pressure, I fully agree with. I will speak of that later on when I come to point out the method of alternate distribution which I think meets all the points that Mr. Leonard desires. The statement that the safety of the alternating current is necessarily less, due to the existence of the high primary pressure, I beg to deny. The three-wire system in use gives an absolutely continuous metallic contact from dynamo to lamp, from street main to lamp, and from every lamp on a circuit to every other lamp on that circuit. These three-wire systems, finding that they could not operate their street circuits with any economy, have installed high tension machines, carrying considerably higher voltage in many cases than the ordinary alternating system. It is very evident that the first contact between that high pressure wire and the street main at any point, however slight it may be, puts that high tension on every lamp on that circuit. To do that with the alternating system you have to break down the insulation of every converter. Personally I have never known of a case of contact between the primary and secondary coils of a converter. I know that such have occurred, but I do not think that there has ever been one worth considering when we think of the enormous number of converters that have been put into service, the immense strides that have been made by the alternating system, and the small knowledge we had of it when we first started to install it. Those are accidents which will teach us lessons, but which should not lead to a condemnation of the new system. The high primary pressure we must have no matter whether we use the continuous or the alternating current. We cannot carry the current without it. It is exactly the same as with water pressure or with steam pressure. Twenty years ago fifty pounds were considered high steam pressure. To-day eighty pounds is the average. I do not think that of the new boilers that are being installed less than twenty-five per cent. are being put in for a pressure of less than one hundred and fifty pounds, and in ten years one hundred and fifty pounds of steam pressure will be used where eighty is now used, and two hundred pounds where one hundred and fifty are now used. We know that in all new stations that are now being installed in all new plants where steam is being used for power, the constant tendency is to raise the pressure. It is kept safe simply by the addition of proper precautions due to the increased pressure. The statement as to its current not being adaptable to commercial use for motors so far would seem to be proved, but four years ago that same argument was brought forward—that the current could never be used for meters. I think that the alternating current meter has pretty well fought out its own case and worked out its own salvation. I do not think that to day there are any direct current meters on lines in which they are in use which can compare with the meters which have been brought forward as the direct result of the introduction of the alternating system. I therefore think that in a few years we shall see the motor in the same way. We do have a demand however for power, and so far we must admit that the alternating motor, except in small sizes is not well adapted for use for certain central stations although it is of great use in isolated installations. I think however the experience of every central station is that it is better to have separate circuits for power and for light. And I think that this plan will meet all the requirements of the central station, and that you can use the alternating current for your lighting and the continuous high tension, constant potential circuit for your motors. The constant potential circuit can also be used for charging storage batteries and for any of the other purposes for which the direct current is used. The safety to the consumer by the use of converters is not only limited to the accidents from the system itself, but it also has its value in the case of lightning. Not long ago there was a discussion between the advocates of the direct and of the alternating currents at which one of the advocates of the direct current called attention to the fact, and gave it as a warning against adopting it, that the converter was simply a good lightning arrester to protect one company at the expense of the other, and one alternating current advocate present had the good sense to rise at once and thank him for the advertisement. I do not think that there is any stronger argument which you could use for its adoption. The people who are operating stations presumably know what they are about. They know that they are handling a dangerous element, and they will take care of it. Their employes should be well instructed, and then if an employe is injured it must be due either to his own carelessness or to those accidents which must to a certain percentage always happen. I think that when you sum up the disadvantages of the alternating system you will bring it practically down to one, and that is poor efficiency on low loads. To meet that a system must be devised which will have all the advantages of the alternating system, and which will have an efficiency practically the same at low load as at high load. At high load I think that the efficiency of the advanced former system is as nearly perfect as we are likely to get it. The further improvements will come in by the use of better material and of greater care in manufacturing. With these improvements I think it will pretty nearly reach the theoretical advantages. The thousand volt primary current which is in ordinary use is not high enough for large cities. Ferranti uses 10,000 volts, and has been operating under that current for several months and with apparently great success. I think there is no doubt that the time must come when we will use higher pressure than one thousand volts at central stations, and then get right out in the outskirts where we can have cheap fuel or water power, and from there send into the city under high pressure the whole current, taking off nothing on the way, that we will have sub stations where the current will be reduced from very high pressure—which must not be handled at all—to a lower pressure midway between the generating pressure and the distributing pressure, and with that we can supply the districts. In the sub station it will then be possible to install three or four large converters—or any number that may be required—connecting them up in multiple arc, and then when the load gets light instead of changing over to another system we will simply cut out some of those converters on both ends, leaving only fully loaded converters to carry the load. This of course is open to the objection that it requires the presence of an attendant, but devices have been made and are in operation in England whereby that change is made from the central station by means of automatic switches which can throw in one, two, three, four or five of those large sub-converters. I do not believe in the use of small converters. I think the larger you can keep your converters the better, but yet we have to weigh very carefully the disadvantage of having too few lights on one converter and too many lights in one group where by grounding of one part of the group you may affect the safety of another part. It is between those two limits that we must fix upon our most efficient size of converters. The same rule holds in figuring up the sizes of conductors. In figuring up the size of blast pipes used in our large rolling mills, and in the size of water mains, that question is continually coming up, and the limits on one side are the interest on the extra money expended in the first place, and the loss by friction, or by resistance, or by pressure, or whatever it may be. The use of the two systems in this way by keeping all the customers continually wired up upon an alternating system avoids great danger of connection between your high tension wires and your low tension main. If your high tension wires get crossed with your high tension direct wires for the supply of power, the station may be hurt, but the consumer is not likely to be. Say what you will it comes down to this, that it is the consumer who will regulate the running of your station. If he does not regulate it by legislation he will do it by hurting your business, by refusing to take what you supply under arbitrary conditions. And so we come back to the proposition with which we started, that no corporation, individual or government can defy the public and not suffer for it

MR. LEONARD: Mr. Smith seems to have made the error of assuming that I am appearing in the role of an advocate of the three-wire system. If such an impression exists, I wish to correct it as promptly as possible. My remarks with reference to the three-wire system and the alternating were such that they would be admitted by almost every one to day. I presumed that any one familiar with the facts would admit that the average efficiency of the three-wire system was higher; that it was conspicuously higher at loads; and in speaking of the possibilities and advantages of the system which I have proposed, I was only giving consideration to the existing conditions of to day. First, I will speak upon the points that Mr. Smith has mentioned, as I have noted them. He spoke of the disadvantages of operating the multiple arc. And yet it seemed as though the universal opinion must be that a multiple arc arrangement of dynamos is preferable to a separate one when we remember that in the first part of the business of electric lighting, machines of constant potential were operated on separate circuits, and that they have gradually been placed in multiple arc is due to the advantages gained by this arrangement. I think you will seldom find to day an isolated plant where we have a large number of machines supplying a constant potential distribution, in which each machine is supplying a separate circuit. The possibilities of regulating and the economics are so much higher when the machines are in multiple arc that entirely outside of any consideration of central station supply or of the three wire system it seems as though the result of experience has been that where machines can be operated perfectly, simply and reliably with multiple arc, it is better to do so. With reference to the question of grounding the neutral wire, I can dismiss that by stating that I agree thoroughly with Mr. Smith that the grounding of the neutral wire is extremely bad practice, and that there is no argument for grounding the neutral except perhaps that of laziness. As to high pressure primary, the paper which I have read of course bears evidence in itself that I am a thorough believer in the necessity of high pressure primaries for reaching any great distance, and there certainly appears to be an advantage in having those high pressure wires as few in number as possible. Instead of having a complete network through the city of high pressure wires, if we can by any means obtain a few of the high pressure wires at centers there would be less liability of any trouble due to the existence of high pressures. Mr. Smith has mentioned that in his belief an alternating current motor will soon be attained in practice and ready for service. I thoroughly agree with Mr. Smith on this point, and have no doubt that an alternating current motor will soon be ready for commercial service, but how soon is a

[redacted] yond that of the three wire system. As to the sub station method of operating on the outskirts of a town, that is unquestionably, when the alternating current motor is at hand, a very desirable way of operating. And yet it seems to me that even there, until we have our two hundred volt [redacted] bution something which will enable us to reduce the cost of our conductors on the consumers' premises to a point far below that of 50 volt lamps. As I have pointed out in the paper the cost, at the same distance and at the same [redacted] system will be but one-twelfth of that of a two-wire system with 50 volt lamps, [redacted] the two-wire system and our secondary distribution, it would be but one-sixteenth. Consequently, when we have delivered our high pressure to the sub-station and are ready to distribute to our consumers, we would have to have a very large number of sub-stations in order to operate 50 volt lamps, or else we must have an enormous expenditure in conductors. It seems to me that under the existing conditions it will be well, and indeed the best way that we have at present at command, to use the three wire system, as it does enable us to distribute from that center at low pressure and at the least cost. When the time comes that the 220 volt lamp is commercial, the three wire system will of course [redacted] reduce the cost, but the high pressure which will be realized then may be a [redacted] 500 volts in the premises of the consumer, and may make the 200 volts satisfactory.

MR. SMITH: I fully understand Mr. Leonard's attitude in this matter. My remarks about the three-wire system were not made with any idea that Mr. Leonard is upholding it as against the alternating, but because he in his new plan calls for all inside wiring to be done on the three-wire system for lamps of 110 volts. I apparently did not make it clear that the 200 volt direct current in the building is what the insurance people are afraid of now, and that consequently we must abandon that in any new system which is to be an improvement upon that. The use of an alternating current of 220 volts I do not believe would have that disadvantage, and in that case Mr. Leonard's plan would be all right. But as his plan contemplates using during a part of the time a continuous current of 220 volts I feel that the 220 volts should be barred altogether. Of course on a 55 volt lamp we can use the three-wire systems, and in many cases where buildings have been already wired we may get a proportion of [redacted] that way. With regard to the [redacted] that in my experience the multiple arc in isolated work has been used to save the running of new feeders. Where a plant has been wired up throughout and one dynamo installed, and then enough lights put on to take up the whole capacity of that machine, and the customer wants more light, he taps the wires which he has But when he goes to put on new power, he simply couples his new dynamo right into the bussbar, just as a man who puts in a new boiler in a steam plant couples in the old steam pipe. If the old steam pipe were too small he would run a new main. And so it is with an electric light plant. Where we install an isolated plant we always put it so that three or four dynamos can operate, though as a general rule they are all in multiple arc. A thousand light dynamo is about just so far good for practical use, but we have 3,000 light dynamos for the alternating current and larger ones are to be built and used. In that case I do not think that there can be any question about multiple arcing. With regard to sub-stations I would say that Mr. Leonard seems to have slightly misunderstood me. The sub-stations are not for the purpose of direct supply to the consumer. They are for supplying the sub-mains which are run at much higher pressure than we would introduce to the customer, and the customer is supplied through a second series. That of course gives us the double conversion, and the loss caused by double conversion as against the loss caused by a single conversion, but it gives us the advantage of running one of those converters always at its highest efficiency, namely, a full load. The whole question, of course, as I have said, comes back to one of interest on first cost as against loss in feeders. So that, in speaking of sub-stations, I do not mean to be understood as saying that there would be an enormous number of sub stations, but only one for each district, very much the same as Mr. Ferranti is now operating in London. We have been looking very anxiously for the completion of that station. He is a very young man, and has taken hold of [redacted] lem in a way calculated to alarm a great many [redacted] but his own personal energy and constant superintendence of every detail is such that I think we can [redacted] praise for the success that he has made at [redacted] is handling there pressure which we never [redacted] years ago. I well remember when on the floor of this convention [redacted] volts was spoken of as [redacted] through the country on a line of poles, it was considered it should have a dead line [redacted] feet each side. Ferranti is carrying [redacted] through the [redacted] crowded city, and [redacted] as a rule, the less the public does know about such things the better,

MR. [redacted] I think Mr. Smith has [redacted] ingenious argument [redacted]

hardly feel that his position is sustained by the facts or by practice. Of course, as he has pointed out, where conductors are placed on one dynamo and the load gradually increased they are driven to the multiple arc arrangement unless they are going to put in new conductors. The fact is, that every large isolated plant that I have ever had occasion to bid on has been so specified and rated by the common consent of the companies that have entered bids, that the dynamo should be multiple arc when there were eight or ten at the beginning, and it is the universal practice in all companies to so design their plants, and hence the multiple arc arrangement is one that has been forced by the unexpected enlargement of the plant rather than by a deliberate design to obtain the best results in the beginning. Mr Smith has spoken of an arrangement of sub stations, but he has not yet pointed out how he gets rid of the losses that will occur upon the final converters. He has put an intermediate set of converters in, and has taken means to take out converters as the load diminishes, but his final converters in his distribution throughout the city are still connected, and are the same as we have had before.

MR. SMITH: I would use the same plan as Mr. Leonard proposes in his system. I would have them grouped and switched in and out by the operator, just as I do in the sub stations. I am only comparing one system with the other. With regard to the multiple arc, I will say that I still hold to my proposition that multiple arcing is not put in because it is a great advantage, but it is put in to allow of two machines being connected together. It is a good thing, simply because in an isolated plant the conditions are different from what they are in a central station. Your loads are all one side of the buss bar, and you are required to run two dynamos cut apart, and it is similar to running them together in the same building. If you take an ordinary building where as an ordinary rule two machines are put in for use against the chances of break-down, the machines have to run in multiple arc because the wires are fed from the same feeder. Our alternating station is run in practically the same way, only instead of switching the dynamo out of the multiple arc we switch a feeder into the multiple arc on another dynamo. Our dynamos are united inside of our circuit. In the one case the dynamo is multiple. In the central station we simply shut down the dynamo and we transfer the feeder load. I cannot see that running the station in multiple arc is any particular advantage, or that running an isolated plant in mutiple arc bears upon the question direct.

MR. LEONARD: Mr. Smith explained how he was going to reduce the loss of the final converters of the circuit by throwing off a part of the load when the load became too heavy. This necessarily assumes an arrangement of converters in multiple arc on the secondary which is not contemplated in my scheme, and is not in practice today.

DR. BELL: At the risk of stirring up all parties in this discussion I want to make one or two suggestions with regard to this scheme, and the first of them is to suggest the question as to whether or not a 220 volt alternating circuit is a pleasant thing to have around the house. I have very grave doubts about that. I am not afraid of the direct circuit or of 220 volts straight circuit, but when it comes to turning loose 220 volts on a three-wire system, alternating around and about the house, it seems to me that it is a good thing to avoid. I know that there are plenty of alternating current men who say that they have no fear of a current of 1,000 volts. But in all seriousness I think that 220 volts alternating current is a thing which has got to be handled rather delicately if buildings are to be customarily wired for it. I do not know that there would be any risk to life from 220 volts of alternating current, but at the same time I think the public would view the matter with a little doubt. As to the question of alternating currents I think that we ought to remember that on the other side of the water alternating currents are habitually run for the purpose of keeping the whole system loaded to its fullest capacity. We do not happen to do it here, but they make a practice of it over there, and with great success. As to the reason for it I think it is all summed up in the saying that it is a good thing not to put too many eggs in one basket. If you have a one hundred kilowatt machine, and anything happens to it, the whole station is shut down until that machine is fixed. If you have three or four smaller machines you may be able to [illegible] and keep going, but I have heard grave doubts suggested by those who know Ferranti personally as to whether he will ever complete those machines. There is such a thing as getting an alternating current so [illegible] and I think that [illegible]

[illegible]

Another thing: our three-wire stations have developed in practice (although I doubt if any of them would admit it in public) a very easy but very reprehensible practice of burning out their grounds at night. When they discover a ground upon the system they find it easier and cheaper just to slip in three or four big machines, and let her go, and they will find out where the ground was next morning. That is pretty bad as regards the danger to life, and I think very much greater than any chance of any accident arising from a 220 volt shock. I am not contending for 220 volts of alternating current. I do not like it myself. I am only pointing to the fact that as compared, one with the other, if 220 volts of direct has not been found dangerous or objectionable, the 220 volts of alternating will not be found so.

MR. ORFORD: In Bridgeport we have been running the three-wire system, and we have had 3,000 lights in operation. The question of danger, that Mr. Smith speaks about we know nothing of. We have never had any trouble whatever in that way. We have had a few fuses blown, as every person has had, but as for fires we have never had any. We are able to distribute the current from the dynamos to a distance of three-quarters of a mile, giving us a pretty large district. But we found that we had some outlying districts that we were not able to reach, and then we began to inquire into the question of putting in an alternating plant. I visited several managers of the central stations in the neighboring towns, and when I talked with them, so long as they thought that I was a stranger to the business, they would represent the matter as being eminently successful in every respect, but when I came to ask a few leading questions they would sometimes turn and ask me why I asked the questions, and who I was. We are so satisfied with the continuous current in Bridgeport that it has been adopted in New Haven, and some other places. They have an alternating system in New Haven also, but it is the occasion of many complaints. It may be that the complaints are due to the fact that they are not able to operate it. I think that in Philadelphia, where Mr. Smith is able to give better service than the man with the continuous current machine, his competitors must have a very poor manager. I think that I could wake them up a little bit. I do not think that you would see any variation in our light at eight o'clock in the morning. We put our machines in, and they go from 100 amperes on each side, up to 1,000, and I defy anyone to tell when we put a machine in or when we take it out. Of course we are not under the Edison patent. We are forced to steal our devices, or contrive them for ourselves. As for such things as regulators as you call them, we have none of them. It would be seemingly impossible to keep our lights at equal pressure all over the system, but we have a method of our own by which we are able to do it, and so satisfactorily that our customers are not putting in any gas pipes. We have dry goods stores where they are paying out from $2,000 to $3,000 per year for light, and they have no gas in the buildings. Their meters are gone, and the gas fixtures have been taken out. We have not paid in the shape of rebates five cents in five years, and we have had no customers say to us that our lights were out for five minutes. As to the cost of running, we are not able to tell anything about it except that when a customer puts out his lights we do not use any more power, and when he puts out his lights on the alternating current there is just as much lost on the machine as there was before he put them out. That may be a little exaggerated, but it is in that direction. Now with regard to the fuses. We took the fuses out of the secondary altogether, and we took them out of the primary also so far as they related to the converters, and we adopted the plan of having a switch, and in the switch box there is a fuse which is connected directly from the main. So if we have occasion to do anything with a converter we can disconnect the circuit with it entirely. We have had no trouble with converters. We have had quite a number of them in operation for over a year, but have had no trouble with them. I am surprised that we have had so little trouble. We took the precaution of grounding our circuit at the terminals and at various points in the center. There is one thing which I have found out about the alternating system, and that is that it is not able to take care of itself. It generally wants some one to look after it. The other day we had two wires come together in one of our branches of primaries. It was a stormy evening, and it crippled the whole service on that branch. We had a fuse in, and fortunately the machine was able to blow the fuse. But an alternating machine is not able to rise to such a necessity as that. I will say also that my idea of fuses has never altogether met the approbation of the insurance people. I do not quite believe in copper wire because it takes a high heat to melt it, and I do not believe in putting in a small fuse. I do not like a single fuse put in below ten amperes. Ten amperes is not a very large amount of current. We never use less than No. 18 wire. We have had no trouble whatever in that direction. I would say in conclusion that so far as we have gone we see the necessity of both the continuous current and of the alternating current, and we do not think that any station is complete without both.

MR. SMITH: Replying to the last speaker, I would say that this is simply an individual case where, by first-class management, he has got a first class station. With regard to the people telling him that they have not advised their customers to take out the gas, I would ask him if direct companies do advise their customers to take out the gas. On our station of 3,000 lights, we have seven newspapers, and four of those papers have not had gas used in their building for about four years. One of our customers is the Franklin Institute in Philadelphia, which [illegible] school and library open every night. The day we put the light in they took all their gas fixtures out and they have not used them since. We installed an [illegible] that was put in on the central station plant [illegible] two years ago, of 250 lights in the [illegible]. Before that time Mr. [illegible] been using the direct current system. His refinery has been running night and day since the 19th of September two years ago, and in that time he has never lost a light nor has his plant cost him one penny to run, as he has told me more than once. We advised that no gas pipe be put in and there has not been a foot of pipe put in that building. I may mention that estimates for piping that building for gas were $1,500 more than his entire electric light plant cost him, including boilers engines, wire, dynamo and everything complete. The question whether your light will be reliable or not has a great deal more to do with the way in which it is run than the system used, and I think that is a point which is not enough considered. For every station using alternating currents which has put in direct current apparatus afterward I think we can show a dozen that first had the direct and put in the alternating afterward. The two systems have their uses, undoubtedly. The point I wish to make is that I believe for lighting purposes you can do just as much with the alternating system when you have spent one-half the time and one half the money on it as has been spent in bringing the direct current system to its present perfection.

CAPT. BROPHY: I only wish to say one thing in regard to the matter of fuses. I have studiously insisted on increasing the size of fuse. The system of using a certain sized fuse for a given number of lamps has caused a great deal of trouble and annoyance. As a rule, in the central stations the fuses are altogether too small. They should never be below the safe carrying capacity of the wire, and in ninety-five cases out of one hundred they are, except perhaps in our own territory where I have insisted on their being increased. I believe that if we use high potential or dangerous currents we should let the people know it.

Mr. Burleigh then read the following paper on "Uniformity in Method of Keeping Central Station Accounts":

UNIFORMITY IN METHOD OF KEEPING CENTRAL STATION ACCOUNTS.

BY J. J. BURLEIGH.

The National Electric Light association partially fills its mission by bringing together, twice a year, central station managers and others interested in the production of light and power, but notwithstanding the very valuable paper of A. R. Foote, read at the Niagara Falls meeting, and the papers of Messrs Smith and DeCamp, read at the Kansas City meeting, absolutely nothing has been accomplished toward a uniform system of accounts or a classification of expenses. All, I am sure, feel the very great necessity for a more comprehensive and uniform system of accounts—a system that will show the exact cost per unit of their output; a system that, being kept uniformly by all, will give managers an opportunity of comparison with each other.

This knowledge of cost per unit of output is particularly felt at this time, since nearly all central stations are in direct and active competition with other illuminating companies and with other means of supplying power. At present no two keep their accounts alike, hence comparison with each other is out of the question.

The principal function of accounting is to bring out the fact that the average cost of certain items of expense per unit of output in one station exceeds the average cost per unit of the same items of expense in another station, and the accuracy of these averages depends entirely on the uniformity of accounting. Great differences in these averages would prompt an inquiry as to the cause, and if the circumstances did not warrant higher averages, steps could be taken to reduce the cost of these particular items.

To make these comparisons of any value to those desiring to make use of them, a uniform classification of accounts should be adopted, and to insure accuracy, the different items of expense, chargeable to the different accounts, should be specified. The operating accounts proper embrace the current working expenses and the cost of keeping in good order the original plant.

All expenses that are naturally or entirely charged to either arc lighting, incandescent lighting or power, are entered in their respective columns; expenses that are not entirely charged to any one service are apportioned on horse power output basis, making the division, as between arc, incandescent or power, in the proportion which the horse power used for each bears to the total horse power output.

For the proper division of those accounts not chargeable entirely to any one of the principal departments—for example, the total output of the station being 1,000 horse power, the company operating 500 arc lights, 2,500 incandescent lights and 250 horse power for power—the division of a bill for boiler repairs, engine repairs, fuel and similar divisible accounts would be half arc lighting, quarter incandescent lighting, quarter power. The division should be accurately determined each month.

No intelligent economy can be practised without a thorough knowledge of the cost in the past and a comparison of the same with the present outlay. Constant comparison of accounts tends to economy. The experience of other companies is a good guide and would be found of great utility.

I would like to urge upon the convention the importance of the adoption of some uniform classification of expenses that they can recommend to central station managers for their adoption. It does not follow that central station managers are to expose their books in detail, but to so prepare their accounts that they can give the secretary of the National association replies to such questions of cost per unit as would be proper to exhibit to the other members. Such statistics would be of the greatest interest and value; indeed, it would be of more value than all the other papers combined. I have a station producing arc and incandescent light and power, earning a moderate dividend for its shareholders, but I have nothing to guide me as to how my expenses per unit compare with other central stations. I would give much for such information. Therefore, I

conclude that this is one of the most important subjects that can engage the attention of the association.

The company with which I am connected has classified its accounts as follows:

Charge made to	Arc Lighting.	Inc. Lighting.	Power: St. Cars.	Power: Stationary.	Total.
Boilers, repairs of					
Belting "					
Boiler House and Stack, repairs of					
Carbons					
Clerks					
Converters, repairs of					
Dynamos, repairs of					
Dynamo Attendants					
Enginemen and Firemen					
Engines, repairs of					
[illegible]					
General Officers' Salaries					
Horses, Wagons and Harness					
Insurance					
Interest on Notes, Bonds and Mortgages					
Incidentals					
Instruments of all kinds					
Lamps, repairs of					
Lamp Supports and Fixtures					
Lamp Globes					
Lamps, Incandescent					
Linemen					
Labor at Stations					
Labor on Street Cars					
Loss and Damage					
Legal Expenses					
Meters, repairs of					
Motors "					
Oil					
Office Expenses, repairs and furniture for					
Poles and Lines, maintenance and renewals of					
Right of Way					
Station, repairs of					
Stationery and Printing					
Superintendent and Foremen					
Steam Piping, repairs of					
Shafting, repairs of					
Taxes, City					
Taxes, State					
Tools, repairs and renewals					
Trimmers and Inspectors					
Water					
Waste					

CAMDEN LIGHTING & HEATING COMPANY.

STATEMENT OF EXPENSES FOR ....189 .

Heads of Accounts.	Arc Lighting.	Inc Lighting.	Power: St. Cars.	Power: Stationary.	Total.
Boilers, repairs of					
Belting "					
Boiler House and Stack, repairs of					
Carbons					
Converters, repairs of					
Clerks					
Dynamo, repairs of					
Dynamo Attendants					
Enginemen and Firemen					
Engine, repairs of					
Fuel					
General Officers' Salaries					
Horses, Wagons and Harness					
Insurance					
Interest on Notes, Bonds and Mortgages					
Incidentals					
Instruments of all kinds					
Lamps, repairs of					
Lamp Supports and Fixtures					
Lamp Globes					
Lamps, Incandescent					
Linemen					
Loss and Damage					
Labor at Station					
Labor on Street Cars					
Legal Expenses					
Meters, repairs of					
Motors "					
Oil					
Office Expenses, repairs and furniture					
Poles and Lines, repairs and renewals					
Right of Way					
Station, repairs of and furniture					
Stationery and Printing					
Superintendent and Foremen					
Steam Piping					
Shafting					
Taxes, City					
Taxes, State					
Tools, repairs and renewals					
Trimmers and Inspectors					
Water					
Waste					
Total Expenses for Month					

Total average arc lights
Total arc light hours
Total cost per arc light hour ..
Total inc output in ampere hours..
Total as shown by meters
Total loss
Total cost per 100 ampere hours ..
Total stationary power output in watt hours ..
Total as shown by meters
Total loss
Total cost per 1,000 watt hours

REMARKS.

CAMDEN LIGHTING & HEATING CO.

[illegible]

HEADS OF ACCOUNTS.	
[illegible]	
[illegible]	
Boiler House and Stack, repairs of	
[illegible]	
[illegible]	
[illegible]	
[illegible]	
Dynamo Attendants	
[illegible]	
[illegible]	
Fuel	
General Officers' Salaries	
Horses, Wagons and Harness	
Insurance	
Interest on Notes, Bonds and Mortgages	
Incidentals	
Instruments of all kinds	
Lamps, repairs of	
Lamp Supports and Fixtures	
Lamp Globes	
Lamps, Incandescent	
Linemen	
Loss and Damage	
Labor at Station	
Labor on Street Cars	
Legal Expenses	
Meters, repairs of	
Motors, repairs of	
Oil	
Office Expenses, repairs and furniture	
Poles and Lines, repairs and renewals	
Right of Way	
Stations, repairs of and furniture for	
Stationery and Printing	
Superintendent and Foremen	
Steam Piping	
Shafting	
Taxes, City	
Taxes, State	
Tools, repairs and renewals	
Trimmers and Inspectors	
Water	
Waste	
Total Expenses for month	

COMPARATIVE STATEMENT OF OUTPUT.

REMARKS.

.... Secretary.

CAMDEN LIGHTING & HEATING COMPANY.

GENERAL STATEMENT OF EARNINGS AND EXPENSES FOR MONTH OF ....189 .

EARNINGS		EXPENSES				
	Increase.	Decrease.	Expenses of	Inc.	Increase.	Decrease.
Arc Lighting			Arc Lighting			
Inc. Lighting			Inc. Lighting			
Power—St. Cars			Power—St. Cars			
Stationary			Stationary			
Misc. [illegible]			Total			
Total			Net			

BALANCE SHEET.

DR.		CR.	
To		By	
Net Earnings			

Respectfully submitted,

[illegible] rights acrue to you which you have forgotten, and which [illegible] any central station manager will find a system of this kind of great advantage.

Then we have a monthly abstract of earnings and expenses. We [illegible] month, and I [illegible] 12th or 15th of the month following. In addition to having that copied [illegible] the cost of our power as compared with the variable expense of the station made up to what I estimate at the engine, the busbar and at the service, allowing for the average drop. I also have the cost of our total power turned out compared with our total earnings. Then I take our light. I know whether we do our business by the meter basis and then I figure actually what we get per horse power per hour for our earnings from incandescent lamps and from our meters and if I am called upon [illegible] any time I can tell for every preceding month the average. I can tell what it has cost to produce our power at the engine at the busbar and at the service for every month since we have been in operation, and consequently I am in a position to know exactly what we are doing. I do not know whether that is the general practice, but I find in my experience that it is of very great interest.

In regard to proper division, with an arc light circuit running commercial lights especially, how are you going to know how much power you are furnishing for your arc lights, and the same may be asked with regard to your power circuits? On a power circuit sometimes you will have a full load that may last for half an hour. Then again you will have but a fourth of a load on. The point is how are you going to tell in order to fix your divisions here what proportion to divide among these different branches and how you are going to make anything accurate. I find it impossible for me to tell what my engines are carrying at different times. The light is going on and off constantly. Most of my lights are commercial lights. Of course with the street lighting they are thrown on and off at a definite time but with the commercial light you cannot tell anything about it. Now how are you going to divide that so as to make anything accurate? The same with regard to Mr. Nichols' point; as I understand him he has the card taken from his engine to get at his power. Now if you take a card at the present time, perhaps in ten minutes from now there will be a hundred horse power taken off and that will remain off twenty minutes or it may come right back again.

MR. NICHOLS: I can explain that in a very few words. Although we indicate our engines frequently, we take our power card from our ampere meters. We have the readings of our ampere meters taken down every fifteen minutes. Then I have a book of 400 pages. We use 365 pages. I have that diagram of the power output as indicated by the ampere meters plotted out on this diagram for the whole twenty-four hours. Last year I had it in black ink. This year I have it on the same page in red ink—the diagram of the ampere output for every quarter of an hour during the twenty-four hours. We run continuously; we never shut down. That is the best approximate means of estimating the power.

In regard to the other matter, I think Mr. Burleigh should properly reply to that.

MR. BURLEIGH: I cannot determine accurately. I only determine approximately. But the fact that I cannot determine accurately does not debar me from getting as near to it as possible. We take our arc circuits and assume that they are full from the beginning to the end of their run.

The convention adjourned until 10 o'clock Thursday morning.

Thursday's Proceedings.

The association met at 10 A. M.

The president read an invitation from the Business Men's association of Norfolk, Va., to hold the next meeting of the association in that city; also invitations from Robert M. May, mayor, the Cotton Exchange Exposition company, and the Commercial club of Augusta, Ga., to hold the next meeting of the association in that city. The invitations were received and referred to an executive session.

THE PRESIDENT: The first business in order this morning will be the reading of the paper by Capt. Eugene Griffin, entitled "Three Years' Development in Electric Railways."

THREE YEARS' DEVELOPMENT OF ELECTRIC RAILWAYS.

BY EUGENE GRIFFIN.

The first recorded description of the electric car is [illegible] in the fourth verse of the second chapter of Nahum: "The chariots shall rage in the streets, they shall justle one against another in the broad ways; they shall seem like torches; they shall run like the lightnings."

Notwithstanding [illegible] it was not until 1888 that the electric railway became a practical commercial success. I fix the date at 1888 as it was in that year that Bentley and Knight [illegible] the Allegheny City road to regular traffic, and the Sprague [illegible]

equipped the Richmond road, and the Thomson-Houston company installed the Eckington and Soldiers' Home road in Washington. It was in 1888 that railway officials began to realize the possibilities of this new tractive force; that the great West End system of Boston adopted electricity to the exclusion of cable, and that orders began to flow in upon the electric companies for street car motors to such an extent as to soon make the manufacture of such motors one of the leading branches of the electric industry.

Previous to 1888 electric motors had been used on several roads. Some of these roads were doing well and have been prosperous since; but to the public these were experiments on a comparatively small scale, and did little to inspire general confidence. The early inventors found it difficult to secure adequate financial backing; orders were few, and business unprofitable. The stronger companies which took up the work in 1888 had the organizations and capital necessary to achieve success.

The pioneers who devoted their brains and frequently their purses to this work previous to 1888 are deserving of all credit. It was their misfortune, not their fault, that their ideas were not developed and worked commercially. It is difficult for one man to combine the qualities of inventor, manager, superintendent, seller, expert, and financier, and yet this is what Van Depoele, Daft, Bentley and Knight and others had to attempt. The record of their efforts is an interesting one, but the chronological record of electric traction has been so frequently given that it would be a waste of your time to repeat it again.

There are, however, one or two of the early trials that are specially worthy of consideration, not only because of what was actually accomplished, but principally on account of their bearing on later developments. On the 27th of July, 1884, an electric car was running scheduled trips over a mile of track of the East Cleveland Street Railway company in Cleveland, Ohio. This was the first electric car in regular operation on a street railway track in the United States. The motor was placed between the wheels and supported from the car body, and geared to the axles by belts of spring wire cables. The current was conveyed to the car by conductors supported on insulators in a small, wooden conduit, and connection made with the conductors by means of a plow extending through the slot to the conduit. This was the initial installation of the Bentley and Knight system. Mr. Bentley has a photograph of the car in his office in Boston.

The road was given up in 1885, and the Bentley-Knight works transferred to Providence, R. I. After various experiments the road in Allegheny City was begun in the summer of 1887. The cars were started during the winter of 1887-8, although the road was not formally opened to traffic until February, 1888. Four cars were furnished to this road which, I believe, are still running. On the lower end of the road was a mile of double track conduit which was continued by an overhead system of about five miles. The conduit was on a long grade of about 12 per cent. Over-running trolleys were used with the overhead system. The conduit was in operation for two years or more, but has now been taken up and replaced by the overhead system.

As early as 1874, while C. J. Van Depoele was engaged in Detroit, experimenting with electric motors, generators, etc., it occurred to him that trains of cars, and even ordinary street cars, could be run by electricity. This was demonstrated to the satisfaction of his associates in various ways, but no public exhibition was made until 1883. When the Chicago elevated railway was under consideration, it was proposed to demonstrate the feasibility of utilizing electricity as a motive power. A track 400 feet in length was built, with a 5 per cent. grade in the center. One car was equipped with a 3 horse power motor and ran for several weeks with considerable success, carrying crowds of people. This was in February, 1883. In the same year an elevated railway car was operated electrically at the Chicago Inter-State Fair. The car was suspended from the truck instead of being mounted on it, and was in operation during the entire exposition—some fifty days.

During the Toronto annual exhibition in 1884 an electric railway some 3,000 feet long was operated from the entrance to the grounds to the main building. This was a conduit road and the wires carried a potential of [illegible] A [illegible] horse power electric locomotive was used hauling trains of cars.

[illegible] equipped [illegible] Montgomery, Ala., Detroit, Mich., Windsor, Ont., Appleton, Wis., Port [illegible] Binghamton, [illegible] N. Y., St. Catherines, Ont., and elsewhere, many of [illegible]

[illegible]

electric roads were actually on operation in January 1, 1888

ROADS.	SYSTEM	LOCATION	Miles	No. of Mtr. cars
Union Pass. Ry. Co.	(Daft)	Baltimore, Md...	2.00	3
Windsor Electric Ry.	(Van Depoele) opp	Detroit, Mich....	1.25	2
Appleton "	do	Appleton, Wis...	5.50	5
Port Huron "	do	Port Huron, Mich	2.75	4
Highland Park	(Fisher) ...	Detroit, Mich ..	3.25	4
Scranton Su'ban rd.	Van Depoele ...	Scranton, Pa.....	5.00	12
Los Angeles Electric Ry. Co.	(Daft).	Los Angeles, Cal.	5.00	6
Lima Street Ry. and Motor Power Co.	(Van Depoele)....	Lima, Ohio	4.00	8
Columbus Consolidated Street Ry.	(Short)	Columbus, Ohio,	1.00	2
St. Catherines Sreet Ry. Co.........	(Van Depoele)....	St. Cath'ines, Ont.	7.00	1[illegible]
Seashore Electric Ry. Co.	(Daft)	Asb'ry Park, N. J.	4.00	8
San Diego Street Ry. Co.	(Henry)	San Diego, Cal..	3.00	6
East Harrisburg Pass. Ry. Co...	(Sprague)	Harrisburg, Pa...	4.50	10

A total of 13 roads, 48 25 miles of track and 95 cars.

On July 1, 1891, there were 354 roads in actual operation, with 2,893 miles of track equipped electrically, and 4513 motor cars. Such has been the growth of three and a half years.

This development has been marvelous and unprecedented. Referring to it, General Francis A. Walker said to me, not long since, that it seemed as though at least thirty years' normal developmemt had been crowded into three years.

It has indeed been a fruitful period, and the progress has been so rapid that the public is just beginning to appreciate the benefits which science has conferred upon it by the adaptation of the electric motor to street car propulsion.

During the past spring the legislature of the state of Massachusetts was considering a proposition which practically amounted to the imposition of new taxes upon the West End Street Railway company, and the abrogation or virtual annullment of certain vested rights which the company might claim. In his able and vigorous defense of his corporation, President Whitney was forced to investigate and determine the true relations which exist between his company and the public, and he was surprised himself to see how closely the welfare of the city of Boston and its surrounding suburbs was identified with the welfare of its street transportation system.

He at once entered upon a "campaign of education," and his speeches in Somerville, Roxbury, Dorchester and elsewhere (several of which have been published in pamphlet form) are masterly, impressive, straightforward and convincing presentations of the close relations which exist between the rapid transit systems and the health, wealth, morality and prosperity of our large cities.

I commend these speeches to the consideration of you all. I have not hesitated to draw from them largely myself.

I consider this growing realization of the true position which transportation companies occupy in respect to the public as one of the most important of recent developments, and it may be well to give it some consideration.

The officers and directors of a street railway company are quasi public officers with most important and serious duties devolving upon them. Their duty to their stockholders is to see that the company is economically and efficiently administered so as to produce a fair return upon the capital invested. Their duty toward the public is to see that the best possible transportation facilities are afforded, having in view "the greatest good of the greatest number." This broad statement of their public duty is unquestionably true, and yet the failure to appreciate this axiom is the most fertile source of adverse criticism of railway management. The critic almost invariably argues from a personal standpoint. If he would only remember that the road is run for the benefit of the masses and not for his personal, individual benefit, the lives of general managers would be made less burdensome.

The last census has clearly shown a strongly-marked tendency of our population to gravitate toward the large cities. In every state the percentage of growth in cities is far greater than in towns and villages. Such condensation of population means an increase of the tenement house system in contradistinction to the cottage system, a crowding of people beneath each roof, an increase in vice, immorality, misery, crime and the death rate. How is it to be avoided? The laborer must live near his work, near in time and near in money. He can spare but a fraction of his time, but a fraction of his day's wages in going to and from his work. If the zone fare system exists, as in Europe, the area within which he can live is limited by this consideration. Two cents per mile might restrict him to a radius of 2½ miles (5 cents). If the single-fare system prevails, as in this country, time is practically the only restriction. Let us assume that he can allow thirty minutes morning and evening for his car ride, paying five cents for each ride At the rate of six miles per hour, fast for [illegible] of three miles and an area of 28[illegible] [illegible] At the rate of nine miles per hour, slow for electricity, he has a [illegible] and an area of [illegible] This example suffices to illustrate the point. An increase of [illegible] of transit [illegible] the available residence area without increasing the time or [illegible] to and from his work

The [illegible] road, the underground [illegible] rapid transit, but their application is restricted within very narrow limits [illegible] the electric roads can be [illegible]

[illegible]

area, of encouraging the cottage system and discouraging the tenement system, will be readily conceded by all. The health and morality of a great city are universally proportional to the number of people beneath each roof. The electric railway is one of the great moral agents of the nineteenth century.

The experience of the past three years has settled many disputed questions, resolved many doubts, systematized methods and improved construction.

A variety of styles, systems and methods were used prior to 1888. We had storage batteries, conduits and overhead wires, single trolley and double trolley wires, over-running trolleys and under-running trolleys.

Storage batteries have made little progress. They have nowhere scored a pronounced success, and have been abandoned on nearly every road. They are but little considered in the field of electric traction, except in reference to future possibilities.

The very few conduits built have disappeared and have been replaced with overhead wires. The overhead wire is now generally recognized as the only practicable method of conveying electricity from the generator to the car motor.

The objections to overhead wires have been, and in many places still are, very strong; but actual experience has shown that the objections are not well founded. Wires are not an ornament to the street, and objections on this ground will always exist; but lamp posts, signs, railway traks, and many other similarly useful objects are not ornaments. Overhead wires will never be condemned on this ground alone. Objections on the score of unsightliness become of less and less importance each year as the methods of construction are improved and the public appreciate more freely the benefits of electric motive power.

One of the early apprehensions in reference to the use of overhead wires was the possible danger to life from the current used. On this point I think the public are now well satisfied. While there are few employes on any of the roads now in operation who have not had the full shock of 500 volts repeatedly, there is not a single instance of any of the patrons of these roads who have been killed or even seriously injured by the 500 vo't current from the overhead wire. Electric cars will run over and kill the careless pedestrian or the drunken passenger who falls from the platform in front of the wheels as will the horse car, but no passenger or pedestrian has ever been killed by the trolley wire, and statistics do not show that the electric car is in any respect more dangerous to life than the horse car or cable car. Last year (1890) the West End Street railway system of Boston carried 114,853,081 passengers and all the steam railroads of the whole state of Massachusetts only carried 98,843,712. The West End system killed 15 passengers and employes and the steam roads killed 325. Of the 15 fatal accidents on the West End system, 5 were attributable to electric cars and 10 to horse cars. It is only fair to say that the narrow and crooked streets of Boston and the enormous traffic of the West End system are conditions peculiarly conductive to accidents.

The fear of the electric current is one born of ignorance, and time alone can overcome it.

In the year 1889 nine human beings were killed by the arc light wires in New York city (2,500 vo'ts) and the authorities were roused to such a pitch of frenzy that the poles were chopped down and a large part of the city left in darkness. Yet with perhaps one exception all of the victims were employes of the lighting companies and suffered because of failure to observe proper and well-known precautions. In the same year twelve persons were asphyxiated by gas and over thirty were killed by signs and other objects falling on their heads as they walked peacefully along the streets.

In time we are able to estimate every danger relatively, but in the beginning unknown dangers, those to which we are not accustomed, are greatly exaggerated.

Ralph W. Pope, in a very interesting paper read before the Franklin Institute last year, gives some curious illustrations of this tendency to magnify unknown dangers and arrest the progress of improvement. I quote:

"In an article, entitled 'How our Ancestors Traveled,' we find the following pertinent observations on the subject:

"Carriages met with great opposition at their first introduction, and laws were made to suppress their use. As early as the year 1294, Philip the Fair, of France, issued an ordinance for suppressing luxury, in which the wives of citizens were fordidden the use of carriages. Beckmann tells us that there is preserved in the achives of the County of Mark, an edict in which the feudal nobility and vassals are prohibited from using coaches under pain of incurring the punishment of felony. Duke John, of Brunswick, published an order in 1588, roundly rating his vassals for neglect of horsemanship, and forbidding them to appear or travel in coaches. A few years after this, the English Parliament took up the discussion of the subject; but, on the 7th of November, 1601, the bill to restrain the excessive use of coaches within the realm of England was rejected. But the bitterness of antagonism to them did not cease with this legislative decision. In a pamphlet called the 'Great Concern of England Explained,' published 1673 the writer very gravely attempts to make out that the introduction of coaches was ruining the trade of the realm. Following is an example of his method of reasoning: 'Before coaches were set up, travelers rode on horseback, and men had boots, spurs, saddles, bridles, saddle-cloths, and good riding suits, coats and cloaks, stockings, and hats, whereby the wood and leather of the kingdom were consumed. Besides, most gentlemen, when they traveled on horseback, used to ride with swords, belts, pistols, holsters, portmanteaus and hat cases, for which in these coaches they have little or no occasion. For when they rode on horseback, they rode in one suit, and carried another to wear when they came to their journey's end; but in coaches they ride in a silk suit, silk stockings, beaver hats, etc., and carry no other with them This is because they escape the wet and dirt, which upon horseback they cannot avoid whereas, in two or three journeys on horseback these clothes and hats were wont to be spoiled, which done

they were forced to have new very often, and that increased the consumption of manufacture.' In another part of his pamphlet, the same writer puts the following query, evidently with the notion that it was a clincher: 'Is it for a man's health or business to be laid fast in four ways; to ride all day with strangers, often times sick, diseased, ancient people, or young children crying, all whose humors he is obliged to put up with, and crippled with their boxes and bundles?' As an additional objection against the introduction of coaches, the writer urges that they would discourage the breeding and lessen the value of horses.

"The following passage occurs in a protest against the construction of railways, which is preserved in the archives of the Nurnberg Railway, at Furth, which was the first line constructed in Germany. It was drawn up by the Royal College of Bavarian Doctors

"'Travel in carriages drawn by a locomotive ought to be forbidden in the interest of public health. The rapid movement cannot fail to produce among the passengers the mental affection known as Delirium Furiotum. Even if travelers are willing to incur this risk, the government should at least protect the public. A single glance at a locomotive passing rapidly is sufficient to cause the same cerebral derangement, consequently, it is absolutely necessary to build a fence ten feet in height on each side of the railway.

"These were all European, however, so in order to assure you that these peculiar views were held in our country, the following protest from the good citizens of Philadelphia, in 1833, against the introduction of gas, will be of interest to you:

"'*Philadelphia, November 28, 1833.*

"'*To the Honorable, the Select and Common Councils of the City of Philadelphia:*

"'GENTLEMEN:

"'The subscribers beg leave to respectfully remonstrate against the plan now in action for *lighting the city with gas*, as they consider it a most offensive, inexpedient and dangerous mode of lighting. In saying this they are fully sustained by the accounts of explosions, loss of life and destruction of property where this mode of lighting has been adopted.

"'We consider gas to be as combustible as gunpowder and nearly as fatal in its acts; as regards the immense destruction of property, we believe that the vast number of fires in New York and other cities may be in a great measure ascribed to this mode of lighting. The leakage of pipes and carelessness of stopping off the gas furnish almost daily instances of its destructive effects. And when we consider that this *powerful and destructive agent* must necessarily be left often to the care and attention of youth and domestics and careless people, we only wonder that the consequences are not more *appalling*. It is also an uncertain light, sometimes suddenly disappearing and leaving streets and houses in total darkness.

"'The waters of the Delaware and Schuykill, now considered the most pure and salubrious in the world, as many long voyages have fully tested, must soon, we fear, experience the deterioration which has reduced the water of the Thames to the present impure state, for no reservoir will be able to contain such fetid drains from such an establishment, and very soon the rivers must be their receptacle, to the destruction of the immense shoals of shad, herring and other fish, with which they abound; the same cause must produce the same effect. Salmon, smelts, and other fish formerly caught in vast quantities in the Thames, have nearly all disappeared. The constant digging up of the streets, the circumstances of the gas pipes, which, at the intersection of each square, must come in contact with the water pipes, are difficulties and evils which we would anxiously avoid.

"'In conclusion, we earnestly solicit that the *lighting our city with oil may be continued.*

"'And your petitioners, etc.

"'Signed by 1,200 of the leading citizens of Philadelphia, whose names are attached hereto, such as Horace Binney, Hartman Kuhn, Jacob Ridgway, Paul Beck, Henry Pratt, Benjamin Chew, (on whose farm the battle of Germantown was fought), John Sargeant, Charles Wharton, Richard Willing, Edward Pennington, Robert Baux, Joshua Longstreath, Matthew Newkirk, and 1,200 others.

"'N. B.—The above are only part of the names, as many of the remonstrances have not yet come in.'"

The double and single trolley systems have each had ardent advocates, but three years' experience has decided the question in favor of the single trolley and the ground return.

In July, 1888, several roads were using the over-running trolley and it was a question whether the over-running or under-running system was preferable. Three years have decided this question also, and practically all of the electric roads of to-day operate with under-running trolleys. The "fish pole" of 1888 has been supplanted by the neat steel rod of 1891, and the "broom-stick train" can no longer be spoken of with disrespect as regards outward appearances.

Three years have not passed without much litigation and already we have historical cases finally determined, which tend to fix the legal boundaries of the rights of electric railways. Some of these decisions are of great importance.

The telephone companies have quite naturally been ardent advocates of the double trolley, and to avoid suffering from the induced currents of the single trolley, they have sought to induce the courts to compel railway companies to use metallic circuits. A recent decision of the Supreme Court of the state of Ohio, is a fair statement of the present legal aspect of this question.

Single Trolley System v. Double Trolley

(Supreme Court of Ohio.)

SYLLABUS.

1. The dominant purpose for which streets in a municipality are dedicated and opened is to facilitate public travel and transportation, and in that view, new and improved modes of conveyance by street railways are by law authorized to be constructed, and a franchise granted to a telephone company of constructing and operating its lines along and upon such streets, is subordinate to the right of the public in the streets for the purpose of travel and transportation.

2. The fact that a telephone company acquired and entered upon the exercise of a franchise to erect and maintain its telephone poles and wires upon the streets of a city, prior to the operation of an electric railway thereon, will not give the telephone company, in the use of the streets, a right paramount to the easement of the public, to adopt and use the best and most improved mode of travel thereon; and if the operation of the street railway by electricity as the motive power tends to disturb the working of the telephone system, the remedy of the telephone company will be to re-adjust its methods to meet the condition created by the introduction of electro-motive power upon the street railway.

3. Where a telephone company, under authority, derived from statute, places its poles and wires in the streets of a municipality, and in order to make a complete electric circuit for the transmission of telephonic messages, uses the earth, or what is known as the "ground circuit," for a return current of electricity; and where an electric street railway afterward constructed on the same streets, is operated with the "single trolley overhead system" so called, of which the ground circuit is a constituent part, if the use of the ground circuit in the operation of the street railway interferes with telephone communication, the telephone company, as against the street railway, will not have a vested interest and exclusive right in and to the use of the ground circuit, as a part of the telephone system.

The telephone companies have been beaten in every case, and the fact has been definitely settled that railway companies may use a single overhead trolley wire and a ground return without infringing any rights of the telephone companies.

Many interesting legal questions have arisen in reference to line construction.

Objection was made by the summer residents of Newport to the construction of an overhead electric railway, and eminent counsel was employed to place every possible legal obstacle in the way. The case was carried to the Supreme Court of the state of Rhode Island for determination of some of the novel points involved, and one of these points was:

Are Poles and Wires an Additional Servitude upon the Streets?

The Court held:

"The fourth ground alleged is that, if the act of incorporation authorizes the use of electricity for the operation of said street railway, and the erection of the poles as ancillary thereto, it is unconstitutional and void, because it authorizes the imposition of additional servitude upon the streets without providing for any additional compensation to the owners of the fee of said streets. We think it is settled by the greater weight of decision that a railroad constructed in a street or highway and operated by steam in the usual manner imposes a new servitude and entitles the owner of the fee to an additional compensation; but that a street railway operated by horse power, as such street railways are ordinarily operated, does not impose any new servitude, and does not entitle the owner of the fee to any additional compensation.

"The distinction is not often stated as a distinction between steam and horse railroads; but the distinction properly rests, not on any difference in motive power, but on the different effects produced by them respectively on the highways or streets which they occupy. A steam railway is held to impose a new servitude, not because it is operated by steam, but because it is so operated as to be incompatible with the use of the street in the other usual modes, or, in other words, so as practically to exclude the usual modes of use.

"A steam railroad on a street, so operated as to be consistent with the use of the street in the usual modes, has been held not to impose a new servitude.

"It is not the motor but the kind of occupation, whether practically exclusive or not, which is the criterion.

"The only considerable privilege which the horse-car has over other vehicles is that, being confined to its tracks, it cannot turn aside for other vehicles, while they are forced to turn aside for it; but this is an incidental matter, insufficient to make the horse railroad a new servitude.

"The street railway here complained of is operated neither by steam or horse power, but by electricity. It does not appear, however, that it occupies the streets or highways any more exclusively than if it were operated by horse power.

"Reference has been made to cases which hold that telegraph or telephone poles and wires erected on streets or highways constitute an additional servitude, entitling the owners of the fee to additional compensation; and from these cases it is argued that the railway here complained of is an additional servitude, by reason of the poles and wires which communicate its motive power. There are cases which hold as stated, and there are cases which hold otherwise, but, assuming that telegraph and telephone poles and wires do create a new servitude, we do not think it follows that the poles and wires erected and used for the service of said street railway likewise create a new servitude. Telegraph and telephone poles and wires are not used to facilitate the use of the streets where they are erected for travel and transportation, or, if so, very indirectly so; whereas the poles and wires here in question are directly ancillary

In the purely technical field all obstacles have been over-

any well-planned power plant.

I attended the exposition at Bremen, in North Germany, last summer, and had the pleasure of riding on an electric railway, operated by two 50 horse power Thomson-Houston

Armington & Sims engine, and one by a 125 horse power German engine. So closely did the small American engine regulate that no variation in potential could be observed

slow to respond, and the variations in speed were marked. I was subsequently informed that a medal was awarded to the American engine, although it had not been entered as an exhibit.

This is indicative of the enterprising way in which the inventors and manufacturers of the United States have met the new conditions imposed by the adoption of electricity as a motive power.

The difficulties Mr. Sprague encountered in Richmond in using copper brushes have now been avoided by the introduction of the carbon brush, for which we are indebted to Mr. C. J. Van Depoele.

As early as 1885 [illegible] with his motors. When the Van Depoele Electric Manufacturing company was purchased by the Thomson-Houston company in 1888, Van Depoele went to the Lynn factory of the latter company. Many did not then consider the carbon brush as practicable, and it was some time before Mr. Van Depoele had an opportunity to demonstrate its possibilities. [illegible] great value was so apparent that it was at once adopted for motor work, and subsequently has been used exclusively with generators.

Since the general adoption of the present method of mounting the motors directly on the axles, double reduction motors have been used. The supposed necessity of high speed of revolution in the armature made this obligatory. In 1890 it was found practicable to make motors in which the armature revolved at a slower rate and a single gear sufficed for the now greatly reduced reduction. From 10 and 12 to 1 with the old motor we come to 4½ to 1 with the new motor. The gears are inclosed in boxes and run in oil so that the noise has been reduced to a minimum, the offensive noise of the gears being practically eliminated. We have also gearless motors with no reduction and no gears.

Generator construction has kept pace with the improvements.

As large stations have been built generators have increased in size, and electrical companies are now producing 500 horse power dynamos as readily as the steam engine builders respond to similar demands.

We have learned what it costs to operate electric railways, and the result is gratifying. In 1888 it was prophesied that while electric roads might make good showing so long as the apparatus was new and curiosity riding lasted, in a short time the machinery would begin to wear out and the roads would be swamped by the great repair bills. In reality we find the almost universal testimony is that the longer the road runs the less is the cost of repairs. This is, of course, not due to the fact that the apparatus improves in quality with age, but the explanation is to be found in the very simple fact that as small defects are eliminated and the employes become more experienced and the organization is perfected, the apparatus is better cared for, and injuries are prevented.

A very conspicuous example of this is the West End Street railway, which has been under my immediate observation.

In the contract between the Thomson-Houston Electric company and the railway company it was provided that we should keep the overhead line and electrical apparatus on the cars in repair at a given price per car mile. There were many reasons which influenced us to make such a contract, but the chief reason was that this was the uncertain element in the operation of an electrical railway, and unless this uncertainty could be eliminated, the West End would not make any contract. The cost of these repairs has steadily decreased, and on the 1st of October the West End company avail themselves of their option and relieve us of this part of our contract, knowing there is now no uncertainty, and that they can do the work themselves for less money than they pay us.

Some months since President Whitney gave to the public the detailed figures showing the receipts and operating expenses of the West End road. These are of very great interest to all, and I give them in full for the purpose of drawing some conclusions from them:

	[illegible]	[illegible]	[illegible]	[illegible]
Gross receipts	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]
General expenses	[illegible]	[illegible]	[illegible]	[illegible]
Track and [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Motive power	[illegible]	[illegible]	[illegible]	[illegible]
Total operating [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net earnings	[illegible]	[illegible]	[illegible]	[illegible]
Mileage	[illegible]	[illegible]	[illegible]	[illegible]
Ratio of mileage	[illegible]	[illegible]		
Per cent [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Earnings per mile run:				
Maintenance	[illegible]	[illegible]	[illegible]	[illegible]
Car repairs	[illegible]	[illegible]	[illegible]	[illegible]
Damage	[illegible]	[illegible]	[illegible]	[illegible]
Conductors and [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Other expenses	[illegible]	[illegible]	[illegible]	[illegible]
Total [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Net [illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Gross earnings	$ 44[illegible]	$ 374,[illegible]	$ [illegible]	$ 4[illegible]7
General expenses	22,[illegible]	[illegible]	12,217	20,[illegible]7
Transportation and car expenses	1[illegible]	127,[illegible]	[illegible]	[illegible]
Motive power	117,[illegible]	11[illegible],972	1[illegible],216	110,2[illegible]1
Total op. exp.	27[illegible]	[illegible]	2[illegible]3,525	272,8[illegible]
Net earnings	[illegible]	105,[illegible]40	[illegible],720	130,[illegible]
Miles run	[illegible]	1,[illegible]	1,07[illegible],71[illegible]	1,120,[illegible]77
Ratio of mileage	73 34	74 42	71.85	74 21
Per cent of op. exp.	[illegible]	71 05	66 7[illegible]	66 5[illegible]
Earnings per mile run	3[illegible]	34 22	36.05	[illegible]
Exp. per mile run:				
Motor power	10 [illegible]	10 56	1[illegible]83	[illegible]
Car repairs	[illegible]	[illegible]	[illegible]	[illegible]
Damages	[illegible]	00 37	[illegible]	[illegible]
Conductors and drivers	08 2[illegible]	08 24	08 25	08.23
Other expenses	[illegible]	04 [illegible]	04 21	05 07
Total exp. per mile run	25 5	[illegible]	24 55	24 35
Net earned per mile run	[illegible]	[illegible]	12 [illegible]7	12 23

[illegible]

	April.	May.	June	July
Gross earnings	$ [illegible]	$ 51[illegible]244	$ 54[illegible],543	$ 551,431
Gen. expenses	3[illegible]97	30,47[illegible]	2[illegible],[illegible]3	27,[illegible]13
Trans. and car exp.	1[illegible],14	173,[illegible]44	165,027	170,853
Motive power	14[illegible],[illegible]33	14[illegible]	142,[illegible]7[illegible]	14[illegible],070
Total op. exp.	[illegible]	353,[illegible]	337,2[illegible]4	350,1[illegible]7
Net earnings	[illegible]	1[illegible]5,524	212,2[illegible]	[illegible]
Miles run	[illegible],47[illegible]	1,4[illegible]	1,[illegible]3,7[illegible]	1,497,5[illegible]8
Ratio of mileage	100	10[illegible]	100	100
Per cent of op. exp.	70 82	68 12	61 37	63.1[illegible]
Earnings per mile run	32 [illegible]	3[illegible]	38 33	37.02
Exp. per mile run:—				
Motive power	10 01	10 16	0[illegible]4	0[illegible]53
Car repairs	[illegible]	00 7[illegible]	00 70	00.75
Damages	[illegible]77	00 50	0[illegible]15	00.07
Conductors and drivers	08 [illegible]	0[illegible].01	08 00	07 01
Other exp	04 [illegible]	04 55	04.07	05.12
Total exp per mile run	24 34	24 [illegible]1	23 52	23 38
Net earned per mile run	07 85	11.25	14 81	13.04

Taking the June figures, it will be noticed that the net earnings per electric car mile exceed the net earnings per horse car mile by 10 07 cents, while the operating expenses of the horse car lines exceed those of the electric car lines by 4.20 cents per car mile. The difference is 5 86 cents per car mile which is the gain to the company due solely to the public satisfaction with the electric service. Mr. Arthur Jones of the T.-H. International company first produced this figure which he calls the "satisfaction figure."

The net earnings per electric car mile exceeded the net earnings per horse car mile by the following amounts:

In April 6.08 cents per car mile.
" May 6 47 " " " "
" June 10.07 " " " "

Mean 7.54 " " " "

The net sarnings of the horse cars for the three months averaged 9.36 cents per car mile, hence the electric cars showed a gain of 80 per cent. in the net earnings per car mile over the horse cars.

For the three months, we have the following figures for the electric cars:

Total receipts...	$ 432,947
" expenses	243,456
Percentage of expenses to receipts	56 per cent.

In St. Paul and Minneapolis, with a combined population of 350,000, there is to-day not one single horse car. Minneapolis has 120 miles of electric railways, all equipped with the overhead system, and St. Paul has 75 miles of electric railways and 15 miles of cable. Most of the cable mileage is to be abandoned and supplanted by electricity. The last car horse disappeared from the streets of Minneapolis in June of this year. The July report of the Minneapolis system shows:

Gross earnings........	$ 107,571
" expenses...	52.585
Net earnings	54,985
Percentage of expenses to receipts	49 per cent.

Cleveland, Buffalo, Rochester, Toledo, Omaha, Cincinnati and many other large cities are now operating their street cars almost exclusively with electric motors, and the universal testimony is favorable to the increased facilities afforded the public, and the increased profits to the stockholders.

Not the least important of the developments of the last three years has been the financial development. The fine showing as to earnings, the gradual decrease in operating expenses, where increases were expected, the oft-demonstrated ability to run electric cars in all kind of weather, in ice, snow, sleet, hail or rain, has greatly improved the standing of electrical securities. An electric road is no longer an experiment, it is a paying investment and there are not a few instances where the introduction of electricity has been the salvation of a horse road that otherwise would have soon been in the hands of a receiver. The rapidly increasing demand for electrical securities is an evidence of healthy growth of public sentiment in this direction. To equip electrically means the expenditure of money which [illegible] bonds stock issued. The ability of the public to rapidly absorb these new bonds [illegible] of the ability of the [illegible] direction.

In August the West End Street Railway company put [illegible] for additional electrical [illegible] provided [illegible] book [illegible]

sands who are now unprovided, and many years' work for our electrical factories.

DISCUSSION.

MR. HAMMER: This is an admirable paper, containing a number of chronological events which deserve to go on record, but I think that some have been omitted. To say nothing of the experience of Dr. Siemens, whose railroad is still running in Berlin, and which antedates any that Capt. Griffin has mentioned, I might refer to the experiments made in 1881 in Paris at the time of the electrical exposition. I believe the date given as the earliest, in this paper, was 1883. I have a very vivid recollection of an electric railroad which was in operation in 1880 and 1881, a mile and a half in length, at Meno Park, and which attained a speed of no less than forty miles per hour, and within a very short time after that was extended to three and a half miles in length. It was such an elaborate experiment at that time, and of such great commercial value, that I think the fact should be put on record in connection with a paper of the importance that this is.

MR. GRIFFIN: I would like to say with reference to early experiments which I have referred to that I did not intend that the list should be taken as complete. I intended to confine it simply to the United States. The car I refer to, on the Cleveland road, was the first one I know of in operation upon any existing street railway on the streets of a city as an existing road. There were lots of experimental roads which were built in addition to those I have mentioned, that were built for the purpose of demonstrating the feasibility and the possibility of operating street railways by electricity, but I think that that car in Cleveland was the first car that was put into regular operation upon an existing street railway upon the streets of a city, and put in schedule operation. That may be a small distinction, but such as it is it is one which Mr. Bentley and Mr. Knight have always delighted to make a great deal of.

MR. ARMSTRONG: I believe that at the present time I represent a corporation, and possibly the only one that is a member of this association that operates a street railroad by electricity. While I am president of the Camden Lighting & Heating company, I am also the accredited representative of the Camden Horse Railway company, which operates one of its lines by electricity, and our Camden Lighting & Heating company furnishes the power. I want to say so far as the experience we have had is concerned, that the very fact of operating our lines by electricity has brought us large additional travel. I had a letter last night from our street car company which said that Monday, Labor Day, was the largest day they had ever had, and that the receipts were beyond anything that they had ever had before. They did not have one moment's delay, nothing was out of order in the station or cars, and in carrying these heavy loads—carrying more than they had ever carried in their history before—they moved along very easily and very satisfactorily. As to accidents, I may say that on our electric road we have had one fatal accident. We were drawing a trail car with a motor car, and there were six young fellows coming over to some sort of a picnic, and they got into the motor car, which was closed but afterward, while the car was in motion, going up the street, they thought they would like to get into the trail car, and so a young man while attempting to swing from the motor to the trail car, caught his foot and was thrown under the wheels of the trail car before the brakes could be applied. This same letter that I have just received tells about an accident on the very street on which I live. A son of a friend of mine was riding on a bicycle along the track, and in some way he was thrown beneath the wheels of the street car, and before the brakes could be applied he was killed. So that of the two fatal accidents that we have had on our road neither of them could by any manner of reasoning be attributed to the use of electricity. We have had no difficulty so far as the wires are concerned, in the shape of accidents. There is one thing with which I am not yet able to agree with Capt. Griffin. Possibly later experience may lead me to agree with his statement, that it will pay to put down an electric road where a horse road would not pay. So far as my observation is concerned, I cannot bear out that statement, because you can surely operate a horse railroad at less expense by running fewer cars, than you can possibly operate an electric road where you have to have your steam plant and your power for producing electricity ready all the time. Our experience has been that it pays us only because we carry so many more people than we did when we were operating by cars.

DR. BELL: I had occasion last year to look into this very question with a good deal of care, and in answer to my inquiries I received replies from considerably over one hundred roads, with reference to the effect of a change of motive power on the traffic, and on the actual operating expenses. The result of the experiences detailed in those replies (and they were from representatives of all the well known systems) was singularly uniform. I found that there had been a great increase in traffic, varying from 30 per cent. to 500 per cent., following the change from horses to electricity, whereas the actual expenses (although formerly greater with electricity than with horses) were much less in proportion to the traffic with electricity than with horses, and that furthermore very frequently a real decrease in the running expenses was observed. I think that there are certain classes of roads which are operated every day by electricity, that never would be profitable operated by horses, and that is roads on grades which are far too severe for successful regular operation with horses, and which at the same time run through regions too sparsely settled to permit of surmounting grades by cables. There is a very considerable field of that kind which can not be operated except by electricity. We are now operating in many places 10 to 12 per cent. grades, and operating under circumstances where it would be almost impossible to handle the cars by any amount of animal power that you could get on the street. It is in these special cases that the advantages are most manifest, although I think to-day experience shows that in a fair sized system the actual running expenses per car mile are quite a little less with electricity than with horses. Of course on the great West End system that is very marked indeed, and that location is specially favorable. But the balance is, I think, in at least one half the cases that I have been able to get information about, in favor of electricity in the line of expense—the total expenses per car mile—quite aside from the question of increased travel.

ELECTRICAL STATISTICS FOR THE CENSUS.

The president read the following telegram with reference to the census statistics:

MR. ALLEN R. FOOTE: All investigations in charge of expert special agents have been postponed until after the meeting of Congress. All agents have been dropped, including yourself. Letter by mail

THE PRESIDENT: That is looking forward to dropping the idea of gathering together a lot of valuable statistics, right at the time when we are in the middle of it. Since that telegram was received the letter has also arrived, and I think has been handed to Dr. Mason, who will give us further information in relation to it, and will give us some suggestions.

DR. MASON: You will remember a year ago in our meetings resolutions were introduced relative to a committee on legislation, and a resolution was then adopted urging Congress to make an appropriation in support of the movement to take a thorough census of the electrical industry. A bill which had been introduced in Congress having this object in view was urged, but at the last moment, in the pressure of business, the matter was passed over, and no appropriation has ever been made for taking the census of the electrical industries. Some $15,000, which had been already expended, has been taken from other funds by General Porter—all the time hoping that they could get on in that way until an appropriation could be made by Congress. But in the confusion with regard to census matters General Porter has found himself obliged to take the action stated in this telegram, and followed up by the letter, which perhaps it is not necessary that I should read to you further than to say that in view of the facts in the case he states that it does not seem practicable for him to continue furnishing the funds as he has been doing, and without a special appropriation. In this letter he looks to the retaking up of the work on the part of Mr. Foote when proper appropriations shall have been secured. It seems to me of the utmost importance that at the present meeting this association should take definite action looking to the securing of the appropriation which was asked for a year ago, and which should have been granted at the session of Congress then being held. Personally I feel that Congress has been guilty of an absurdity. Look at the statistics which have been brought us here in the last hour relative to the applications of electricity as motive power in matters of traction. Look at what has been done in the past two years—and no statistics being gathered, no record being made in this census of the work of the last ten years particularly, all along the various branches of applied electricity. It is now proposed that this shall be dropped; that there shall go on the record with the census of 1890 no mention of electricity. The thing is absolutely absurd. It seems to me that if properly presented to Congress at its next meeting suitable action may be taken. But in the meantime what shall be done? After $15,000 has been expended on the work it is dropped. I doubt whether it can be laid down and taken up again. It should go on now, and some provision should be made by the secretary of the interior, which will enable this work to be finished. I beg to offer the following:

WHEREAS, the Hon. Robert P. Porter, superintendent of the eleventh census, has authorized the collection of the statistics of the electrical industries and has appointed Allen R. Foote special expert agent for that purpose; and.

WHEREAS, Mr. Foote has prepared schedules for the collection of such statistics covering nearly every known practical use of electrical energy; and,

WHEREAS, These schedules provide for information of great public value that is imperatively demanded for the intelligent discussion and settlement of questions of grave public importance; and,

WHEREAS, This association is advised that the work undertaken is in danger of being delayed, if not altogether abandoned, by reason of insufficient appropriation, thus utterly wasting the $12,000 or $13,000 already expended, and what is of far more serious moment, depriving the people of the benefits derived from a report that there is reason to believe would be a thorough and reliable authority on the subjects of which it treats.

Therefore be it *Resolved*

That this association respectfully requests the Hon. Robert P. Porter, superintendent of census, or, if he is not sufficiently empowered, the Hon. John W. Noble, secretary of the interior, to provide for the carrying to the earliest possible completion of the work so well begun.

That immediately upon the convening of the 52d Congress the executive committee of this association be directed to secure the reintroduction of Senate Bill No. 4320 of the 51st Congress appropriating $50,000 for the special work under Mr. Foote's direction and to use all proper means to secure its passage at the earliest possible date

That this association hereby expresses its approval and high appreciation of the work Mr. Foote has done in his official capacity as special agent of the eleventh census for the collection of the statistics of the electrical industries and its belief that the reports he may prepare, if enabled fully to carry out his plans therefor, as shown by the schedules submitted by him for examination, will have a value equal to that of the most valuable reports ever issued by the United States government

That the president and secretary of this association be directed to at once forward a certified copy of these preambles and resolutions to the Hon. John W. Noble, secretary of the interior, Hon. Robert P. Porter, superintendent of census, and Allen R. Foote, special agent for the eleventh census, at Washington, D. C.

I desire to say in addition that I hold in my hand several schedules which Mr. Foote has prepared in his foundation work for the gathering of the information needed with regard to matters connected with electricity, and I have examined them with a great deal of care. I do not consider myself competent to pass judgment upon them, but I will say this, as one who has something to do with statistics, that they are the most complete of any that I have ever seen. I had something to do with the census of 1880. I would say that I have examined every part

of it with the greatest care, and I know of no department of the census of 1890 that in its foundation work will compare with Mr. Foote's work as represented by the schedules in this book. I will go further and say of my own personal knowledge that the ablest men and the ablest judges in our country on this subject, such men for instance as those who are at the head of our great telephonic and telegraphic interests, have the same opinion that I have expressed, and look forward with profound interest to the completion of this work. We are not the only ones interested, but all the industries into which electricity is entering as a factor are interested in this question. I hope that this matter will not end with this association, but at the convention of the Street Railway association similar resolutions may be passed, and that action may be taken by all other associations who are interested in kindred matters.

MR. ARMSTRONG: I gladly second those resolutions, but I think we ought to go farther than that. I particularly appreciate what Dr Mason has referred to, as to stopping the work that has now begun. A delay of six months is a most serious thing for us. Why? Because we are trying to gain information which will enable us to make great strides in advance in the next six months. That is the reason why we have been having conventions twice a year. I apprehend that the reason why this work is permitted to lag is largely because it is not understood. I feel that the matter is of sufficient importance to make it advisable for us to have a committee headed by such a man as Dr. Mason to go to Washington. Our resolutions may go to Washington, but do you know, in the pressure of business, what is done with resolutions that are received there? The importance of the matter is not understood. It is not a toy that we are playing with, but how many there are who regard the whole electrical industry as simply a toy. They do not understand it. But those who come in contact with it and who know what a business it has become can appreciate it. There are very few, if any, more important industries in this country than those which are connected with electricity. The interest which we represent comprises only one department of the science, if I may so term it. Let us send from this body to Washington a committee, and if we have done nothing else at this convention, and the committee succeeds in having the work continued now, it will well have repaid us for coming here. I trust that Dr. Mason will add to his resolutions that a committee of three or of five members be appointed by this body to present the resolutions, and that they go to Washington and at once present them to the superintendent of the census, to the secretary of the interior, and, if it be necessary, to the president himself, in order that direction may be given for the continuance of this work. There is enough of interest in the work for us—there is enough involved in it for us as an association—to assume all the expense, and to take all the time necessary to be expended and to make all efforts that may be required to accomplish this work and prevent its being dropped for a month or for a week.

MR. FRANCISCO: I fully agree with Judge Armstrong in the position that he has taken with regard to this question. I have had occasion during the last year in a matter which I have had in hand regarding statistics to draw heavily upon the census department, and have received very valuable information which has been gathered as has been illustrated here. I hope and trust that this matter will be pushed vigorously, and that, as Judge Armstrong says, this association will take it up and carry it forward immediately. Let us not be content with merely sending these resolutions to Washington. Resolutions are not apt to be acted upon promptly. When they get to Washington they are hastily read, chucked under the table, and the colored boy picks them up and throws them in the waste basket. I have been there myself and I know how it works. I would offer as an amendment to Dr. Mason's resolutions, that the president appoint a committee, as Judge Armstrong suggests, and that Dr. Mason be made chairman of that committee.

DR. MASON: It is evidently the sense of the meeting that something of this sort should be offered, and I will offer this now if you will allow me. I move that a committee of three members of this association be appointed, whose duty it shall be to carry the resolutions to Washington.

The resolutions were unanimously adopted.

DR. MASON: I will now introduce the portion that I had in mind:

That a committee of five members of the National Electric Light association be appointed who shall carry to Washington the preamble and resolutions just adopted, present the same to the honorable, the superintendent of census, the honorable the secretary of the interior, and if desirable, to the president of the United States, and urge the necessary of containing, without a day's delay, the work of Special Agent Foote.

The resolution was unanimously adopted.

MR. SMITH: May I say that I know that circulars with regards to statistics have been received by electric light companies, some of which did not think they were called upon to give what the statistics asked for? They did not feel that the letter compelled them to do it, and they feared that some of the statistics might be made use of in an illegitimate way. Therefore there was some hesitation in giving the information. Would it not be wise for this association to issue a circular to every electric light company in the country, saying that the statistics were asked for from every electric company in the country; that the matter was very important, and that the information sought was useful to all the industry, and urging every one to make prompt replies. I speak now from experience and observation of the difficulty in the way of getting this information. I would like some one to make a motion to that effect. It strikes me also that it would be a good plan to bring influence to bear upon our representatives. If the secretary of the interior had $50,000 now to appropriate for this work, that would end the matter so far as we are concerned—if we can get him to do it, but I feel that if we wait for Congress to make the appropriation we may have to wait forever. I believe that every state should take up the matter and ask its representatives to present this matter, and support it in Congress when the proper time comes. If this be done the money will be appropriated, otherwise it may not be. I think it would be a very good plan for the different companies of the state to take it up and issue a letter from each company to the local representative in Congress. I think that plan would carry great weight.

THE PRESIDENT: I would state in reply to a suggestion as to the difficulty in collecting the statistics, that Mr. Foote has had a special agent go to as many cities and towns as he has had time to reach, and personally interview the central station men and get this information, which at a later date is to be incorporated in the records.

Dr. Mason presented the following:

[illegible]

The resolution was unanimously adopted.

WIRING AND INSURANCE RULES.

The report of the committee on wiring, etc, was then called up for discussion.

DR. MASON: In order to facilitate business here, I want to call attention to the last words in the recommendation attached to the report of the committee on safe wiring—for I prefer to call the committee by that name. I call your attention to the resolution which was offered by the committee.

That a committee of five be appointed by the president to act as a permanent committee on safe methods of construction and operation, and with instructions that may come from the committee from time to time to be called by the president.

I have made this motion at the initial stage of the consideration of this report, for the reason that whatever we may do with this report we need such a committee, and in the second place, because there has been a great deal of honest and earnest work done by this committee, and we cannot but appreciate its value. But at the same time neither this committee nor any other committee has presented a full report on this matter with rules which would be satisfactory to all of us, and probably they could not be presented until we had obtained the sanction of a majority of the association to them in every particular. There are certain things in this report which seem to me, if I may be allowed in that way to criticise it, to be absolutely absurd, as for instance when the committee commenced with the statement they "have formulated certain preliminary requirements which they think essential to safe wiring," and then say "These must not be considered as rules to be absolutely followed." Now, gentlemen, if we are to have rules that are absolutely essential to safe wiring, but which are not to be absolutely followed, why then let us stop work. I think that we ought to have adopted by this association certain rules which shall govern so far as we can control the future, all installations, or rather all installations in the future, and control them absolutely. If with the co-operation of all the insurance men, and of all the electrical engineers, and the expression of the wisdom of our own members, we cannot make such rules, then we ought to be ashamed of ourselves. I do not think we should adopt anything which we will not consider should be absolutely followed, but what we say should rather be in the nature of suggestions as to the line upon which each local association may form its own rules in detail, independently. Let us make rules, and let us make rules to be followed, and let us ask that they shall be followed. So much for that. Now, most of these rules will probably be acceptable, and accepted by every member of this association in just the form in which they have been presented. Others of them will not be so accepted. At least I know that I should question the expediency of some of them. When they shall be taken up seriatim I shall express my feelings in regrad to them. I desire, if that resolution shall be adopted, to have this matter taken up point after point as rapidly as may be done, in order that suggestions may be made and discussed, and in order that we may adopt what we can and then refer to this new committee all those on which we entertained doubts Let them consider them for another six months, and come in at the next meeting and present them to us Most of these rules we can adopt without question. We can leave the rest of them in the hands of this new committee.

MR. NICHOLS: I quite agree with the desire expressed by Mr. Mason to have the association adopt a code of rules, but will it not be necessary before we can adopt and enforce those rules, to have the insurance authorities agree with us as to the rules in detail?

MR. FRANCISCO: I will simply say with regard to this insurance business, that I am a member of the insurance fraternity of the United States, and from the knowledge that I have I am able to state that fifteen states have already practically adopted these rules as they appear here, and the New England Insurance Exchange will adopt them. I advocate the adoption of these rules just in the form that this committee has reported them. We appointed a committee which has spent a great deal of time in investigating the subject. That committee is composed of the ablest men we have in the association in respect to the subject on which they have been working. They are men who have had practical experience in this business, and who understand just what is required. They have gone over this entire field. Of course they have taken up all of these points, have investigated them, and have consulted with insurance companies and with the insurance associations of the different states with regard to all these different points. Now if you undertake to cut these rules up, and to change them, you will at once get into trouble with the Insurance association. The Insurance association of the Northwest practically adopted these rules. If you now change these rules of course you will bring a conflicting element into all those associations in the northwest, in the southwest and in the New England states at once. I trust that this association will adopt these rules just as they stand. If there is any little point that the members do not agree to, or think they cannot

[illegible]

devoted his time and contributed his experience in devising the [illegible]

[illegible]

son, of Mr. Francisco, or of Capt. Brophy, whether it would not be possible to go a little further than the committee has gone here in this resolution, and to have this [illegible] with the general scheme Dr. Mason is entirely satisfied. Let us therefore adopt it as a general scheme, just as the matter now stands, because if the notions of each member of the convention are to be applied to each one of these rules we shall not have time to do anything else during this convention. [illegible] this kind the committee can determine doubtful points better than the convention itself could determine them. So that I think it would be better to have the whole matter go back to the committee, provided, of course, the general scheme, as it stands, is satisfactory, and I apprehend that that is the case.

DR. MASON: I think that I have failed to make myself understood. The motion which I have made is simply to adopt a certain resolution, but if you will allow me I will answer these points now in order to make it clear. My point was exactly that which Judge Armstrong presents. I say let us adopt absolutely what you can, and deny nothing, but simply refer to the new committee matters in respect to which we are in doubt, in order that they may do just what we have said. Now it is no use for us to consider what the insurance people do. We settled it a year ago, that we did not care a fig what the insurance men might say, for we know more than they do about certain things. I say "we," for I am as largely interested as any of you in electric light and power plants. No matter what the insurance men may say we do not wish to adopt rules which do not commend themselves to us. We settled it a year ago that we would do this thing independently, after securing, as far as we might, all the wisdom that there was in them. I want you to understand that I desire to have the majority of these rules adopted and made absolute—not adopted tentatively, but adopted absolutely, and that everything on which we have serious doubt be referred back to the committee for its further consideration. I believe that Capt. Brophy, and every other member of the committee, if they will give me five minutes, will be convinced that they have made grave mistakes in respect to some of these rules.

MR. FRANCISCO: It stands just here with regard to the insurance companies: They insist upon certain conditions. If you don't comply with what they consider essential conditions you will get into trouble. Now the insurance people have conferred with this committee and they have practically approved these rules. By adopting them you not only secure the adoption by these insurance associations of your own committee's rules, but you make a harmonious thing through the whole field.

MR. ARMSTRONG: I want to be informed by the committee whether if we adopt these rules we make them absolute rules or make them as rules which we may use or not, just as we please.

THE PRESIDENT: I thought you were going to raise a point of order. The question before the house is on the adoption of the resolution recommended by the committee—that a committee of five be appointed for future action relative to the safety of wires. That motion has nothing whatever to do, as I understand, it with the adoption of these rules by this association. We have received the report of that committee, but we are making no disposition of the report of the committee as yet as I understand this resolution.

MR. ARMSTRONG: I understand that a point of order may be raised, but it seems to me that this resolution is broad enough to let the whole scope and scheme of the committee come in for discussion under it—because if we do not want the scheme we do not want the committee.

THE PRESIDENT: We want a new committee for future work, but as to the adoption of these rules, that is something that will come before the convention after the pending resolution is disposed of.

The resolution was adopted.

THE PRESIDENT: Now you have before you, as I understand it, the report of the committee on rules for safe wiring, and it is for you to signify your pleasure in the matter. It seems to me that while we all have confidence in our committee, still I do not think there are any of us who want to adopt these rules without first having an opportunity to go through them in detail. As suggested by Dr. Mason it will take a good deal of time to go through them in detail in this convention, but I can see no harm in receiving the report, permitting the thing to stand as it is, and making it a special order of business for the next meeting of the convention.

MR. ARMSTRONG: Is it at all necessary under the resolution that we have already adopted to do anything at all? We have appointed a committee which committee will be the arbitrator of rules for safe wiring. I take it that it would be a waste of time for us even to attempt to adopt these rules, and I am sure it would not be a mark of wisdom for a popular convention, as this is, to undertake to adopt these rules. We have now resolved to appoint a permanent committee on safe methods of construction and operation. Within a year these rules in many essential points may be absolutely changed. I know that in our station we have had to throw out things which a while ago were recommended as important or essential, and the things now adopted may soon have to be changed for something else. So, while these rules may stand as suggestions, coming from the committee it would be inadvisable to adopt any of them absolutely.

MR. MASON: [illegible]

do? We throw this matter into the hands of other people. There are rules here which I declare to you are absolutely absurd, and I cannot understand how they could have passed this committee. What are we to do with them? Are we to leave ourselves to be bound by rules which we cannot approve? In what position as members of the National Electric Light association do we stand?

Upon motion of Mr. Armstrong the convenaion went into executive session, and afterward reported the following rules:

TABULATING WIRING AND INSURANCE RULES:

CLASS A.

CENTRAL STATIONS FOR LIGHT OR POWER.

Generators or motors must be:

1. Located in a dry place.
2. Insulated on floors or base frames which must be kept filled to prevent absorption of moisture, and also be kept clean and dry.
3. Not exposed to flying or combustible materials.
4. Each covered with a waterproof cover when not operating.

In no case must a generator be placed in a room where any hazardous process is carried on, such as the working room of a cotton, jute, flax, woolen or flour mill.

CARE AND ATTENDANCE.—A competent man must be kept on duty in the room where generators are operating.

Oily waste must be kept in metal cans and removed daily.

CONDUCTORS.—From generators, switch-boards, rheostats, or other instruments, and thence to outside lines, conductors must be:

1. In plain sight.
2. Wholly on non-combustible insulators, such as glass or porcelain.
3. Separated from contact with floors, partitions or walls through which they may pass, by non-combustible insulating tubes.
4. Kept rigidly so far apart that they cannot come in contact.
5. Covered with non-inflammable insulating materia, sufficient to prevent accidental contact.
6. Ample in carrying capacity to prevent heating. (See Capacity of Wire Tables.)
7. Connected by splices or joints equal in carrying capacity to the conductors themselves, soldered if necessary to make them efficient and permanent.
8. When under floors or in distributing towers, placed in spaces ample for inspection and ventilation, and provided with special insulating covering.

Switch-boards must be:

1. So placed as to make it impossible to communicate fire to surrounding combustible material; accessible from all sides when the connections are on the back; or may be placed against a brick or stone wall when the connections are entirely on the face.
2. Kept free from moisture.
3. Made of non-combustible material, or of hard wood, filled to prevent absorption of moisture.
4. Equipped with bars and wires in accordance with rules 1, 2, 3, 4, 5, 6 and 7 for placing conductors.

Resistance boxes and equalizers must be:

1. Equipped with metal or non-combustible frames.
2. Treated as sources of heat.
3. Placed on the switch or a distance of a foot from combustible material, or separated therefrom by asbestos or cement.

Lightning arresters must be:

1. Attached to each side of every overhead circuit connected with the station.
2. In plain sight.
3. On the switch-board or in equally accessible place, away from combustible material.
4. Connected with at least two earths by separate wires of large size.
5. So constructed as not to maintain an arc after the discharge has passed.

TESTING—All series and alternating circuits must be tested every two hours while in operation to discover any leakage to earth, abnormal in view of the potential and [illegible] operation.

All multiple arc low potential systems (300 volts or less) must be provided with an indicating or detecting [illegible] readily attainable, to afford easy means of testing where the station operates perpetually.

Data obtained from all tests must be preserved for examination by insurance inspectors.

CLASS B.

[illegible] SYSTEMS.

[illegible] outside overhead conductors [illegible]

1. Covered with some insulating material, not easily [illegible]

[illegible] an insulation equal to that of the conductors they confine.

[illegible]

be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.

6. Provided with petticoat insulators of glass or porcelain. Porcelain knobs and rubber hooks are prohibited.
7. So spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered to insure preservation and covered with an insulation equal to that on the conductors.

The following formula for soldering fluid is approved:

Saturated Solution of Zinc....5 parts
Alcohol......................4 parts
Glycerine.....................1 part

Conductors should not be run over or attached to buildings other than those in which light or power is being, or is to be used, but on separate poles or structures always easily inspected.

Service blocks must be covered over their entire surface with at least two coats of waterproof paint and so maintained.

Telegraph, telephone and similar wires must not be placed on the same arm with electric or power wires and should not be placed on the same structure or pole.

INTERIOR CONDUCTORS.

All Interior Conductors must be:

1. Where they enter buildings from outside terminal insulators to and through the walls, covered with waterproof insulation, and must have drip loops outside, preferably slanting upward toward the inside and bushed with moisture-proof and non-combustible insulating tube.
2. Arranged to enter and leave the building through a double contact service switch, which will effectually close the main circuit and disconnect the interior wires when it is turned "off." The switch must be so constructed that it shall be automatic in its action, not stopping between points when started, and prevent an arc between the points under all circumstances; it must indicate on inspection whether the current be "on" or "off," and be mounted on a non-combustible base in a position where it can be kept free from moisture, and easy of access to police or firemen.
3. Always in plain sight, never covered, except in special cases, where an armoured tube may be necessary.
4. Covered in all cases with a waterproof non-combustible material that will adhere to the wire, not fray by friction, and bear a temperature of 150 degrees F. without softening.
5. In dry places, kept rigidly apart at least one foot, except when covered (in addition to insulation) by a waterproof, non-conducting and non-inflammable tubing, which must be strong enough to protect the insulating covering from injury. Conductors thus placed may be run not less than three inches apart, and be fastened with staples, under which are placed mechanically rigid insulating strips or saddles of greater width than the metal of the staple, by which possibility of injury to the tube may be prevented.
6. In damp places, attached to glass or porcelain insulators, and separated ten inches or more.
7. When passing through walls, floors, timbers or partitions, treated as in central stations under like conditions.

LAMPS AND OTHER DEVICES.

Arc lamps must be in every case:

1. Carefully isolated from inflammable material.
2. Provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base. No broken or cracked globes may be used.
3. Provided with a hand switch, also an automatic switch, that will shunt the current around the carbons, should they fail to feed properly.
4. Provided with reliable stops to prevent carbons from falling out in case the clamps become loose.
5. Carefully insulated from the circuit in all their exposed parts
6. Where inflammable material is near or under the lamps, provided with a wire netting around the globe and a spark-arrester above, to prevent escape of sparks, melted copper or carbon.

Incandescent lamps in series circuits, having a maximum potential of 350 volts or over, must be governed by the same rules as for arc lights, and each series lamp provided with a hand switch and automatic cut-out switch; when lights are in multiple series, such switches and cut-outs must not control less than a single group of lights. Electro-magnetic devices for switches are not approved.

Under no circumstances will incandescent lamps on series circuits be allowed to be attached to gas fixtures.

CLASS C.

INCANDESCENT (LOW PRESSURE) SYSTEMS—300 VOLTS OR LESS.

Outside overhead conductors must be:

1. Erected in accordance with general rules for Arc (Series) Circuit Conductors.
2. Separated not less than six inches, where they enter buildings as service conductors, and be provided with a double pole fusible cut out, as near as possible to the point of entrance to the building, and outside the walls when practicable.

Underground conductors must be:

1. Provided with suitable protecting devices at the ends of tube or conduit services inside the walls of buildings, as a guard against moisture and injury.
2. Terminated at a properly placed double pole house cut-out.
3. [illegible] insulated conductors after leaving the [illegible] and separated at least ten inches, [illegible]

INSIDE WIRING.

Wire should be so placed that in the event of the failure or deterioration of their insulating covering the conductors will still remain insulated.

At the entrance of every building there shall be a double pole switch placed in the service conductors, whereby the current may be entirely cut off.

Conductors must not be:

1. Of sizes smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G.
2. Lead or paraffine covered.
3. Covered with soft rubber tube.
4. Laid in mouldings of any kind in damp places.
5. Laid in mouldings with open grooves against the wall or ceiling.
6. Laid in mouldings where less than half an inch of solid insulation is between parallel wire, and between wires and walls or ceilings.

Cleatwork is not desirable, and cleats must not be used unless

1. In a very dry place.
2. In a place perfectly open for inspection at any time.
3. They are of porcelain, or well-seasoned wood, filled, to prevent absorption of moisture.
4. They are so arranged that wires of opposite polarity, with a difference of potential of 150 volts or less, will be kept at least two and one-half inches apart, and that where a higher voltage is used, this distance be increased proportionately.
5. There is a backing provided, of wood at least half an inch thick, well seasoned and filled, to prevent absorption of moisture.

Metal staples must never be used to fasten conductors unless

1. Provided with an insulating sleeve or saddle rigidly attached to the metal of the staple and having such strength and surface as to prevent mechanical injury to the insulation of the conductor.
2. Under conditions in which cleatwork would be acceptable or where driven into a moulding specially adapted for open work.

SPECIAL WIRING.

Wherever conductors cross gas, water or other metallic pipes, or any other conductors or conducting material (except arc light wires), they should be separated therefrom by some continuous non-conductor at least one inch. In crossing arc light wires the low tension conductors must be placed at a distance of at least six inches. In wet places an air space must be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run over all pipes upon which condensed moisture is likely to gather, or which by leakage might cause trouble on a circuit.

In breweries, dye-houses, paper and pulp mills, or other buildings specially liable to moisture, all conductors, except where used for pendants, must be:

1. Separated at least six inches.
2. Carefully put up.
3. Supported by porcelain or glass insulators.

Moisture-proof and non-inflammable tubing may be accepted in lieu of such construction.

No switches or fusible cut-outs will be allowed in such places.

Interior Conduits must not be:

1. Combustible.
2. Of such material or construction that the insulation of the conductor will ultimately be injured or destroyed by the elements of the composition.
3. So constructed or placed that difficulty will be experienced in removing or replacing the conductors.
4. Subject to mechanical injury by saws, chisels or nails.
5. Supplied with a twin conductor in a single tube where a current of more than 10 amperes is expected.
6. Depended upon for insulation. The conductors must be covered with moisture-proof material.

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury, and as far as possible from moisture.

Twin tube conductors must not be separated from each other by rubber or similar material, but by cotton or other readily carbonizable substance.

Conductors passing through walls or ceilings must be encased in a suitable tubing, which must extend at least one inch beyond the finished surface until the mortar or other similar material be entirely dry, when the projection may be reduced to half an inch.

Double pole safety cut-outs must be:

1. Placed where the overhead or underground conductors enter a building and join the inside wires.
2. Placed at every point where a change is made in the size of the wire (unless the cut-out in the larger wire will protect the smaller). This includes all flexible conductors. All such junctions must be in plain sight.
3. Constructed with bases of non-combustible and moisture-proof material.
4. So constructed and placed that an arc cannot be maintained between the terminals by the fusing of the metal.
5. So placed that on any combination fixture no group of lamps requiring a current of six amperes or more shall be ultimately dependent upon one cut-out.
6. Whenever used for more than six amperes or (where the plug or equivalent device is not used) equipped with fusible strips or wires provided with contact surfaces or tips of harder metal soldered or otherwise having perfect electrical connection with the fusible part of the strip.

Safety fuses must be so proportioned to the conductors they are intended to protect that they will melt

before the maximum safe carrying capacity of the wire is exceeded.

All fuses, where possible, must be stamped or otherwise marked with the number of amperes equal to the safe carrying capacity of the wire they protect.

All cut-out blocks when installed must be similarly marked.

The safe carrying capacity of the wire changes under different circumstances, being about forty per cent. less when the wire is closed in a tube or piece of moulding than when bare and exposed to the air, when the heat is rapidly radiated. It must be clearly understood that the size of the fuse depends upon the size of the smallest conductor it protects, and not upon the amount of current to be used on the circuit. Below is a table showing the safe carrying capacity of conductors of different sizes in Birmingham, Brown & Sharp, and Edison gauges, which must be followed in the placing of interior conductors.

Brown & Sharp		Birmingham		Edison Standard.	
Gauge No	Amperes	Gauge No	Amperes	Gauge No	Amperes
000	175	0000	175	000	175
00	145	000	150	00	160
0	125	00	130	0	135
1	110	0	110	1	110
2	95	1	95	2	95
3	80	2	85	3	85
4	70	3	75	4	75
5	50	4	65	5	65
6	45	5	60	6	60
7	35	6	50	7	50
8	30	7	45	8	40
9	25	8	35	9	30
10	20	9	30	10	25
12	15	10	25	12	20
14	10	11	20	13	15
16	5	12	15	14	10
		13	10	15	5
		14	5		

Switches must:

1. Be mounted on moisture-proof and incombustible bases, such as slate or porcelain.
2. Be double pole when the circuits which they control are connected to fixtures attached to gas pipes, and when six amperes or more are to pass through them.
3. Have a firm and secure contact, must make and break readily, and not stick when motion has once been imparted by the handle.
4. Have carrying capacity sufficient to prevent heating above the surrounding atmosphere.
5. Be placed in dry accessible places, and be grouped as far as possible, being mounted, when practicable, upon slate or equally indestructible back boards.

Motors.—In wiring for motive power, the same precautions must be taken as with the current of the same volume and potential for lighting. The motor and resistance box must be protected by a double pole cut-out and controlled by a double pole switch.

Arc lights on low potential circuits must be:

1. Supplied by branch conductors not smaller than No. 12 B. & B. Gauge.
2. Connected with main conductors only through double pole cut-outs.
3. Only furnished with such resistances or regulators as are inclosed in non-combustible material, such resistances being treated as sources of heat.
4. Supplied with globes protected as in case of arc lights on high potential circuits.

FIXTURE WORK.

1. In all cases where conductors are concealed within, or attached to fixtures, the latter must be insulated from the gas pipe system of the building.
2. When wired outside, the conductors must be so secured as not to be cut or abraded by the pressure of the fastenings, or motion of the fixtures.
3. All conductors for fixture work must have a waterproof insulation that is durable and not easily abraded, and must not in any case be smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G.
4. All burrs or fins must be removed before the conductors are drawn into a fixture.
5. The tendency to condensation within the pipes must be guarded against by sealing the upper end of the fixture.
6. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.
7. Each fixture must be tested for possible "contact" between conductors and fixture, and for "short circuits," before the fixture is connected to its supply conductors.
8. The ceiling blocks of fixtures should be made of insulating material.

ELECTRIC GAS LIGHTING.

Where electric gas lighting is to be used on the same fixture with the electric light:

1. No part of gas piping or fixture shall be in electrical connection with the gas lighting circuit.
2. The wires used with the fixture must have a non-inflammable insulation, or where concealed between the pipe and shell of the fixture, the insulation must be such as is required for fixture wiring for the electric light.
3. The whole installation must test free from "grounds."
4. The two installations must test perfectly free of connection with each other.

PENDANTS AND SOCKETS.

No portion of the lamp socket exposed to contact with outside objects must be allowed to come into electrical contact with either of the conductors.

Cord Pendants must be:

1. Made of conductors, each of which is composed of several strands insulated from the other conductor by a mechanical separator of carbonizable material, and both surrounded in damp places with a moisture-proof and a non-inflammable layer.
2. Protected by insulating bushings where the cord enters the socket.
3. So suspended that the entire weight of the socket and lamp will be borne by knots, above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws. All sockets used for wire or cord pendants should have openings at least equal to one-quarter inch gas-pipe size.
4. Allowed to sustain nothing heavier than a four-light cluster, and in such a case special provision should be made by an extra heavy cord or wire, as a mechanical reinforcement.
5. Equipped with keyless sockets as far as practicable, controlled by wall switches. In no case may a lamp giving more than fifty (50) candle power be placed in a key-socket on a flexible pendant.

CLASS D.

ALTERNATING SYSTEMS—CONVERTERS OR TRANSFORMERS.

Converters must not:

1. Be placed inside of any building except the central station, unless as hereinafter provided.
2. Be placed in any but metallic or non-combustible cases.
3. Be attached to the outside walls of buildings, unless separated therefrom by substantial insulating supports.
4. Be placed in any other than a dry and convenient location (which can be secured from opening into the interior of the building, such as a vault) when an underground service is used.
5. Be placed without safety fuses at the junction between main and service conductors and safety fuses in the secondary circuits where they will not be affected by the heat of the converter.

PRIMARY CONDUCTORS.

In those cases where it may not be possible to exclude the transformers and primary wires entirely from the building, the following precautions must be strictly observed:

1. The transformer must be located at a point as near as possible to that at which the primary wires enter the building.
2. Between these points the conductors must be heavily insulated with a coating of moisture-proof material, and in addition, must be so covered and protected that mechanical injury to them or contact with them shall be practically impossible.
3. The primary conductors, if within a building, must be furnished with a double pole switch, and also with an automatic double pole cut-out where the wires enter the building, or where they leave the main line, on the pole or in the conduit. These switches should, if possible, be inclosed in secure and fireproof boxes outside the building.
4. The primary conductors, when inside a building, must be kept apart at least ten inches, and at the same distance from all other conducting bodies.

SECONDARY CONDUCTORS.

The conductors from the secondary coil of the transformer to the lamps or other translating devices must be installed according to the rules for "inside wiring" for "Low Potential Systems."

CLASS E.

ELECTRIC RAILWAYS—POWER STATIONS.

All rules pertaining to arc light wires and stations, shall apply (so far as practicable) to street railway power stations and their conductors.

RAILWAY SYSTEMS WITH GROUND RETURN.

Electric railway systems in which the motor cars are driven by a current from a single wire, with ground or floor return circuit, are prohibited except as hereinafter provided:

1. When there is no liability of other conductors coming in contact with the trolley wire.
2. When the location of the generator is such that the ground circuit will not create a fire hazard to the property.
3. When an approved automatic circuit breaker or other device that will immediately cut off the current in case the trolley wires become grounded, is introduced in each circuit as it leaves the power station. This device must be mounted on a fireproof base, and be in full view of the attendant.

TROLLEY WIRES.

Trolley Wires must be:

1. No smaller than No. 0 B. & S., copper or No. 4 B. & S., silicon bronze, and must readily stand the strain put upon them when in use.
2. Well insulated from their supports, and in case of the side or double pole construction, the supports shall also be insulated from the poles immediately outside the trolley wire.
3. Capable of being disconnected at the power house, or of being divided into sections, so that in case of fire on the railway route, the current may be shut off from the particular section and not interfere with the work of the firemen in extinguishing the flames. This rule also applies to feeders.
4. Safely protected against contact with all other conductors.

CAR WIRING.

All wires in cars must be run out of reach of the passengers, and shall be insulated with a waterproof insulation.

LIGHTING AND RAILWAY POWER WIRES.

Lighting and power wires must not be permitted in the same circuit with trolley wires with a ground return, except in street railway cars, car houses, and power stations. The same dynamo may be used for both purposes, provided the connection from the dynamo

[illegible] time.

CLASS F.

[illegible] private [illegible] latter [illegible] from [illegible] ence of potential.

CLASS G.

1. The wiring [illegible] "grounds" before the current is turned on. This test may be made with [illegible] resistance of [illegible] 250 volts are used.
2. No ground wire [illegible] attached to gas pipe [illegible]
3. All conductors connecting with telephone, district messenger, burglar alarm [illegible] and other similar instruments must, if in any portion of the length they are liable to become crossed with circuits carrying currents for light or power, be provided near the point of entrance to the building with some protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest an abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor through which it may become charged with a relatively high pressure.

Certain questions have come before the committee, which they considered of too great importance to be decided at this stage. Among these are the subjects of the grounding of the neutral wire in compensating or three wire systems—the grounding, either permanently or by automatic cut-outs, of the secondary wires in transformer systems—the adoption of a uniform alloy for fusible cut-outs—and the adoption of better methods for testing circuits.

From the nature of the electrical business and the rapid advance it is making, there must, of necessity, continually arise questions which can only be decided by a later and larger experience, therefore the object of the association would be best served by the appointment of a permanent committee to which should be referred all such questions, which it shall consider and report upon at the next succeeding meeting of the association.

Your committee, therefore, offers the following:—

Resolved: That a committee of five be appointed by the president to be a permanent committee on safe methods of construction and operation—any vacancies that may occur on the committee from time to time to be filled by the president.

The resolution was adopted.

C. J. Field then read the following paper on Electric Railway Construction and Operation.

ELECTRIC RAILROAD CONSTRUCTION AND OPERATION AND A CONSIDERATION OF THEIR CONNECTIONS WITH CENTRAL STATION INTERESTS.

BY C. J. FIELD.

The advantages of the electric railway have passed beyond the age of experiment or question. They are proved by their development in the past four years, and any argument as to their advantage in the general development of street railway practice or suburban rapid transit is antedated. It took several years to convince old staid financiers and directors of the larger street railway properties that it was to their financial advantage to throw in the scrap heap several million dollars, more or less, in equipment and spend that amount in addition and still make it pay; but they have seen this advantage in the development and increase of traffic and returns to the company. These returns have been brought about principally by the development of rapid transit, in the introduction of electricity and the flexibility of the system in adapting itself to all and any conditions of commercial practice.

In looking over the past four years of practice in electric railway work, we have much to commend and considerable to condemn. The boldness of the achievements, the problems that have been solved, the rapidity of development and the perfection of the apparatus, seem almost beyond comprehension. That this apparatus, in less than four years, should reach the high state of perfection, economy and efficiency that it has, as compared to the [illegible] years of development of other mechanical appliances, is remarkable. The natural consequence of this large amount of work and development in this short time is that there has been much work done that had better been left undone, in the way of poor engineering, cheap work, and not a proper appreciation of the problem to be solved. These, in some poor instances, have retarded the development and progress of electric railway work in their vicinity, but street railway companies have now come to a proper appreciation of the necessity of good work well done and that the wisest and best method is to consider economy in what will bring the best return for the money invested—not necessarily on the blind basis of the highest cost being the cheapest, for money can be wasted in this way as well as others. We have examples now in several [illegible] large equipments being installed on a sound engineering basis and with careful consideration of the best interests of the electrical interests, street railway owners and public combined, and we can safely add that there is no problem in this line which cannot to day be taken up with a full assurance of practical solution and successful development in electric railway traction.

The future outlook of electricity in the development of rapid transit, inter-suburban, and even express service, is assured. We are coming on to the solving of the larger problems in this work and, bringing the public to a proper

appreciation of the resources and possible achievements in this line and its superiority over the old fogy systems of the past. We even see a considerable number of our friends from cable engineering lines of street railroad work coming over into the electrical fold, fully appreciating that the cable system has a very limited field for successful development and that electric traction is very broad gauge in the field of engineering work. Therefore, with this outlook, better construction work, better engineering, better mechanics, the solving of these larger problems is assured, and we see even to-day, in a number of cases, electric suburban traffic supplanting steam on a cheaper, better and more succesful basis. The favorable report of the New York Rapid Transit Commissioners has done much to add to public confidence in this direction. Electric manufacturing companies are assisting the development of the work by making their apparatus more substantial, better in construction and more satisfactory in its mechanical design and operation. The reduction in the speed of motors, the development of single reduction and even of direct connected motors, is doing much to add to the confidence in this line.

We hear asked sometimes, by laymen, the question: "What speed can electricity obtain in railway work?" The able consideration of this subject in several papers, and practical experiments as well, enables us to reply very briefly but confidently to this inquiry, that speed and power in electric railway traction are only limited by roadbed construction; in other words, any speed is obtainable within the range of possibility, with the maintenance of proper track. We do not intend, however, to generally review electric railway work, but more particularly to give some details of the practical problems in their construction and operation, and, therefore, we will leave the consideration of other parts of the subject to papers, which will, no doubt, treat it more fully.

The consideration of the best developement in the power generation of electric railway work has been one that has received considerable attention in past years from the best engineers in this line. We reach here a part of the problem which requires much more careful consideration than has been given steam power in electric lighting generally in the past. The work to be successfully done by the steam engine in the generation of electricity for the operation of railroads is the severest kind, and can be compared only to that of the engine operating rolling mill trains. It is owing to not fully appreciating this fact that we hear in some parts of the country of failures of steam plant on this kind of work. Electrical manufacturers are assisting the solution of this problem by the building of larger generators in units of 200 to 400 or 500 horse power. What we want in the generating station for electricity is the smallest division of units consistent with the safe and economical operation of the station. Following the problem out on this line, we can build a successful station; and we would add to this that each unit should be entirely independent and separate from all other units, thereby increasing the reliability. This cannot be obtained in a safe and economical way by the use of our old friend, the countershaft. Undoubtedly, the countershaft has been of much use in electric lighting service, and particularly in arc lighting, but in railway work, with large generators, we can see no excuse at the present time for its use. Generators should be belted direct to the engines, whether Corliss or high speed, or else coupled direct to the engine shaft. With a Corliss engine of 500 horse power, operating at 80 or 90 turns, with a fly-wheel of 18 or 20 feet in diameter, we can belt with belt centers of, say, 40 feet, 2 inches, generators of several different commercial types; this gives us advantages which we have heretofore had only in high speed engines with direct connection. The engines should, in any event, as heretofore stated, be extra heavily built for the work to be done, with ample fly-wheel capacity. On engines of this size and speed a fly-wheel capacity of approximately 60,000 lbs is about right. On engines operating about 150 turns, say, 30,000 to 40,000 lbs.

While laying particular stress on the rapid and sudden changes of load, we do not know how to illustrate it more forcibly than in a practical case of changes in the indicator diagram within one minute, placed on the cylinder of an engine running on railway work, which shows a variation within that time of from full load to no load and back again several times. These cases impress on the mind more forcibly than words can the requirements of this work. High speed engines in the development of railway work have received in some cases a setback, owing to the engine manfacturers not appreciating fully the conditions and necessity of the work undertaken. So-called high speed or automatic engines can be as successfully operated on this class of work as any other, if they are specially built [illegible] of more ample [illegible] there should [illegible]. The bearings [illegible] 15 or 17 inches in length. In the case of engines built in this manner, there [illegible]

company is having built, for the electric railroad at Buffalo, two engines of this class, by the Lake Erie Engineering Works, which we believe will do much to develop this line of work, and, also, will be particularly adapted for coupling direct to the engine shaft. The trouble in this line has been to get electric manufacturing companies to take up the building of large multipolar generators adapted for direct coupling at a speed of from 100 to 200 revolutions. This problem was developed on a much smaller scale in this country, for marine plants, several years ago. We find that in Europe, where their work has been more special, that they have successfully developed this type of engine and generator, and beyond any question, it is going to be both for lighting work and for railway work the type of unit for central station practice in the future. It means, where the vertical engine is used, the installation of the steam and electric plant in the space formerly used for engines alone. This means reduction in the cost of building, operation and maintenance.

In concluding this part of our subject on steam generation, we trust that our experience in the past in lighting will show us the fallacy of poor steam engineering, and that we will build our stations for the future, and not have the problems before us nine-tenths of the electric lighting stations have today, which mean, that in order to get down to commercial economy and competition, they have got to rebuild their whole outfit. We will merely append to the consideration of the steam plant part of our problem a few interesting figures and data which the writer collected for presenting to street railway companies, in order to give them some useful information in this respect. We believe that they may be well introduced here. The figures given on the tables, etc., are not ones that the manufacturer of an engine would tell you were those of the best economy for his engine or plant, but they are figures which will be appreciated by station owners and railway companies as those which are obtained in everyday commercial tests.

The relative commercial economy of engines and cost as follows:

TYPE	Lbs. of Coal per H. P. Hour	Cost per H. P. Sets Over 100 H. P.	Lbs is based on an evaporation of [illegible] lbs water per lb of coal.
High speed single ...	4 to 5	$11 to $13	
" " compound	3 to 3½		
" " " cond	2¼ to 2½	14 to 16	
" " " triple	1¾ to [illegible]	18 to 22	
Corliss single	3½ to 4	16 to 18	
" compound cond	1⅔ to 2	22 to 25	
Corliss triple ...	1½ to 1⅔	27 to 30	

There are four classes of boilers:

1. Horizontal return tubular, which is the most general in use, and costs $9 to $10 per horse power.

2. Vertical tubular (Corliss or Manning) which is a vertical tubular boiler with water leg, giving an internal firebox, economical in floor space, largely used throughout New England. Cost $10 to $12 per horse power.

3. Sectional or water tube boiler, of which Babcock & Wilcox is the best known, especially adapted for higher pressures and safety. Cost $17 to $19 per horse-power.

4 Scotch type of marine boiler—one that has not been used to any extent as yet in station work—but we believe it will be as an offset to the sectional type, and fulfilling the requirements for higher pressure and economy of space.

Capacity of engine requisite for different generators:

Generator	ENGINE.						
		High Speed.			Corliss.		
Watts.	Horse Power	Size	Speed	Wt. of Fly-Wheels	Size	Speed	Wt. of Fly-Wheels
50,000	75	12 x12	2[illegible]	7,000 lbs.	....	.	....
80,000	125	[illegible]x16	225	[illegible] "		.	..
[illegible]	[illegible]	[illegible]¼x18	200	[illegible] "	20x36	[illegible]	[illegible] lbs.
[illegible]	45[illegible]		.	....	24x40	80	[illegible] "

Steam pressure, 100 lbs.

The cost of steam plant complete is about $50 to $60 per horse-power for high speed, and $65 to $75 per horse-power for Corliss.

The question of the best electrical generating plant for railway work is one which is allied closely to that of steam plant, particularly in relation of the generators to that of the engines. In some respects, in treating of the steam plant, we have intimated what our idea was in connection with the generators. All large generators of from 200 to 500 horse power connected as directly as possible, either by direct belting or shaft coupling, with the engines operating the same. It is only by this development that the safest and best solution of electric railway station practice —in fact, station practice in general—can be reached. Manufacturers of railway generators have had an experience extending back many years, that experience in the development of direct current incandescent machinery, although not of quite the same voltage, has led the way up to the safe, economical and commercial development of railway generators; and we find the railway generator of to-day one of the most perfect and reliable factors in the electric railway system. The only problem remaining to [illegible] connection is to build them in larger [illegible] speed for direct shaft coupling [illegible] to the severest and [illegible] particularly those of small type, [illegible] going to remove,

to a great extent, the question of the overloading of the machine. Railway machines are often subjected to an overload of from 25 to 50 per cent. In general these are only momentary, and we find most of them able to stand up to the work to be done.

The question which puzzles many of the railway companies, as well as the electric companies, is what amount of generating capacity is necessary for the operation of a given number of cars. This question, of course, has got to be carefully considered in connection with each case, but there can in a general way be laid down an approximate basis for this work. Some railway companies, in order to show a higher economy than their competitors, are unwisely claiming the requirement of a smaller amount of power than others; but the wisest manufacturer is the one who urges his client to install a larger amount of power than is barely required for the successful operation of the road under any and all conditions. For if any one thing will lead the public to condemn the electric railway traction it is a lack of power, thereby causing the cars to move slowly, and in case of any accident, disabling part of the power. A fair basis on general conditions for 16 to 18 foot car bodies is 20 to 25 horse power per car, which, with a properly designed and constructed plant, will give the desired power. The cost of generating this power for railway work for 16 and 18 foot cars is three to five cents per car mile for all expenses of the generating station. In some roads we find that cars of a larger size than these do not necessarily take a proportionately larger amount of power. We find from practical experience that a car 32 or 33 feet long, double the size of the 16 foot car, takes, under general conditions, about 50 per cent. more power, and we find by the same experience that a trail car adds about 50 per cent. to the amount of work to be done on the motor car for the same size. As to the minimum and maximum amount of power taken on an electric car, we find that a general average for a 16 foot car, under ordinary commercial conditions, without excessive grades, is one horse power per car mile per hour; or, a car operating at an average 10 miles per hour means an average of 10 horse power per car. This same car will give, however, on a load diagram, taking all its conditions, from maximum to minimum, a variation of from nothing to 50, 60 and even 80 horse power. This gives us an idea of the severe strains and conditions to which an electric motor is subjected.

One of the questions on which we find more variety of opinion than any other is what is the best size, type and style of car for given case and conditions. The old standard 16 foot car body we find is now being widely departed from, and the problem is: How large a car can we get on a single truck with four wheels without excessive destructive effect on the roadbed? and, What is the longest car we can operate on street car service economically on an eight wheel base? We believe the limit is reached with a single truck in a 20 foot car body; we know that the truck manufacturers claim in some cases to operate a longer body, but we do not believe it wise. An 18 or 20 foot car running under close headway we believe to fulfill best the conditions of city traffic in the larger cities. Such a car with a wheel base of seven feet, and in some cases seven feet six inches, where curves are not too sharp, will give satisfaction, and not be too severe on the roadbed where the same is properly constructed. As to the difference in effect on the roadbed between the electric car and the horse car, it is briefly that the horse car is pulled by horses, from which it receives a balancing power and a steady pull, whereas an electric car is operating itself by a power moving the wheels against the track, having no steadying or balancing power from the pull of the horses, and transmitting all its power and moving itself through the wheels. We find, therefore, that it subjects the track to a very severe pounding, necessitating a much better construction of roadbed, practically equaling that of a steam railroad.

Some companies have favored the use of a vestibule on street cars. We believe, though, that any vestibule is a failure and a misnomer. It accomplishes no good and causes much trouble; a shield over the dashboard for the motor man in winter weather would give all that would be required. What is wanted on a street car is that which will allow the freest ingress and egress from the car for the passengers, and anything that retards this—and a vestibule most certainly does—is a detriment and an obstacle to rapid transit. On some roads we have tried the introduction of even larger cars, say, 28 foot body, or 30 feet over all. Such a car, of course, has to be put on a double truck. These cars have found favor with some companies when first considering the problem; the difficulty with them is in getting the passengers in and out of the cars as quickly as possible, and making too many stops, due to the larger number of passengers carried. For inter suburban heavy traffic, with few stops, we believe such a car would fulfil the requirements, but only in such a case.

Thus, having gone over the question of the cars, we come to the consideration of the electric equipment for the same. To-day we find the double reduction motor discarded, as far as any new equipments are concerned. All the large electric manufacturing companies are placing single reduction motors on the market, and they are in successful commercial operation. One company is placing on the field a motor directly connected to the shaft and without any gearing—in other words, there is no reduction in speed, the speed of the armature being the same as that of the wheels. The is accomplished by a very ingenious arrangement. We have heard asked in the past the question, Why was it necessary to place 30 horse power to operate an electric car to do the work that two horses had done formerly? The answer is. The two horses did not do the work in a proper manner and give rapid transit. The life of a street car horse is very short, and we find under general condition that 30 horse power with two 15 horse power motors has been found about right, in fact, we even find the

companies tending toward a larger installation of power, particularly when using larger than a 16 foot car body, and we find today being installed for rapid transit in inter-suburban work, 40 and 50 horse power electric equipments per car, many of them operating at a speed of 30, and even 40 miles per hour. As the amount of power is directly proportionate to the speed, we can readily see the requirement for such an amount of power. The cost of a single car equipped, including the car body truck and motors, is from $3,000 to $3,500, and the cost of the electric part of the power generating plant is from $35 to $45 per horse power.

We find in the past about as great a development in overhead and line construction for electric work as in any other part of the subject. While formerly this was one of the greatest sources of unreliability in the operation of the plant, to-day it has reached a very practical development. Formerly the trolley wires were too light, the feed wires were insufficient to furnish power, and the line was giving trouble, grounding and breaking continually. In the insulation of a single trolley system, with one side of the system grounded, we have the most severe requirements that it is possible to obtain in any electric insulation, in that any grounding on the other side of the system means trouble in the operation of the road. This has led to the introduction of double and even triple insulation into our line material to properly protect the trolley wire from grounding. Where streets are wide enough to spread the tracks to six feet and six feet six inches within the near rails we see introduced in many places center iron poles, which make a considerably stronger style of construction than cross-suspension. There are not many streets, however, where street cars are in operation that are wide enough, or where the city will allow the spreading of the tracks to this distance, and in closer proximity it is not safe to operate with center poles. On the work installed by the Field Engineering company in Buffalo, we find the most extensive system of overhead and underground construction in operation anywhere. Here all the feed wires, with a few exceptions, are placed in underground conduits, thus removing all cause for objection to the unsightliness of a large number of feed wires overhead. These underground feed wirss are connected to the overhead wires from junction boxes up the poles. Thus, one of the lines on the Buffalo Railway spstem, which gives an idea of this style of construction, as well as the use of the large cars, which are 36 feet over all.

The cost of overhead construction may be about summarized as follows:

Line construction per mile, complete, including track bonding, plain pole work, cross suspension or bracket with feed wire	$2,000 to $2,500
With sawed and painted poles	2,500 to 3,000
Iron poles, cross suspension, concrete setting, double track, feed and guard wires	6,500 to 7,500
Same with center poles	4,500 to 5,500

We also append a table which will give a general summary of the cost of electric equipment of street railway systems, omitting the track construction, which, of course, varies with the number of miles to be equipped.

COST OF ELECTRIC EQUIPMENTS FOR STREET RAILROAD.[1]

No. of Cars.	Steam Plant H.P.	Capacity of Generators, K. W.	Steam Plant.[2]	Station Electrical Equipment.	Car Equipments, Car Trucks and Motors.	Line Construction ⅝ mile of Double Track per car.	Total Equipment (omitting track).
6	120	80	$7,000	$[illegible]	$10,500	$7,5[illegible]	$40,[illegible]
10	225	150	[illegible]	10,500	32,500	12,5[illegible]	66,500
15	375	240	17,5[illegible]	15,000	48,75[illegible]	30,000	111,25[illegible]
20	[illegible]	300	22,000	17,5[illegible]	65,000	40,000	144,5[illegible]
30	675	450	28,000	22,000	97,500	60,000	237,500
50	1,125	750	50,000	33,000	162,500	187,500	433,000
100	[illegible]025	1,350	[illegible]	60,000	325,000	375,000	[illegible]

1. The figures are approximate only, and based on the best city railroad practice.
2. Add 25 per cent to these figures for Corliss.

The track of street railway companies before the introduction of electricity was more behind the times than any other part of their equipment. The old flat rail is antiquated and antedated, and in a few years its use will be obsolete. The necessities of electric railway traction—in fact, of any traction—have impressed upon the street railway companies in their equipments the requirement of a good road bed for the successful operation of a road, and we find this part of the problem receiving as much attention as any with companies who appreciate fully the work before them. The general construction to day is girder rails of from 60 to 80 lbs. per yard, placed on chairs where block paving is in use; with ties 2½ to 3 feet between centers. We find in some cases even 90 and 100 lb. rails used, but we believe in more moderate weight for the rails and the ties placed closer on centers. We believe this has been the general experience in railway work. Such a style of construction costs from $9,000 to $10,000 per mile, In suburban roads, on streets where there is no paving, we find the T rail being used; the road bed can be properly constructed on this basis with 45 to 50 lb. rail, for $6,000 to $6,500 per mile, the rail being spiked directly to the ties.

In order to make a summary of the data and figures, I will summarize them in a practical example.

I propose to take, as the best means of illustrating practically, the purchase, equipment and operation of a street railway system with electricity, a city with a population of say 100,000:—with a dilapidated street railway system, earning a gross income of $125,000, to purchase same for $500,000—property rights, franchises, etc., and equip it with 40 miles of single track and 65 electric cars.

Steam Plant 1,500 horse power

Five engines, 250 horse power each, compound condensing, size [illegible] inches x [illegible] inches x 42 inches, with wheels weighing [illegible] lb.	$[illegible]	
Eight R. T. boilers, 72 inch x [illegible] feet	[illegible]	
Jet condenser	[illegible]	
Two boiler feed pumps	[illegible]	
Steam and exhaust piping	[illegible]	
Five engine foundations	[illegible]	
Eight boiler settings	[illegible]	
Five 30-inch belts	2,000	
Erecting and starting	[illegible]	
Freight and miscellaneous	[illegible]	
		$72,700

Electrical plant:

Five generators, 200 kilowatts, $7,500,	$37,500	
Switchboard installation, foundations, etc	[illegible]	
		[illegible]

Building:

Power station, including stack, traveling crane, etc.	$25,000	
Car house and repair shop, including tools, etc.	15,000	
		[illegible]

Track Construction:

40 miles girder rail construction, ties 2½ feet centers, 63 lb. rail, etc. $1.15 per foot.	$2[illegible]	
Relaying, including paving, etc., at 60 cents per foot	126,720	
Trucking, hauling, etc.	24,000	
Ties, including 10 per cent. of joint ties, 130,000 at 40 cents	52,000	
Ties, including 10 per cent. of joint ties, 15,000 at 70 cents	10,500	
		456,100

Line Construction:

Ten miles iron poles, etc.	$75,000	
Ten miles wooden poles, etc.	40,000	
		115,000

Car equipment:

65 electrical equipment at $2,000	$130,000	
65 car bodies, 18-foot body, with open ends	65,000	
65 trucks at $250	16,250	
		211,250

Summary:

Steam plant	$72,700	
Electrical plant	41,500	
Building	40,000	
Track	456,100	
Line construction	115,000	
Car equipment	211,250	
		$936,550
Superintendent's and Engineer's work	$50,000	
General and miscellaneous	50,000	
		100,000
		$1,035,550
Original purchase		500,000
Total cost re-equipped		$1,535,550

Gross income, say, $350,000.

Net income, say 35 per cent., equal to 8 per cent., on cost, on the basis of an investment of about one million and a half of dollars, and from a property which in many instances was hardly earning its fixed charges formerly.

We have here illustrated a practical example of what is being done every day in this country at the present time in the purchase and equipment of street railway systems. In fact, we find a large number of bankers and capitalists giving it their earnest attention as one of the best fields for investment at the present time.

We desire to call the attention of central station owners to the profit to be made from the furnishing of power in street railway operation, and also by the combining in smaller towns of the street railway companies and electric light companies. The trouble in most cases in central stations obtaining contracts for power, outside of small roads, has been to convince the railway companies that the electric light station can economically and reliably furnish this power, and we must say that in many cases their fears are well founded. Therefore, it behooves the central station companies to place their generating plants and station, not only for their own business, but for this added business, in such a shape as to remove this objection. There is no reason why electric light stations should not do a large, profitable business in this line as well as in stationary motor work, for the same factor is introduced here and the same reasons why they can safely and profitably furnish this power; if they have a station properly built, and large enough to add this power, that factor is established. If they have a proper station operating force, in many cases this force need not be added to at all. As to what basis this work can be profitably done on, we hesitate to state figures, except in specific cases, but will try to give a general idea of some of them. For many small roads power contracts have been taken at so much per day, assuming a basis of 100 to 125 miles operated. Such contracts have been at from $3 to $5 per car; The regular basis, in accordance with which most [illegible] company furnishes the generators and the station owner furnishes the steam power and all expenses of both steam and electric power due to ordinary wear and tear. A [illegible] more moderate size towns of, say, up to 30,000 or 40,000 inhabitants, in the installation of combined electric railway and lighting stations; the companies either equipping new ones or purchasing old street railway systems and dilapidated lighting plants running on an unprofitable [illegible] field for business. Such companies have proved very profitable, as the combining of the operating expenses for railway and lighting station has done much to reduce expenses, and in many cases one manager or superintendent has proved sufficient for the entire system.

What we have tried to prepare here has been, not a paper which will be so attractive to merely read, but in which will be combined a certain amount of information which will be of use in the further consideration of the problems herein outlined, and trusting that, if we have accomplished nothing else, we have led you to a profitable line of thought, it is respectfully submitted.

MR. BURLEIGH: The paper is an exceedingly interesting one to me. I would like to ask what service is rendered by the local lighting company for the three cents per car mile.

MR. FIELD: The actual service is to operate the generators which the street railway companies should install. I believe that the street railway company should install its own generators, because I believe that questions will arise about accidents happening to generators, and the station should only be responsible for ordinary wear and tear—not accidents due to short circuiting, lightning or other causes. That I think is the most satisfactory basis for this kind of business.

MR. BURLEIGH: The loss of an armature in that case would be borne by the street railway companies.

MR. FIELD: Yes, sir.

MR. BURLEIGH: Then this three cents per mile is for current?

MR. FIELD: For furnishing the steam and the labor. There are some cases where the current has been contracted for for four or five cents, temporarily. In Boston, where the West End company owing to delays in building its car house, has had to contract with companies that could not afford to furnish it any less than four or five cents per car mile, this was done.

MR. BURLEIGH: I would like to ask Mr. Field if he advises central station men to attempt the care of overhead lines, the electrical part of the car equipment, etc.

MR. FIELD: In general I would say no. I think that is the street railway company's own business. Any street railway company that is running on a proper basis should have an emergency gang to take care of its own line. Otherwise questions are going to arise. I do not believe in a central station manager attempting any more than he has got under his direct care now, and that is the running and furnishing of power from his station.

THE CHAIRMAN: We enjoyed the paper very much. It has proved very interesting and I regret that it was so late when it came up. I think the lesson taught by this sort of experience will result in our taking more time on our programme for the transaction of business which we are here for rather than for outside entertainments. We are compelled now to pass over Mr. Field's paper at a time when we would all be benefitted by the liberal discussion which I know would take place. But our programme is fixed, gentlemen, and the next thing to do is to come as near carrying it out as we can. I [illegible] memorandum from Mr. Huntley, which says that the governor-general, who arrived this morning, will receive at four o'clock at the residence of Sir Donald Smith.

The convention then adjourned until September 11th, at 10 A. M.

Friday's Proceedings.

The meeting was called to order at ten o'clock.

THE PRESIDENT: The first order will be the paper of J. I. Ayer, entitled "Some Details of the Care and Management of an Arc Light System as Practiced in the 'Municipal', of St. Louis.

SOME DETAILS OF THE CARE AND MANAGEMENT OF AN ARC LIGHTING SYSTEM AS PRACTICED IN THE "MUNICIPAL" OF ST. LOUIS.

BY J. I. AYER.

As central station men, it seems to me that we should demand of each other as much knowledge of our practice and experience as is practicable to give. If [illegible] this association is to be useful, our meetings should be largely "experience meetings" [illegible] ence of those engaged in the development [illegible] and kindred industries, [illegible] would be followed closely [illegible] production of electrical apparatus and [illegible] would do much to advance [illegible] appliances. Believing that we are [illegible] tion managers, for [illegible] interchange of ideas and experience [illegible]

present you a limited, though doubtless dry, outline of the practice which obtains in the central station under the writer's charge.

The station, as designed, has a working capacity of 6,000 arc lights, and is now operating daily 3 500, and about 2[illegible] constant current motors, 2,000 of these lights are distributed over an area of 60 square miles, suspended between and from poles 50 and 65 feet in length, at a height of from 35 to [illegible] feet above the roadway, an average distance apart of about [illegible]00 feet, and used for street lighting. The motors and about 1,500 lamps are operated for the usual varied service of private consumers; 69 circuits supply the lamps and motors, containing about 1,200 miles of wire and supported on 12,000 poles.

For generating the current, we have six 600 horsepower Corliss engines, which drive 300 feet of shafting, from which are driven sixty-five 60 light and twelve 80 light, 2,000 candle power arc dynamos. The arrangement of the dynamos is such that we have ample room for the care of 85 machines on a floor space of about 100x45 feet, and are able to operate a large number of dynamos with a very limited amount of help. Four boys and one young man of very limited experience care for all the machines during the night, in an entirely satisfactory manner; while a suitable man, with three assistants, gives the necessary care to the dynamos during the day.

Thirty-one trimmers, with horses and carts, travel about 500 miles a day to renew the carbons in the street lamps. The average number of lamps to each of these trimmers is 68. Sixteen trimmers care for the 1,500 commercial lamps. Five inspectors, or trouble-men, with carts and horses, care for the lines night and day, answer fire alarms, locate faults and correct minor troubles on the lines. Two day and two night inspectors care for the commercial arc and 2,500 incandescent lamps. A stable of 20 horses, in addition to the 40 horses owned by the trimmers and inspectors, is required. The maintenance of 60 vehicles justifies a blacksmith and wagon shop, which, with the stable, require the services of eight men. Two men care for the shafting, and three engineers and four oilers for the engine room. In the boiler house, where there are nineteen 300 horse power boilers, there are two pump men, with two assistants, twelve stokers, one boiler cleaner and six coal shovelers. These, together with an average force of 35 line and ground men, foremen, chief trimmer, chief inspector, superintendent of lines, store keeper, repair shop employes, carpenters, clerks, etc., constitute a force of about 170 men. A very large per cent. of these men are called upon to perform duties which are simple, yet, because of their extreme newness, are not thoroughly comprehended by them. To get the best results, each man requires clearly written rules, as few of them as possible, and their rigid enforcement. In all practice this is the wise way to put it; but it is absolutely necessary that it be so with a large force, where many of the men do their work independently, and free from the constant supervision of a foreman.

In the room used as an office at the station by the inspectors and foremen are city maps, mounted on boards, where the locations of the lamps are indicated by tacks and the circuits by strings. For the central part of the city, where there are many circuits on the same line of poles, each circuit is shown on a separate map of that section. A number of printed slips, which represent a pole with cross arms, indicate the location of the wires on the poles on the different streets traversed by the different circuits. Any change of circuits is noted on a separate blank when the work is ordered, and when completed the maps are corrected to correspond. It takes but a few days for a man to become quite familiar with the circuits by keeping them so conspicuously placed. In large stations this method of indicating circuits is almost indispensable, and will prove of great value if used in smaller ones.

For testing purposes we have a portable tachometer for indicating speeds, two Thomson indicators for the engines, a recording steam gauge, two standard ammeters and a voltmeter reading to 5,000 volts for the dynamo room; on each circuit a spring socket for attaching ammeters and a current indicator for indicating the direction the current is flowing through the circuit; near the lightning arresters on the upper floor, a switch board especially arranged for testing only; a Wheatstone bride, magneto bells, etc. The engines are [illegible]

Evaporation boiler tests are made every month to see [illegible] of [illegible] is maintained at the standard [illegible] each day. All live [illegible] for grounds, and all [illegible] as well. In addition [illegible] taking volt [illegible]. The number of [illegible] being known [illegible] given [illegible] by other [illegible] testing a [illegible]

ments in plants of any size cannot be over-estimated, and should be in daily use in all stations, rather than the makeshifts generally supplied.

The stopping and starting of engines and boilers, pumps, dynamos, circuits, etc., are all recorded on reports made by those in charge of the different departments. Each inspector, trimmer, line foreman, storekeeper, and all heads of departments make daily reports of work done and time and material used by them. Each trimmer is charged with a certain number of demerits for each fault on his route, such as defective or dirty lamps, broken or dirty globes, carbons used in excess of the required number, etc., and each month prizes are awarded to those having the best records.

The advantage of using vehicles for trimmers for all street lighting work is being recognized. Provide a man with proper appliances and your service will improve. He cannot carry all that he should and walk long distances, nor will he take the same care when he is worn out with tramping that he otherwise would. We find it desirable for the trimmer to own and care for his own horse, while the company provides a suitable vehicle and harness, which he turns into the stable once a week for inspection, cleaning and repairs when needed.

We select from our linemen those whom we class as inspectors or trouble-men, who are equipped with a light-running cart, with a suitable place for the storage of all tools necessary to use in an emergency. In addition to the special duty required of them during storms or at fires, these men correct all minor troubles reported to the office from various sources. During the first year's operations the average time lost, due to open circuits at night—that is, the average time lost from the time the circuit was opened until it was closed and the lights restored—was an hour and five minutes, notwithstanding that all circuits are more than ten miles in length. When these troubles occur, it is almost always during a storm, but the conveyances with which they are provided and their thorough knowledge of the circuits enables the men to become very expert in locating and correcting troubles. During the past year nearly 15 per cent. of all the calls answered by our trouble men were to correct troubles on the lines of other companies. Because we have wires all over the city, the police and the public generally think that all the wires belong to us, and, when they discover any trouble with them, they are apt to report the same by telephone to our station. During the entire twenty-four hours there is always one man on duty, ready to answer just such calls and correct the troubles.

All arc lamps, before leaving the station, are placed in a test rack, where they are supplied with a current maintained absolutely constant. Voltmeter readings are noted soon after the lamp has been lighted, when the carbons are about half consumed, and also when they are burned quite short. During the early part of the burning the lamp is adjusted so that the readings, taken at three different points, give an average reading of 46 volts. In case of double lamps this work is carried out on both rods. This extreme care in regard to adjustment we regard as absolutely necessary. If a lamp is permitted to consume its carbons, any fault which would not be discovered with a brief test is quite likely to develop. To determine the length of arc by the current and voltage is more likely to result in uniform lamps than where tested by the eye. With ten lamps adjusted to burn at an average of 46 volts, with 9 5-10 amperes, the average number of watts per lamp was 436. Without changing the adjustment of the lamps, the current was increased to 9 8-10 amperes; and there was an average consumption of 524 watts per lamp, an increase of 20 per cent. of energy; and by increasing the current to ten amperes, the average number of watts per lamp was 550, the average voltage 58, the increase above normal being 33 per cent. That means 33 per cent. more coal, 33 per cent. more work at your dynamo, 33 per cent. less capacity in your dynamo, and probably 33 per cent. less life in your armature. One is apt to think that the difference between 8 5-10 and 10 amperes, when supplied to the lamp, is only a difference of 5 or 10 per cent, which is not very serious. This would be true if the lamp were adjusted each time for the ampere current it was to be operated with. To those who have not made this experiment, perhaps, a portion of the mystery as to where the coal goes will be cleared up. By using the ammeter and voltmeter for adjusting the lamps, and then seeing that the circuits are provided with the same ampere current indicated by the same ammeter, one will be apt to bring about like conditions in all lamps; at least, they are more likely to be uniform, than if independent ammeters are used on each circuit. By reference to this statement relative to the amount of energy consumed by change of current, it will be easy to see how expensive one or two low lamps would be on a circuit, where the operator, to correct the trouble, supplies them with current enough to make them bright. Of course it is understood that better service as well is obtained by operating the circuits with no more current than that for which the lamps are adjusted. In this connection, I believe it is proper to again call attention to the well-worn subject of connections. A great deal of time and trouble is spent in soldering joints, and when the lines are led to the lamp they are apt to be poked into the binding posts, held with set screws indifferently tightened, and between these binding posts and the lamp connections proper there are perhaps three or four, if not more, indifferent contacts, all of which look very well in the factory, but are very bad after a few months' service. Hanger boards should be used which have the line wire soldered to connections which cannot get loose. In our practice we accom[illegible] about [illegible] inches of flexible insulated [illegible] soldered to the hanger-board binding [illegible] cut-out boxes are treated in the [illegible] leaving the lineman nothing but an or-

dinary line joint to make, which can be easily done outside. Where lamps are suspended from the hanger-boards by the hooks which conduct the current, we always insist on some character of second connection being made to the lamp besides this. A simple way to do this is to take some small wire and tie the hook to the loop, in much the same manner as you would with a piece of twine. We have no screw connections anywhere in our circuits, and with a little ingenuity and care, they can be avoided always in arc lighting circuits. By the use of a special socket to each circuit for connecting an ammeter, we are able to take the readings with volt and ammeter, and get a correct indication of the actual consumption of energy on a circuit while in operation. With the data relative to the number of lamps in service, and the number of miles and size of wire, we are able to discover any excessive consumption of energy and prevent the development of a series of little faults, which, in a short time, grow to be very serious ones if permitted to continue. Usually these readings are taken on each circuit three times a week, and during the time these observations are made, indicator cards are taken from the engines. From these two sources we get the actual consumption of electrical energy per circuit and per engine. We also get the indicated horse power. From a set of eleven observations taken from July 30th to August 28th, at various hours during the night run, the station shows an efficiency between indicated horse power and electrical horse power at dynamo terminals of 74.9 per cent., ranging from 70.3 per cent., the lowest, to 77.5 per cent., the highest efficiency shown. The circuit readings indicate an aveaage consumption of energy per lamp of about 6-10 of an electrical horse power. The average indicated horse power is about 8-10 per lamp. A good condition of the circuits is maintained constantly, because any neglect in any department is quickly shown by the data obtained from our records. Some months ago, when press of business caused the measurement of circuits to be neglected for a few weeks, the writer discovered an increase of over ten per cent. in the consumption of fuel, when there should have been a slight decrease. An investigation showed that an accident to an ammeter had caused a false reading, which increased the cost of fuel alone about $16 a day. The difference in the appearance of the lamps was not such as to call forth special comments then by those interesfed, yet, when the fault was discovered, it was remembered that some seemed to have been burning high for a week or two. On suburban circuits on long loops, it is our practice to place cut out boxes on the pole where the line branches. This saves a great deal of time in locating troubles; but let me add that unless a thoroughly water-tight and substantial cut-out is used, it will prove more of an annoyauce than an advantage. A log of each circuit and dynamo, as well as of engines and boilers, is a very satisfactory and desirable part of the records, and will frequently assist materially in locating troubles and saving expense.

Throughout the country it is almost the universal practice to wire for arc lights without cost to the customer. There is no valid reason for this custom, and for more than a year it has been our custom to charge for cost of labor, with the result of reducing expenses more than $600 per month. In every case where lamps are discontinued in the spring, we require a contract for fall and winter service, else the wires are removed when the lamp is taken down. We invariably cut down the line between the house and pole where the service is discontinued for the season, though it is to be renewed later. To induce annual contracts, a rebate of 5 per cent. is given at the expiration of the year, and is found to work to advantage.

There are very many details of construction, as well as of office work, which could be referred to, if it were not that this paper is now too long; but I will be glad to furnish a copy of "general instructions to employes," used in the government of this plant, which refer to and bring out some points of management which are not mentioned here, to those who care for them.

DISCUSSION.

MR. NICHOLS: I am very glad that Mr. Ayer dwells so strongly upon the inadvisabillty of central station companies doing free wiring. Of course I am not at the present time interested in arc lighting, but when we commenced incandescent lighting we were advised to do free wiring. I took the ground that it would be unbusiness-like; that it would be on the principle of those people who sell tea at so much a pound and give a chromo with it. We have done our own wiring, for the reason that in our city we have not had the advantage of first-class construction companies upon whose work we could depend. We have connected up—I do not remember the total number but in the last fifteen months we have wired for upward of twelve thousand lights and we have endeavored to make it as near cost as possible, so as not to make it burdensome to the consumer.

MR. FRANCISCO: There is one feature of this business that has been overlooked. It is very convenient to carry out Mr. Nichols' plan, and I fully concur in his views provided there is only one company in the place. But if you have got two or three companies the company that does it for the least money gets the job every time. I hope that we can in time adopt some plan or some management in regard to this very question of free wiring, because it is a very serious difficulty, there is no question about that. In many stations renewals are furnished free. Of course it is a dead loss to the company and the charge should be made for renewals the same as is made for wiring and I trust that in time we may be able to get some basis or plan of operation whereby we can carry this out and have our return for that service just the same as we do for all other service.

MR. NICHOLS. I am glad Mr. Francisco referred to the question of competition. I think it is better to sell your product at a lower price to give a discount rather than to give something for nothing. You then know exactly what you are doing and exactly what you can afford to do. If you do free wiring I maintain that you have no right to charge it up to capital account. You ought to charge it to expense account. When once you wire a customer's premises he has you at his mercy. He can tell you to take your wires out, whereas, if you meet competition by saying we will give you ten, fifteen or twenty per cent. discount, then if you have a row with your customer you simply lose his custom, but you are at no financial loss in the matter as regards the actual expenditure of capital, and I think that is a far more reasonable way of meeting competition—to sell the product at a lower price.

MR. SEELY: Three of the largest companies in New York started in to do free wiring. I think they spent half a million dollars before they realized the fact that it was an expensive luxury. It cost them on an average about three dollars a light to put in. They finally reached a combination whereby they agreed to charge the customer actual cost. Some enterprising gentlemen put the actual cost down to a dollar and a half a light. His opponent kept his price stiff at $3. The three dollar man did not get the business. But I do not agree with the gentleman about the account to which wiring should be charged. In some large buildings there is $10,000 worth of wire alone. If you make a contract with a man to wire a building you make a contract with him to either buy that wire at the expiration of your contract or to remove it. You will find that companies have spent thousands of dollars in wiring large buildings, and it would be nonsense to charge that to expense.

MR. ORFORD: I have been operating arc lamps for seven or eight years, and I have had various types of arc machines, and I know there are some of them, as Mr. Smith said the other day, on which the only governor is a big load. I think it is a very crude way of running a station to trust to a machine without a governor. It is really the same as taking the governor out of the engine. Nobody would dream of setting up a locomotive or stationary engine without setting up a good governor, and in a great many instances the highest price will be obtained for an engine having a good regulating governor, and the same thing can undoubtedly be done with the arc machine.

With reference to this opposition, which is constantly cropping up, when we started into the incandescent business we thought the wisest thing would be to go to the customers, get as good a price as we could, and ask them for as small an amount to begin with as possible. We had to say something to them to get them to adopt the electric light in preference to gas, and we thought it would not be a very good method to begin by telling them that they had to pay for the wire. Consequently we took the ground that the smaller the expense to the customers in the first instance the more customers we would be likely to get. We recognized the fact that we were going to spend a considerable amount of money in wiring stores, and we thought it would be a permanent business. We have had the incandescent lights in stores for four years. We have had very good prices. The cost of the installation is a small amount when you spread it over four or perhaps forty years. I see no deterioration of the material, and the amount of money necessary to keep it in good condition is very small indeed. The question of renewals is one about which we have debated very considerably. The only advantage which I see in the customer buying his lamps would be that we could sell them in a bunch and have done with it, whereas we now supply them one or two at a time as required. The disadvantage of the customer buying his lamps has appeared to us to be that some of them might burn the lamps as long as they would burn and in that way it would not be very creditable to us as we have to compete with very good gas.

MR. SCOTT: We have standardized volt meters and meters made by the parent company, but the volt meters and ammeters on the switchboard are apparently all right according to that, but in testing otherwise I found that one street loop having an amperage of about 7 7-10 running on the series system showed when I put it on to one machine by itself 8 amperes by that ammeter, on the other machine 10 amperes by that ammeter, and on another machine 11 amperes by that ammeter. I transferred the ammeter to the other machine, and I found the trouble was in the instrument itself. In testing the exciters of the direct current machine I found one was giving 98 volts, another 115, another 140. I think it is of a great deal of importance to everybody. Our men are told to test and standardize the volt meter and ampere meter every hour.

In regard to free wiring we have stopped that. We did it because the gas company, which had lowered its rates from $2 to $1.60 in order to compete with us, finding that that was not sufficient, had offered to pipe all large stores and residences free. With small stores they threw in fixtures. We immediately started free wiring. We told the people that the gas company knew it had an inferior article or it would not have done that, because since 1856 every man had had to pay for every foot of pipe from the meter to his burner. The increase of consumption of electric light has not varied a particle since it began with free piping, and we began charging for wiring, and I think that while sometimes it may be a loss of capital for a few months, in the end it is good business management. But when you have a good article and are determined to keep it good and another man is trying to cut your throat, it is poor policy to spend your capital in trying to cut his throat. When we started we of course wired free in stores. We paid the cost of installation of 300 lamps in four blocks on one of the principal streets, which was $696. That was two and a half years ago. Those lamps have paid us $300 a month during that time.

DR. BELL: With reference to what was said by Mr. Orford in relation to the governor I have frequently heard the same remark casually made and I must say that from that standpoint we ought to congratulate the makers of such apparatus from the bottom of our hearts, because I can assure the members of the association that no such result can be obtained by the best scientific instruments made and adjusted with the utmost care, kept in the laboratory and used only by skilled men. I leave it to you how likely it is that such results can be really attained in practice. Take the best laboratory instruments and they will get out of adjustment with the most skillful use, and when they are subjected to a degree of care which could not even be approximated in the most refined commercial work. I think the cause of the error that is so frequently made in ascribing exceedingly fine regulation to commercial apparatus is due to the fact that it is not sensitive enough to show more variation.

THE PRESIDENT: I will call upon Mr. Nichols to read the paper of Mr. Warner, on "Different Forms of Carbons used in Arc Lighting."

DIFFERENT FORMS OF CARBONS USED IN ARC LIGHTING.

BY L. P. WARNER.

In the period just preceding the introduction of the arc electric lighting commercially, experimenters and inventors had brought forward numerous plans, ideas and theories regarding the size, form and manner of using carbons, and in view of the fact that no reasonably cheap method of generating the electric current then existed, a surprising amount of attention was given to the subject, and the developments of the art, shown by many publications, form no small part of our history of arc lighting.

It is not my purpose to dwell at length upon the history of carbons generally, but rather to touch lightly on some of the more notable forms known at the time of which I am speaking, and then to pass on to a consideration of the utility and practical results obtained with the different forms of carbons in use at the present time, paying special attention to the matter of form and size as affecting the results.

The form of a cylinder or pencil, it is noteworthy was that used by Sir Humphrey Davy, in his earliest experiments, and he even devised special holders or clamps to retain the carbon pencils in all alignment and facilitate their adjustment with a view of maintaining a constant and steady light.

Archereau subsequently adopted the pencil form of carbon and used it in his lamp now so justly considered as the first practical arc lamp; it does not appear, however, that he turned his attention particularly to the matter of form.

Wright and others stand on record as experimenters with carbon discs brought edge to edge and made to rotate as they were consumed, and the combination of a disc placed on edge above a vertical pencil of carbon was also tried at this early date.

Wallace and Farmer made use of broad flat plates of carbon, placed in a vertical plane, one above the other, the arc forming between the edges as they were drawn apart and shifting back and forth from one end of the plates to the other. Another inventor at about this same date placed flat plates of carbon side by side with the arc forming at the upper edges of the plates and an intervening insulation of some refractory material, the arc forming at the upper edges of the plates and gradually consuming them.

Jablochoff in 1876 introduced his well known electric candle, a form of arc lamp in which cylindrical carbons are employed placed in a vertical position and held separated by a thin filling of refractory insulating material.

Now when we look back at the work of these early inventors and consider what special object they had in mind in making their experiments, it is at once apparent that it was continuity of action, and it stands on record that they met with fair success so far as this feature is concerned, some of the lamps being capable of twenty hours' burning without attention.

In 1874 Mathias Day produced an arc lamp in which two cylindrical pencils were placed in the upper holders, and two in the lower holders, the upper ones occupying a plane with the lower and directly over them. Here the avowed object of the invention was to secure long-continued operation of the light without requiring attention, and it is certain that he accomplished it in a very creditable and ingenious manner.

Coming now to the time of the commercial birth of arc electric lighting, we find Jablochoff in the lead closely followed by Brush and Weston, each making use of the cylindrical form of carbon pencil and turning his attention most assiduously to the feature of continuity of operation, the first move being an increase in length of pencils. Carre, a French manufacturer, at this time became prominent as a maker of carbons, and succeeded in producing pencils about 7-16 inch diameter and 32 inches in length, and it was thought by the use of lamps of suitable length these long carbon pencils could be advantageously used when long continued burning was a necessity, but owing to the difficulties encountered in the manufacture and also trouble in maintaining proper alignment for the carbons a length of 22 inches was soon settled upon as most practicable and convenient.

As the business increased and the demands became better understood, the inventors again essayed to solve the problem of continuity of action, but, in many cases [illegible]

[illegible] a far simpler and better way, and one, futhermore, that cannot fail to impress the practical electrical engineer. I refer to the simple expedient of using a carbon pencil of ⅝ inch diameter 14 inches in length in an ordinary single carbon lamp. It is true that this is not new, and that carbon pencils of such size, or even greater, were tried long ago; nevertheless, the introduction of carbons of this size and form has a very great bearing on the commercial side of the situation; but before going into that matter I wish to say a few words regarding the lighting efficiency of ⅝ inch carbons.

Having [illegible] whether these carbons would give as much light for a given expenditure of electrical energy, as would those of one inch diameter, I tried the following experiments:

Two single lamps [illegible] circuit, one being supplied with ⅝ inch carbons 14 inches in length, the other with ½ inch carbons 12 inches in length; around each lamp was branched a voltmeter indicating the voltage. The lamps were then adjusted until they had the same voltage, and as current was of necessity the same in each, it was a safe conclusion that equal amounts of energy were being supplied. Photometric comparison of the two lights was then made at the horizontal and at many different angles above and below with the result that no perceptible difference could be found in the power of the lights. During the tests the current was maintained as constant as practicable and care was taken to base the comparison on an average deduced from a large number of readings.

Now while this matter of lighting efficiency is one that concerns the people operating electric plants; it does not interest them to the extent that other features upon which I have yet to touch may, as I happen to know that the management of lighting stations looks long and lovingly on any plan that seems to give good promise of reducing running expenses. To begin with there is the difference in first cost between a single and a double carbon lamp, and the difference in expense for repairs and attendance, these items varying of course with the different lighting systems. Still another important saving is in the cost of carbons, the cost for a given number of hours run being fully thirty per cent. greater with ½ inch than with ⅝ inch carbons. There is the further important saving in the breakage of globes, which often is caused by the sudden shifting of the arc in the double carbon lamp. Twin carbons consisting of two cylindrical pencils placed parallel and in close juxtaposition to each other, and connected by a web throughout their entire length, have of late been introduced and when in use the arc alternates between the different pencils comprising the upper and lower twin carbons. A test of these carbons made principally with a view of determining the life and lighting quality, gave unsatisfactory results in the following particulars. It was observed that the duration of a burning for a given weight of material was not nearly equal to that which could be obtained with the same amount of material in a single cylindrical pencil. This I attribute to the more rapid disintegration of the turn carbon resulting from the very frequent heating and cooling of each member. Indeed this is found to be true of two carbons where arranged as in the Day lamp, or so that the arc alternates frequently between the different sets, and there is quite a noticeable difference in consumption of carbon for a given duration of lighting as compared with an ordinary single carbon of the same diameter burning without interruption.

Another undesirable feature of twin carbons is the shadow cast by the non-burning members, which, while it may not be disagreeably noticeable when the lamp is provided with an open globe, most certainly operates to reduce the total output of light.

It may be argued that the main item of expense in the manufacture of carbons does not lie in the material, and the fact that ⅝ inch carbons cost so little more than ½ inch would bear out such a position, and I have merely mentioned the fact of the rapid disintegration and burning away of the turn carbons by way of explanation.

The paper was received without discussion.

It was decided that the rules for safe wiring adopted by the convention be at once printed, and a copy sent to each central station and insurance association in the United States.

Sir William Dawson, Frank R. Redpath and Prof. Henry T. Bovey were elected honorary members of the National Electric Light association on the recommendation of the executive committee. Thomas D. Lockwood was also elected an honorary member. The convention then went into executive session.

The secretary presented the following report:

SECRETARY'S REPORT.

The condition of the association so far as its membership goes is much stronger and more encouraging than it was at the opening of the year. Many individual memberships have been dropped since the adoption of the present constitution, owing to the fact that memberships are, under it, very largely represented by corporations and firms instead of individuals. Notwithstanding this fact a large addition has been made.

According to the last secretary's report, the number of members who had paid dues for [illegible] was as follows: Active members, [illegible]; associate members, [illegible]; total 172. The present membership stands as follows: Active members, 78; associate members, [illegible]; total [illegible].

I beg to say, in connection with the [illegible] member

ship of this association, that it is far from what it should be, and far from what it might possibly be made, in view of the immense possibilities for the diffusion of valuable information within its grasp. Our active membership list, especially, should be very largely increased, and could be made so by making an active membership a valuable consideration and worth more than the annual dues amount to, in the way of practical information furnished during the year. I would suggest that the committee on data be increased in its membership and that the collection and distribution among our members of important facts, figures and details relating to the furnishing of light, heat and power be carried out systematically, and persistently throughout the year. There is a vast field here for good and I consider it as important a work as the association has to do.

The report was received and filed. The treasurer's report was then presented by Mr. Beane, as follows:

TREASURER'S REPORT.

This report is made from April 1st, dating from the beginning of office until July 1st, our fiscal year dating from January to July and July to January of each year. This report is based on the books of the association and on the trial balance of the auditor on April 17th, and on my trial balance of July 1st.

The operations of the treasurer, as regards receipts, are indicated by schedule "A," the total receipts being $1,265. Total disbursements amount to $1,387.62, making the disbursements $122.62 over the receipts for that period. The proof of this is contained in the following Balance in bank April 17th, indicated by the auditor's trial balance, was $1373.15. Balance in bank July 1st, indicated by trial balance, $1,122,02. Cash on hand July 1st, $128.51. Total of cash on hand July 1st, $1,250.53. Which total is $122.62 less than the amount on hand April 17th, proving the difference between the receipts and disbursements as indicated by the report.

The assets of the association on July 1st consist of cash in bank $1,122.02 and the value of furniture account charged with $214.15. The assets were further increased by the payment of the committee on exhibits of moneys disbursed, and their account is schedule "B".

The report was referred to the finance committee.

Dr. Mason offered the following resolutions, which were unanimously adopted by a rising vote:

RESOLUTIONS.

The National Electric Light association, assembled in Montreal, at the close of its session desires to put upon record its appreciation of the distinguished honor shown it by the Dominion [illegible] the presence of His Excellency, Lord Stanley of Preston, governor-general of the Dominion:

Of the large-hearted hospitality of the city of Montreal, evidenced [illegible] individual

Of the [illegible] executive committee, whose efforts have carried to completion the most successful meeting in the history of this body;

Of the grand work done by the committee on exhibits, issuing in an exhibition of great educational value calculated to develop a larger appreciation of the flexibility of electricity, and its wide [illegible] to human needs.

Of the gracious liberality of McGill college, which has lent the great dignity of its name and the personal influence and labor of its officials to the success of our meetings;

To the press of this city, whose extensive and fair reports of our meetings have extended our influence;

To the railway companies for their liberal reduction in fares, and to the Windsor Hotel management, where as guests we have found a home.

Resolved, That the above minutes be placed on the records of the association and a certified copy thereof be sent to the various bodies mentioned.

The following resolution was also adopted

Resolved, That a vote of thanks be tendered J. I. Gulick for the efficient and successful management of the exhibition now [illegible] this association, the largest [illegible]

And that the secretary be directed to have this resolution engrossed and presented to Mr. Gulick.

On motion of Mr. Seely seconded by Dr. Mason, a vote of thanks was extended to Luther Stieringer and Allan R. Foote.

Frederick Nichols, M. D. Law and A. M. Young were [illegible] members of the executive committee of the [illegible]

Dr. Mason gave notice of the following amendment to the constitution—that in the first article the word "International" be substituted for the word National, so that the title of the Association would be The International [illegible] Light Association.

[illegible] for holding the February [illegible] association.

The [illegible] then adjourned.

Convention Notes.

[illegible] represented the [illegible] company.

[illegible] represented the [illegible] company.

[illegible] represented the [illegible] company.

[illegible] represented the Electrical [illegible]

[illegible] light machines [illegible] represented the [illegible]

[illegible] several [illegible]

[illegible] machinery of the [illegible] freely [illegible]

[illegible] company, Hartford [illegible]

The New York Belting and Packing company distributed circulars, describing its staple supplies and specialties.

The Jewell Belting company, Hartford, Conn., displayed the "Jewell" dynamo belts and explained their special features.

The Crocker-Wheeler company of New York had on exhibition several motors in charge of Geo. W. La Rue of the New York office.

Weston Standard voltmeters, portable alternating and direct current meters were displayed by W. M. Hill and William Moore.

Ventilating fans operated by electric motors were displayed by the La Boiteaux Electric Motor & Fan company of Cincinnati, O.

Simplex wire was displayed to advantage, and the representatives of the company were kept busy talking up the merits of their wire.

W. P. Mullen represented the Shultz Belting company and displayed specimens of the belts this concern is introducing in electric plants.

The Engineering Equipment company of New York and Boston showed trolley wire hangers which commended themselves to spectators.

Delaware Hard Fibre company of Wilmington, Del., was represented by William H. Stanhope, who displayed a full line of fibre goods in a variety of forms.

H. Ward Leonard & Co. had a pleasant nook in the rear of the hall, where Messrs. Leonard and Vance received friends and boomed the new enterprise.

The Germania Electric company of Boston had a neat display in charge of Otis K. Stuart and H. Bottomly. The improved Schaeffer lamp was shown.

The Norwich Insulated Wire company of New York, manufacturer of paper insulated wires and cables, was represented by F. Day Voorhees, general sales agent.

H. E. Chapman, representing the Russell Electric company of Boston, had six lamps on exhibition and explained the operation and merits of them to visitors.

The Gould Packing company of East Cambridge, Mass., showed samples of Gould's steam and water packing to steam engineers connected with electric lighting plants.

The E. S. Greely & Co. was well represented and had a most creditable display. C. P. Frey was on hand to explain the many advantages of the numerous devices which his company exhibited.

"P. & B." was thoroughly advertised by the representatives of the Standard Paint company of New York. This concern distributed literature, etc., and made a favorable impression on the visitors.

M. E. Baird and A. D. Newton of the Eddy company were on hand to explain the features of their motor, which was placed on exhibition in the Toronto Construction & Electrical Supply company's exhibit.

The Globe Electric Cordage company, Philadelphia, was represented by G. H. Smiley of Chicago, who displayed samples of the company's specialties and distributed circulars giving the results of recent tests.

The Canadian Electrical Specialty company's exhibit included a full line of electrical apparatus and the numerous specialties handled by this company. It was admirably arranged and attracted considerable attention.

The Fort Wayne company had a power plant in operation, which attracted considerable attention. W. J. Morrison was in charge of the exhibit, which included a 750-light alternator and a fifteen arc light machine.

The Ball Electric Light company of Toronto exhibited four-ampere double armature arc light machines, with Bernstein incandescent lamps. Wenstrom generators and motors were also shown, as well as a general line of supplies.

One of the most interesting pamphlets distributed at the convention was issued by the National Carbon company of Cleveland. It contained a directory of arc light plants in North America, and will prove valuable to supply men.

George L. Wiley of the Standard Underground Cable company, Pittsburg, showed samples of that company's underground cables. Mr. Wiley received congratulations on behalf of the company on its recent victory at Minneapolis.

The Ries Electric Specialty company of Baltimore, Md., had an attractive exhibit of its new regulating sockets for alternating current incandescent lamps. This company was represented by Elias E. Ries and Lewis S. Greensfelder.

The Thompson & Robertson company of New York exhibited the Fibrous dry battery it has lately placed on the market, as well as the Fibrous Disque Leclanche cell it is now supplying for open circuit work. Louis [illegible] represented the company.

The Bryant Electric company of Bridgeport, Conn., displayed a board on which were arranged specimens of the switches and devices put on the market by this company. It was a complete assortment and proved interesting to central station and supply men.

In parlors 15 and 16, Windsor Hotel, the Electric Merchandise company exhibited a complete line of [illegible] street railway supplies. The exhibit was admired by many. Burton heaters and a powerful electric headlight for street railway cars attracted special attention. D. B. Dean and W. R. B. Wilcox were present to explain the advantages of the specialties displayed.

The Abendroth & Root Manufacturing company issued a handsomely illustrated pamphlet bearing the title of "Steam Boilers." In addition to descriptive matter of importance it contains some valuable tables that will undoubtedly prove of much convenience to the user of steam.

The Chicago delegation was much larger than was expected. Most of the delegates started Saturday night, stopping at Hamilton long enough to drive about town and enjoy the beautiful scene from the mountain. On their arrival at Montreal the delegates proceeded to boom the World's Fair.

The Eugene F. Phillips Electrical Works, had a fine display near the center of the exhibition. This display included electric light, telephone and magnet wire. Mr. Phillips himself was present, assisted by John Carroll, P. C. Ackerman and others. The company had a parlor in the hotel, where it entertained friends.

An interesting fact in connection with the exhibition was that although all the machinery displayed was in operation there was no steam plant in or about the building. The power was furnished from special plants installed in the Windsor hotel and McGill university, the latter institution being over a mile from the exposition.

G. W. Hart represented the Hart & Hegeman Manufacturing company of Hartford, Conn., which made a neat display of switches, including the Hart switch. The actuating spring in this art switch is a flat steel, three-leaf spring, and as it is not in circuit, its temper is not affected by the current, while the make and break are instantaneous.

The Phœnix Glass company of Pittsburg, Pa., and New York, was represented by General Manager A. H. Patterson, assisted by E. H. Peck. The company's exhibit contains specimens of cut glass shades and incandescent bulbs of every imaginable form. A large cut glass globe was suspended in front, in which was a 100 candle power lamp.

James W. Queen & Co. of Philadelphia made an excellent showing in Exhibition hall. E. G. Willyoung represented the company. The display included a new design of Siemens' dynamometer, a new portable testing set for use where there is considerable magnetic disturbance, and a combined portable galvanometer and battery for locating faults.

The International Okonite company of New York and London exhibited armored and lead-covered Okonite cables, light and heavily insulated copper conductors and Okonite lamp cord, all wound on handsome reels. Manson and Okonite insulating tapes were also shown. Captain W. L. Candee, George Manson and Jean Wetmore represented the company.

Pass & Seymour, Syracuse, N. Y., displayed samples of their latest specialties in electrical chinaware, many of the samples being decorated in imitation of hard wood. Some small pieces of china work, pocket vases, cams, and keys perfect in detail and finish, china cleats, china vases of unusual size for T.-H. transformers, and large insulators for covering lightning arresters and for railway work were shown.

The Falls Rivet & Machine company of Cuyahoga Falls, O., was represented by the president of the company, E. L. Babcock, the vice-president, J. A. Long, and the general western manager, F. W. Weir. They explained the features of the company's clutch pulley, and distributed circulars illustrating two of the four lines of shafting in operation in the Municipal station at St. Louis, Mo., the largest arc lighting station in the world.

The Consolidated Electric Manufacturing company was represented by C. E. Bibber, who explained the advantages of the C. E. M. jack-knife switch and the improved Davis arc light cut-out. The special attraction, however, of his exhibit was the Wade dynamo register for indicating to a station manager the exact time any given circuit was or was not in operation. A sample of T. J. Murphy's slate, from which the company makes all its switch-boards, was given to visitors.

The Thomson-Houston company devoted its space to a display of power machinery, of which it is making a specialty. An electric hoisting machine, electrically operated drill and an electric pump occupied much attention on the part of men interested in mining, and there were many present during the operation of the machines. In addition to mining machinery the company showed a full line of electric lighting, power and railway apparatus, regulating devices and measuring instruments.

The Electric Engineering & Supply company of Syracuse, N. Y., had a very interesting exhibit consisting of the new combination ceiling rosettes, sockets and cut-outs and central station switches of large carrying capacity. These devices were arranged on a handsome cherry board. The company also displayed the Packard incandescent lamp, which has become so popular, and for which this company has secured the general eastern agency. Jenney electric motors were displayed to advantage. The exhibit was in charge of F. H. Leonard, D. J. McIntyre and F. M. Hawkins.

Among the exhibits there were several that deserved more than passing notice. Much dissatisfaction was expressed by the exhibitors on account of the failure of the custom house officials to handle the goods properly.

Everything was in confusion and many of the exhibitors were unable to make a display until the convention was about closed. When, however, the exhibits were all in place, the rink presented a most attractive appearance and both exhibitors and visitors were repaid for the inconvenience and delay in arranging the displays.

J. W. Godfrey and George H. Meeker represented the New York Insulated Wire company. This company had a most attractive exhibit. The New York Insulated Wire company of New York, the manufacturer of the "Vulca" electrical wire ducts, had an attractive exhibit, including a complete "fishing system" with junction, distributing and angle boxes. Both single and double tubes are shown, each ten feet in length. "Vulca" tubes are also shown, surrounded with Portland cement and in plaster of paris. Within the boxes shown are inserted porcelain cut-outs of improved pattern.

The Interior Conduit & Insulation company of New York, was represented by General Manager E. W. Little and Assistant Electrician Paul Oscanyan. The company's exhibit illustrates the simple method employed in utilizing interior conduits. Attached to a dark cherry back ground built to represent a section of the wall and ceiling of a room were two complete lines of metal covered interior conduit tubes, one sheathed in steel, the other in brass. The main circuit is carried in two tubes rising through the floor and ceiling passing at an easily accessible point within the room through a metal main line cut-out box, suitably insulated, which forms the point of distribution for that room. Leading out therefrom are small metal covered tubes carrying conductors to different parts of the room and ending in insulated branch terminal or cut out boxes, to which is attached the pendant or electrolier, having lamps in full glow.

The Edison exhibit occupied one-half the center of the hall. It was in charge of the local company, but there were several representatives of the home office on hand to assist in the entertainment of visitors. Among these were Messrs. Insull, Greene, Muir, Shain and Beggs. In the exhibit was shown every detail of the Edison incandescent lighting system, generators, indicating and measuring instruments, controlling switches, wires and cables for overhead or underground distribution, as well as electric motors operating printing presses and also applied to hoisting, rock drilling, pumping, ventilating and railway work. The sample boards of lamps, sockets, wire, switches, etc., were carefully arranged to show the whole line of samples of any one kind. The miniature three-wire system shown in the exhibit connected to a model underground tube system attracted considerable attention.

One of the most interesting features of the meeting to those not directly interested in the discussions at the daily sessions was the formal opening of the exhibition at Victoria Rink. This event had been looked forward to with much interest by the people in Montreal, and long before the hour for the beginning of the exercises the spacious hall and galleries were thronged with interested spectators, including representatives of the leading families of the city. The arrangements for the affair had been conducted under the direct supervision of General Barney and were complete in every detail. The decorations were attractive and in many cases elaborate, while the arrangement of lights produced a most striking effect. Mayor McShane in his opening address referred to the enterprise and ability displayed by the exhibitors, congratulated the association and then introduced Sir Donald Smith, who made an appropriate address. When the opening was actually accomplished by General Barney, the visitors inspected the apparatus displayed and many were the expressions of surprise and admiration for the ingenuity shown by the "Yankee" exhibitors. Interest in the exhibition did not abate when the exercises were finished. Throughout the week crowds thronged the building and examined the displays with lively interest. Several views of the rink, showing different exhibits, are presented in this issue. A glance at these will afford some idea of the extent of the decorations and display.

The social features of the exhibition were conducted under the direction of the citizens' committee, and everything was done that could add to the entertainment of the visitors. On Tuesday afternoon a special review of the fire department on the Champs de Mars was given and proved most interesting. The firemen made a creditable appearance. Following this was a garden party at Terrace Bank, the beautiful residence of Mrs. R. S. Redpath, where the delegates and their friends were presented to the leaders of Montreal society. In the evening there was a conversazione at McGill University. Sir Donald Smith, F. R. Redpath and wife, ex-Mayor Beaugrand and wife, Prof. Bovey and J. W. Beane received the visitors. A lunch was served in a large tent that had been placed between the college and Redpath museum and delightful music was furnished throughout the evening. On Wednesday afternoon the delegates were driven about the city and given a view from the mountain and later there was an enjoyable party at Mrs. Matson's. During the evening there was an informal party at the Windsor. The guests passed several delightful hours in dancing. The programme of Thursday included a ride on the river, shooting the rapids and a reception at the residence of Sir Donald Smith, at which Lord Stanley was present. In the evening there was a grand banquet at the Windsor, which was the formal closing of the festivities, although there were several parties and entertainments Friday and Saturday. The governor-General and all the other high officials participated. President Huntley, Judge Armstrong, the governor-general and many other gentlemen responded to toasts. The affair was a fitting closing for the most enjoyable convention in the history of the association.

The Banquet.

The banquet tendered the delegates by the citizens' committee was one of the most noteworthy affairs of Montreal's society on record. It is seldom the city has had such a distinguished gathering, and this fact was duly appreciated. Windsor Hall was beatifully decorated with American and English flags, red, white and blue bunting, while the stage was a beautiful [illegible] concealed among which was an orchestra which discoursed music throughout the evening. Besides the adornment furnished by skillful artisans, the gallery was a blaze of beauty. The faces of lovely women dressed in handsome costumes added considerably to the splendor of the scene. Covers had been laid for 500, and but few places unoccupied when the feast began. The menu was all that could be desired. When the speeches were in order, Sir Donald A. Smith introduced T. C. Martin, who presented Prof. Bovey a photograph on behalf of the association. Prof. Bovey replied in an appropriate speech. The toasts "The Queen," "The President of the United States," "Our Guests," "The City of Montreal," "The Press," "The Ladies" and "Electrical Service," were responded to. President Huntley was presented with a handsome ebony gavel, mounted with gold and suitably engraved. Lord Stanley made the speech of the evening, in which he assured the visitors of the appreciation of the Canadians of the honor that had been conferred by visiting Montreal.

Queen's Improved Portable Testing Set.

Something over a year and a half ago Queen & company, Philadelphia, brought out their now well known series of portable testing and resistance sets. Extensive experience with these sets seems to have developed very few possibilities of improvement. Almost the only feature which has been suggested as capable of improvement for use under certain conditions has been the galvanometer forming a part of these sets. As heretofore made this galvanometer has been of the astatic type, fiber suspended, and arranged to automatically take the weight of the needle from the fiber when the lid of the case was closed. A control magnet enabled the needle to be made still more astatic. The sensibility of this galvanometer was very great, and it has been found possible to make very accurate determinations of resistance by its use together with the set. Its astaticism, however, rendered it very susceptible to magnetic disturbances and mechanical vibrations.

With a view to doing away with this susceptibility, without detracting from the efficiency of the set, considerable attention has been devoted to the designing of a new galvanometer for use with the sets. The galvanometer finally devised, and shown as a part of the set in the cut, is of the D'Arsoncol type, very dead beat in its action, and remaining almost absolutely steady during all mechanical and magnetic disturbances. The set fitted with this new galvanometer may be used in factories where there is great mechanical vibration, or in central stations, and in the vicinity of dynamo machinery, where the magnetic field is very intense. In some recent tests made by Mr.

QUEEN'S PORTABLE TESTING SET.

Willyoung, of Queen & company, this set was placed upon one large running dynamo while used to measure the insulation and resistance of another dynamo not running. In some other tests of the set it was placed upon a table and measurements made while the table was violently shaken. In both of the preceding tests measurements were easily and quickly made within an accuracy of one-fifth of one per cent.

This new galvanometer is, like the astatic form, removable from the set, and may be used separately for any kind of work desired. This galvanometer cannot, of course, be made quite as sensitive as the astatic form, it is however, sensitive enough for all but work of the very highest accuracy. To accommodate those doing the most accurate work, the set may still be had with the astatic galvanometer, which latter has also been improved by making the control magnet larger and completely removable from [illegible] old type.

New Rawhide Pinion.

[illegible]

NEW RAWHIDE PINION.

shows one that has recently been brought out by the Chicago Rawhide Manufacturing company for street railway motor gearing. Heretofore this company has simply made the blanks for pinions of this character, the finishing work being done by makers of street railway supplies. Now, however, the company proposes to turn out complete pinions similar to the one shown in the illustration. This gear has brass flanges, and is said to be noiseless and more durable than all-metal pinions. Although available for general use, it is especially adapted to street railway work.

Board of Trade and the Telegraph.

It is said that telegraph instruments are to be replaced in the Board of Trade in Chicago. The restoration of the wires will end a long struggle between opposing forces among the members. The wires were taken off the floor in pursuance of a policy outlined for the present administration by the members of the board to crush the bucket-shop evil. The sentiment which at one time was in favor of taking out the wires is now as strong in favor of putting them back again. The change among the prominent commission men has been a gradual one, forced by the realization that the taking off of the wires hurt the big board more than it did the bucket-shops. Colonel Clowry of Chicago, vice-president of the Western Union company, is reported to have said that a majority of the traders appeared to want the wires and instruments put back and that the company would be willing to return if suitable quarters were provided.

Since the above was written the directors of the Board of Trade have arranged for a restoration of the wires. The northeastern corner of the great hall will be used by the telegraph companies, which will have about 1,500 square feet of space. The Postal Telegraph company will put in 56 instruments and the Western Union 86.

Electric Roads for Chicago.

Proposals for new electric roads in and about Chicago are coming thick and fast. Undoubtedly it will be some time before all the projects develop into realities, but the propositions nevertheless show the interest that capitalists hereabouts are taking in electric traction.

Much activity is shown by the backers of the proposed Chicago and Evanston electric railway. It is the intention now to build a surface electric road from Emerson street, in the northern part of Evanston, to the corner of Southport and Clybourn avenues, and from this point to run an elevated road along the river, south to Kinzie or Michigan street, thence eastward to the Fifth avenue or Clark street bridge, [illegible] top story of the bridge to the alley between South Water and Lake streets, thence eastward to State street. The down town terminus will be near the corner of State and Washington streets. When the line is completed, a five cent fare will be charged from the southern terminus to the northern city limits at [illegible] avenue and another fare from there north to Evanston. It is reported that the Edison overhead [illegible] system will be used.

A west side road is that proposed [illegible]

Western avenue west on Twenty-sixth street to Ogden avenue, and on Ogden avenue southwest to Riverside. This would necessitate building a line seven or eight miles in length.

Another project is said to be backed by George M. Pullman. It is proposed to extend the short Pullman line south through the Pullman lands to the Calumet river and west on One Hundred and Twenty-third or possibly on One Hundred and Twenty-seventh street. Much of the right of way would be provided for, inasmuch as a tract of land extending south of Pullman along the Chicago, & Eastern Illinois and Illinois Central Railroads is owned by the Pullman interests.

The Chicago, Riverside and Western Street Railway company, proposes to build an electric road between Aurora and Chicago, to connect at the latter end with one of the lines of the West Side Cable company, presumably the Ogden avenue, when it is built. The distance is 30 miles. The capital of the company is placed at $500,000

The Telegraph in Guatemala.

Albert Sickles, an American who has been in the telegraph construction business in the Central American republics for many years, is in San Francisco purchasing several thousand white pine telegraph poles for projected lines in Guatemala and is also negotiating for the purchase of a large electric lighting plant for the city of Esquintla. Mr. Sickles says that, despite the present poverty of the people and government of Guatemala, there is at this time a great deal of construction work under way. This is a direct result of the recent war with San Salvador, which taught the republic ruled by Barillas a needed lesson on the indispensability of direct and uninterrupted telegraphic communication with the world. This is now had only by means of lines running south through the other Central American republics. When the war broke out the lines were cut in the enemy's territory, and Guatemala was powerless to avert the blow. This disastrous incident made it easy for Mr. Sickles and his associates to obtain valuable concessions from the government for the building of a telegraph line from Guatemala City to Livingston, on the coast of Guatemala. From Livingston the line will connect with Galveston by cable, which will give Guatemala direct communication with the United States, all pole lines being within her own borders.

PERSONAL.

H. T. Paiste of Philadelphia was in Chicago this week.

Enos M. Barton of Chicago left for New York on Monday night.

W. H. Hennessey has succeeded J. J. O'Connell as foreman of the electrical department of the Chicago Telephone company, Mr. O'Connell having been promoted to the position of electrical engineer for the company.

ELECTRIC LIGHT.

The East St. Louis Electric Light company, East St. Louis, Ill., has put in about $10,000 worth of new machinery and otherwise increased its business and the [illegible]

At a special town meeting held in Braintree, Mass., recently, the act of the legislature granting towns and cities authority to establish their own system of electric lighting was accepted by a vote of 119 to 3. The committee appointed to investigate the different systems reported in favor of the arc system, and recommended the [illegible] $20,000 running 100 arc lights, at a cost of about $50 each per year. The report was referred back, and the committee instructed to report at the next meeting on the cost of the arc and the [illegible]

ELECTRIC RAILWAYS.

[illegible]

BUSINESS.

The Wirt lightning arrester is shown in an attractive circular just issued by the Electrical Supply company.

Lovegrove & Co. of Philadelphia are now installing a large boiler plant for electrical purposes for the Pabst Brewing company of Milwaukee. They have numerous orders for future delivery in various portions of the West.

The rapidly expanding business of the Electric Engineering and Supply company, of Syracuse, N. Y., has necessitated the publication of two new catalogues, one devoted entirely to electric railway equipment material. Several new specialties are shown.

The Warfield Manufacturing company, Baltimore, has recently extended its manufacturing interests in order to meet its rapidly increasing trade in electrical apparatus. The outlook for the trade in the South is reported as being better than that of many years.

The Knapp Electrical Works report a booming business on Safety wire and Perkins lamps. They are just placing a new lamp socket on the market, both key and keyless. This socket is very simple in design and it is claimed there is absolutely no danger from a short circuit.

The Baxter Electric Motor company of Baltimore has a number of large contracts on hand and anticipates the best year it has had since it has been in the business. The general manager, Mr. Blackwell, states that on account of the rush of business it was impossible to make an exhibit at Montreal.

The Chesapeake Belting company of Baltimore has a chalk mark in its office which is 7 feet 2 inches long and indicates the width of the driving belt which it made for the Hoosic Falls Manufacturing company of New York. This is claimed to be the largest belt that is at present in active use in the world. This company will soon present to the trade a belt made especially for electrical purposes.

The Chicago office of the Pond Engineering company has just secured an order for two 60 horse power Armington & Sims engines, with foundation boxes, for the gas works in Chicago. One of them goes into the north station of the People's Gas Light & Coke company, and the other into the south station of the Chicago Gas Light company. Both will be used for driving blowers.

M. C. Chase is a pioneer in the manufacture of specialties in hard rubber in the West, having been engaged in this business in Chicago for ten years. Mr. Chase has given much time to the developing of the business, many processes and appliances now used being due to his skill. His factory on South Canal street is fitted up with the latest improved machinery, and what is of much importance to any one desiring a specialty in this line, he gives his work his personal attention.

The Columbia Electric company of St. Paul is now ready to make bids on central station isolated lighting or power plants, furnishing its new pattern Columbia generator. A large amount of time has been spent in perfecting this apparatus, but it is now guaranteed to be equal, if not superior, to any other system offered. All of the details have been attended to and many new and improved appliances are offered in connection with the Columbia for both arc and incandescent lighting. Several installations have already been made, all giving complete satisfaction.

The Mather Electric company (Chicago office) has just refitted the Lyceum theater at Minneapolis, using two of its new style magnetic vane instruments, which can be used for constant readings or at will, the charge being easily made by the turning of a set screw. These instruments are not affected by any magnetic action that may take place in the surrounding wires or metal. They are very accurate and easily handled, any calibration necessary being accomplished by simply moving a hair spring, it being possible for any person of ordinary intelligence to place the instrument in its normal position. The Lyceum theater is also equipped with a new double pole single throw dynamo switch of 300 amperes' capacity. The switch is made of polished bronze, substantial and heavy, and is mounted on a slate base. This plant is also equipped with a new style of rheostat box, made with an iron case and slate front, and fitted with an extra binding post for shunting instead of breaking the field circuit when the machine is stopped. These appliances are all made by the Mather company at its factory at Manchester, Conn.

One of the problems which constantly confronts the electrical engineer is that of distributing the incandescent light over a large and possibly sparsely settled area in an economical manner as to first cost and operating expenses, without loss of efficiency or drop in the candle power of the lights that are far from the station. The Heisler Electric Light company of Philadelphia is confident that it has solved this problem by the use of its long distance series incandescent apparatus, which is thought to meet all the requirements of a successful electric light installation, and to be unequaled in the special features of distributing the light over a large area at a distance from the source of power, at the least cost and in the best manner. The apparatus, while simple in construction, is but little understood by electrical engineers as a body, and the company thinks that a close investigation of the merits of the system could be made with profit by any one contemplating the erection or extension of an incandescent plant. The parent company has its office in Philadelphia, Pa., and will gladly answer all inquiries regarding the system. An attractive catalogue covering the merits of the system in detail will shortly be issued.

the summit of Mount Wilson, a noted peak not far from Los Angeles. The mountain is reached by a toll road, the owners of which now propose to "knock out" the steam motor folks by widening the toll road and building an electric road on it. They claim that they have sufficient water power to run the generators, but it will have to be run down the mountain 1,500 feet to give 125 horse power, then down 1,500 feet to give another 125 horse power.

ELECTRIC MINING.

It has been decided to run the pumps and drills by electricity in the North Tamarack mine, of Michigan. A building is in course of erection near the boiler-house to contain the engine, which will have 250 horse power, and the dynamos.

The Columbia Electric company of St. Paul has just built and sold to Fisher Bros. of Basin City, Mont., a small Columbia generator to run a concentrator necessary in the treatment of the ore coming from their mine, it being of low grade. The concentrator was also designed and built by the Columbia company. The generator is connected direct with the milling machine.

The Northwest Thomson-Houston company of St. Paul, Minn., has just installed a complete electric plant at the Queen of the Hills mine, Neihart, Mont., consisting of a double independent hoist and pumps, with a reserved capacity to handle such drills as may be necessary. The generating capacity will reach nearly, if not quite, 400 horse power capacity, it being possible to drive all of the machinery at the same time. This plant is now one of the largest mining installations in the world and is giving perfect satisfaction.

Electric coal mining machines have now been introduced in the Monongahela coal fields for two years, and their use is rapidly increasing. One of the latest mines in which these machines are employed is the O'Niel & Peterson mine at Bunola on the Monongahela river. The contract for equipping the Bunola mine was made with the Michaels Electric Coal Mining Machine company of Pittsburg. The plant consists of one 50-horse power steam engine, one 30-horse power Westinghouse alternating current generator and eight mining machines with the Tesla motor of the Westinghouse Electric and Manufacturing company attached to each machine.

TELEGRAPH.

Gov. Ambrose Shea of the Bahama Islands announces that arrangements have been fully made for the laying of a cable from Jupiter inlet, on the Florida coast, to Nassau, N. P., and that the contract provides that the same shall be in working order by Dec. 20th of this year. At Jupiter the cable will connect with the United States land wires to Jacksonville, Fla.

TRADE NEWS.

Electric railway specialties are manufactured by the Lieb machine works, 17 to 27 Vandewater street, New York. They are shown in a neatly printed little catalogue, which will be sent free to any address.

It is said that six 50-light Thomson-Houston dynamos have been ordered for lighting the London station of the Midland railway of England. This is an addition to thirteen 50-light arc machines, with lamps, heretofore purchased by the same corporation. The Thomson-Houston International company, through which this business comes, is said to be exporting electrical apparatus at the rate of over $1,000,000 a year. It has lately sold several hundred thousand dollars' worth of railway apparatus for points in South America and Australia.

H. Ward Leonard & Co. have just issued a compact little pamphlet telling "How to Purchase an Electric Plant." They say: "We act solely for the purchaser, and, never under any circumstances, do we act directly or indirectly as the agent of any concern who has any apparatus to sell, nor do we receive any commission of any kind from any source other than the purchaser whom we represent. We ourselves have nothing to sell, and we have no exclusive relations of any kind with any manufacturing concern." Prices range from 1 to 5 per cent., according to work performed

The Northwest Thomson-Houston company of St. Paul is in the midst of a very active season's business, and a large amount of completed work is daily being sent forward to its destination. In the street railway department, among other contracts now under way, is one with the Twin City Railway company, a line approximating four miles in length, now being built between Ironwood and Hurley, Mich., and one with the Willamette Bridge Railway company of Willamette, Oregon, the St. Paul company furnishing 25 standard motor cars. In the lighting department many contracts are under way, some of them of considerable magnitude, including a plant at [illegible] incandescent lights, for the Washburne Electric Light & Power company, [illegible] one hundred arc lights for the [illegible] arcade, [illegible] and a plant of 35 arc [illegible] Brewer of Duluth [illegible] completed. [illegible] has also been active, that agency having recently placed two 50 light arc plants and [illegible] Portland Industrial [illegible] plant of [illegible] Light & Power company, [illegible]

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street.

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used. Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the Boston Fire Underwriter's Union, under date of March 24, 1888, he says: "A Thoroughly Reliable and Desirable Wire in Every Respect."

The rubber used in insulating our wires and cables is specially chemically prepared, and is Guaranteed to be waterproof and will not deteriorate, oxidize or crack and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid, and to a very great extent, fire proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS.

4 LaSalle Avenue, Chicago.

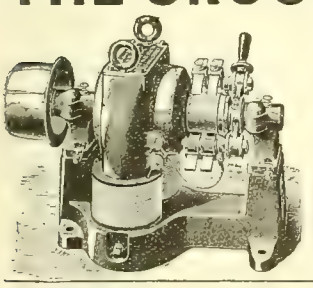
Write us for Prices.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

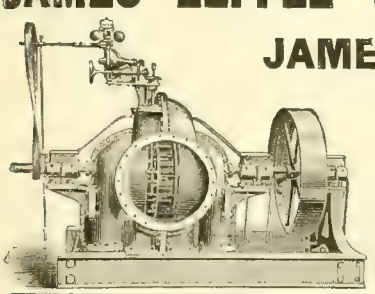
Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.



UPRIGHT AND HORIZONTAL, FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

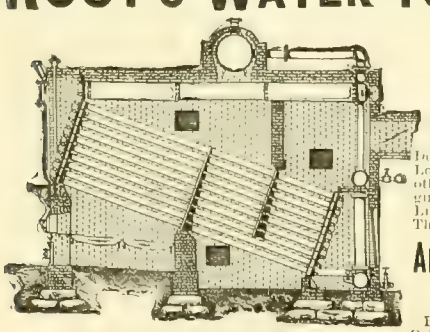
Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE.



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the Electric Light Companies of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City, and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass., and the Thomson Houston Electric Co., Lynn, Mass.

ABENDROTH & ROOT MFG. CO.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

SITUATION WANTED.

Wanted. Position as superintendent of electric station. Six years' experience in the business as electrician and engineer, and in the selling of machinery and in construction work. The best of references. Address "H. S. E.," Care WESTERN ELECTRICIAN.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

WANTED.

A married man with eight years' experience in Electric Lighting and Street Railway work desires a situation as Electrician or Superintendent of a Lighting or Railway plant. Is thoroughly posted on Railway construction. Address "CONSTRUCTION," care of WESTERN ELECTRICIAN.

73-75 W. Jackson St. RELIABLE

WE ARE FITTED WITH

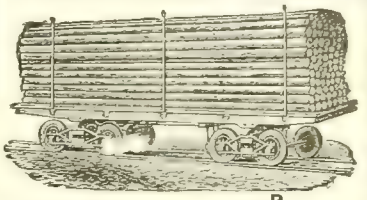
RELIABLE Machinery and Tools,

And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.

ELECTRICAL WOOD.



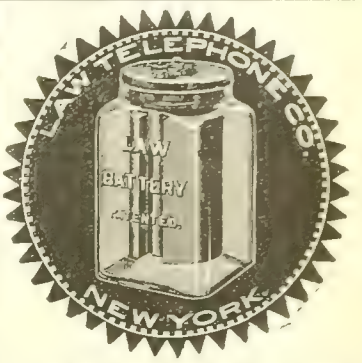
Telegraph, Telephone, Electric Light CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

MAP OF THE UNITED STATES.

A large, handsome Map of the United States, mounted and suitable for office or home use, is issued by the Burlington route. Copies will be given free when it can be done without expense for transmission; or they will be mailed to any address on receipt of six cents in postage by P. S. EUSTIS, Gen'l Pass. Agent C. B. & Q. R. R., Chicago, Ill.



The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., Brooklyn, N.Y.

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES A SPECIALTY.

L. BLATZ, 103-107 West Monroe St., CHICAGO.

THE ELECTRICAL ENGINEERING CO.,

322 DEARBORN ST., CHICAGO.

Contractors for all kinds of ELECTRICAL WORK.

GENERAL WESTERN AGENTS FOR

The Clark Wire.
The Interior Conduit and Insulation Co. of New York.
The Elektron Manufacturing Co.
Perret Motors.
The Standard Dynamo, Manufactured by the Fairbanks Scale Co.

AN EXPENSIVE DELAY

Will Not Occur If You Order Supplies from Us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers: Packard High Grade Lamps: Eddy Motors: "Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.

931 Rookery, CHICAGO. 413 Jackson St., ST. PAUL. 409 W. Michigan St., DULUTH.

SEND FOR CATALOGUE AND DISCOUNT SHEETS.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.

FITCHBURG, MASS., U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

Manufacturers of

OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

BINDERS

— FOR THE —

WESTERN ELECTRICIAN,

ONE DOLLAR.

ELECTRICAL BOOKS

OF ALL KINDS.

Send for Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO, ILL.

THE MOSHER ARC LAMP

For Direct Incandescent Circuits

BEATS THEM ALL.

Read what a customer says:

BENICIA ELECTRIC LIGHT AND MOTOR CO.,
BENICIA, CAL., June 25, 1891.

MOSHER ARC LAMP CO., CHICAGO.

GENTLEMEN:—Yours of 11th inst. received. In reply we have to say the lamp gives satisfaction, and we are well pleased with it. Our superintendent says he has tried two other lamps of different makes and this one is the best of them all. He wants you to send another just like it to the Dixon Light & Water Co., Dixon, Cal., of which he is superintendent.

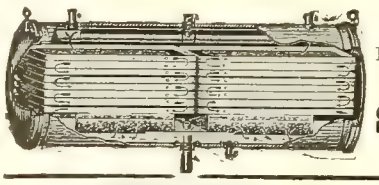
Yours truly, S. C. GRAY, Pres't.

Write for Circulars, Prices and Sample Lamp to

MOSHER ARC LAMP CO.,

125 ONTARIO ST., CHICAGO, ILL.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EVERYTHING IN

WIRE—FUSE— STRIPS.

MANUFACTURED BY

The Sperry Electric Mining Machine Co.,

39th St. and Stewart Ave., CHICAGO.

ALUMINUM

50 Cents per Pound.

THE COWLES

Electric Smelting & Aluminum Co.,

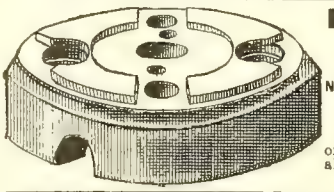
LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum at 50 cents per pound for ton lots in ingots.

Aluminum sheet, wire and castings at lowest market price.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence solicited.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

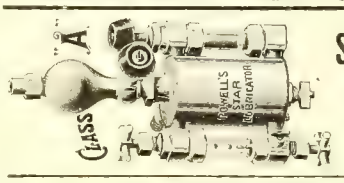
TRUE HARD PORCELAIN.

THREE HARVEST EXCURSIONS.

The Burlington Route, C., B. & Q. R. R., will run Harvest Excursions, Tuesdays, August 25th and September 15th and 29th, from Chicago, Peoria, Quincy and St. Louis to St. Paul, Omaha, St. Joseph, Kansas City, Denver, Helena, Salt Lake and all other points in the Northwest, West and Southwest. Rates very low; tickets for sale at all company's ticket offices at points on and east of Mississippi River. Many connecting lines will sell through tickets for these excursions. Inquire of local agent for full information, or address P. S. EUSTIS, Gen'l Pass. and Ticket Agt., Chicago.

AN ELEGANT OPPORTUNITY

to revisit old scenes in Ohio and Indiana, at slight expense. For the accommodation of Home Visitors, the ERIE LINES will sell at their Chicago offices, excursion tickets to all points in Ohio and Indiana, September 22d, at the rate of one fare for the round trip, tickets good returning thirty days from date of sale. For full particulars as to rates, routes, time and sleeping car accomodations, call on or address A. M. WARRELL, City Passenger Agent Erie Lines, 242 Clark St., Grand Pacific Hotel Building.



This cut represents our Class A

STAR SIGHT "UP-FEED" LUBRICATOR.

There are no joints about it. Arms and body cast in **One Piece**, so you won't be annoyed by leaking and it will work to your entire satisfaction. Will let you try it before you buy it.

For sale by Jobbers, or apply to

THE WM. POWELL CO., - CINCINNATI, O.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

FAN MOTOR,

— MANUFACTURED BY —

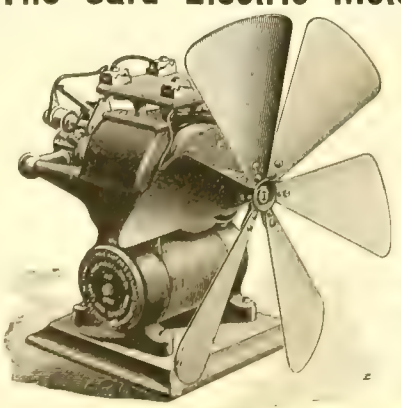
The Card Electric Motor and Dynamo Co.,

Cincinnati, Ohio,

MANUFACTURERS OF

Electric Motors for Arc and Incandescent Circuits, from 1-6 to 50 H. P.

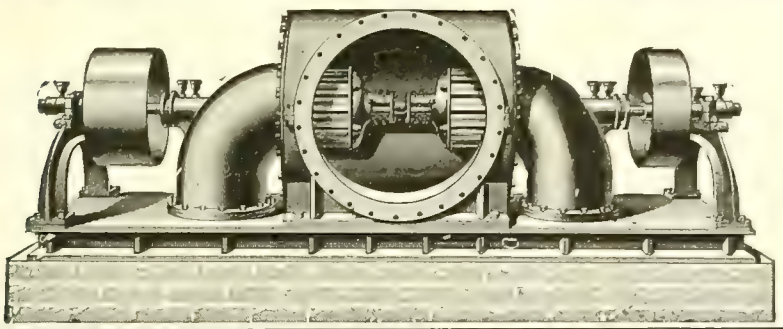
Correspondence Solicited.



AGENTS:

BOSTON—The Eastern Electrical Supply & Construction Co., 65 Oliver St.
CHICAGO—The Thos. L. Johnson Co., 312 Dearborn St.
MILWAUKEE—Henry Ramien, 641 Third St.
WASHINGTON, D. C.—J. Geo. Gardner, 1005 H St.
ST. LOUIS—Stagl Electrical Engineering Co., 1106 Pine St.
MONTGOMERY, ALA.—W. F. Murphy.
DETROIT, MICH.—The Michigan Electric Co., 232 and 234 Griswold St.
MINNEAPOLIS, MINN.—J. M. Lennon, No. 22 Loan and Trust Building.

VICTOR TURBINE WATER WHEEL



The attention of ELECTRIC COMPANIES is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity,** for its diameter, being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In their mechanical use of water it is without an an equal, producing the highest per cent. of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of 12-inch **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft, and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

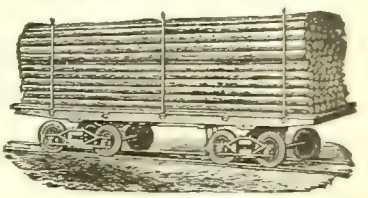
HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,
Consulting and Constructing
ELECTRICAL AND MECHANICAL ENGINEERS.
Complete Equipment of Electric Railways. Steam and Electric Plants.
47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

TO THE

RIP VAN WINKLE Lamp Co.,

Manufacturers of the No. 4620 LAMP:

DEAR FRIENDS:

Sorry to have hurt you so. Keep out of the way in the future. Wear HOB NAILS in my shoes.

Yours,

SUNBEAM INC. LAMP CO. SUNBEAM INCANDESCENT LAMP CHICAGO ILLINOIS U. S. A.

SUNBEAM.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

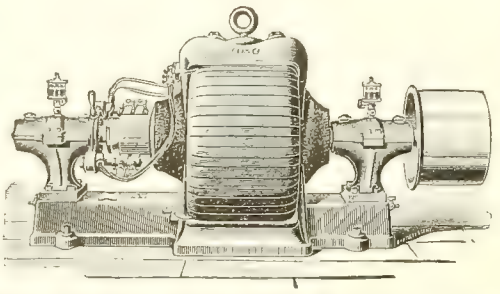
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHŒNIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

PERRET ELECTRIC MOTORS AND DYNAMOS.

REMOVAL NOTICE.

To Our Friends and Patrons:

To meet the increasing demand for Perret Motors and Dynamos, another increase in our facilities has been necessary, and to accomplish this we have moved our factory and general office to Springfield, Mass., where we have secured the property on State Street, formerly known as the Bullard Repeating Arms Works. This property is one of the finest in New England, and is conveniently situated for receiving and shipping goods by all the railroad lines centering in Springfield. With these enlarged and increased facilities, and with a large increase in capital, we shall be able to serve our customers better than ever.

For the convenience of our patrons in that vicinity, we have established an office, storeroom and workshop at 89 Liberty Street, New York City, in charge of Mr. Robert Watson.

NEW YORK OFFICE,
89 Liberty Street.

Respectfully,

THE ELEKTRON MFG. CO., Springfield, Mass.

THOMAS STURGIS, Prest. Wm. C. LANE. Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY. NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

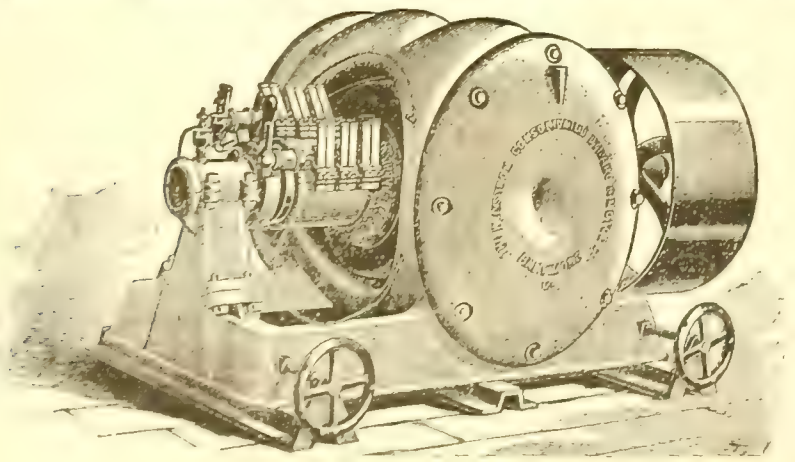
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

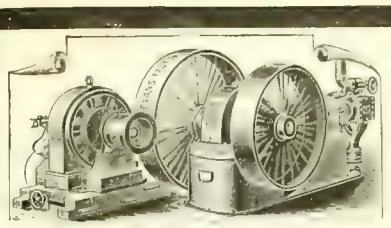
ELECTRIC MOTORS
For All Work.

DYNAMOS
For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

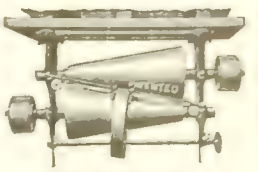


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." PATENT "K. K." LINE WIRE TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

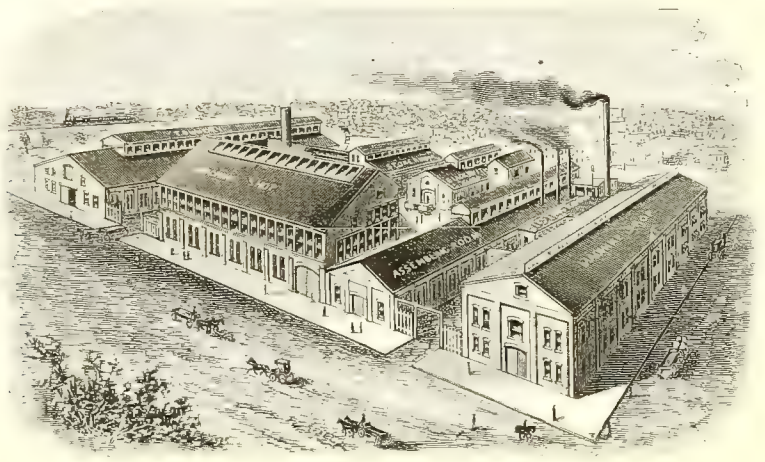
Arc Lighting Apparatus, Electric Motors and Generators,
Alternating Current Apparatus, Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

THE BALL ENGINE CO.,

ERIE, PA.



Our producing capacity has been largely increased, and our Mechanical and Engineering Departments greatly improved by the introduction of modern machinery and superior mechanicians.

We carry on hand, in such a state of advancement that quick delivery can be made, a large and well assorted stock of Single Cylinder, Tandem Compound and Cross Compound engines for 20 to 700 H. P.

Our engines are unequaled for—

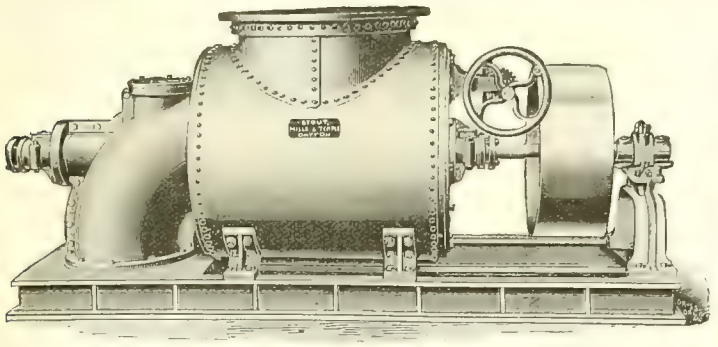
ECONOMY,
DURABILITY,
GOOD REGULATION,
GOOD WORKMANSHIP,
STRENGTH AND MASSIVENESS OF CONSTRUCTION.

These are necessary requirements of engines for—

ELECTRIC LIGHTING,
ELECTRIC RAILWAYS,
ELECTRIC MINING,
ELECTRIC WELDING.

Send for full description and particulars.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shafts.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

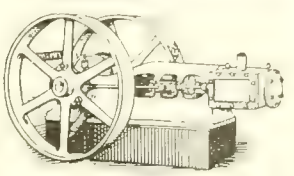
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS, No. 417 North Street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES

A FEW PROMINENT MISCELLANEOUS USERS

(*Excepting Governments and Railroads*).

Adams Express Company; Allegheny City Light Plant; Allegheny County Light Company; Anheuser-Busch Brewing Company; Arbuckle Brothers; Ashcroft Manufacturing Company; E. Balbach & Son; Baldwin Locomotive Works; Bowers Dredging Company; Brooks Locomotive Works; Brown & Sharpe Manufacturing Company; Brush Electric Company of Baltimore; Brush Electric Light Company of Buffalo; Burlington Electric Street Railway Company; Calumet & Hecla Mining Company; Cambria Iron Company; Carnegie, Phipps & Company; Cincinnati Gas Light & Coke Company, Coxe Brothers & Company; Crescent Steel Works of Miller, Metcalf & Parkin; Cumberland & Presumpscot Mills, Denver Consolidated Electric Company; Detroit Dry Dock Company, Detroit Electric Light & Power Company; Dunnell Manufacturing Company; East End Electric Light Company of Pittsburgh; Elgin National Watch Company; Federal Street & Pleasant Valley Electric Street Railway Company of Pittsburgh and Allegheny; Forest Paper Company; Gate City Oil Mills; Glen Echo Electric Street Railway Company of Washington; Herkimer Paper Company; Howe, Brown & Company; Illinois Steel Company; Lehigh Avenue Passenger Electric Street Railway Company of Philadelphia; Lombard, Ayres & Company; McConway & Torley Company; McKeesport Electric Light Company; Metropolitan Electric Light Company of London; Missouri Electric Light & Power Company of St. Louis; Muncie Pulp & Paper Company; New England Dredging Company; Newton Paper Company; G. H. Nichols & Company; Ohio Paper Company; Oliver Oil Company; Omaha & Council Bluffs Electric Railway Company; Omaha Electric Street Railway Company; Otis Iron & Steel Company; Pacific Rolling Mill Company; Pencoyd Iron Works; Pennsylvania Steel Company; Philadelphia & Reading Coal and Iron Company; Pittsburgh Locomotive & Car Work; Robert Poole & Son Company; Quaker City Dye Works; St. Charles Car Works; Sawyer-Man Electric Company; Schenectady Locomotive Works; Williams Sellers & Company; Sherman Oil & Cotton Company; Shoenberger & Company; Southern Cotton Oil Company; Claus Spreckels' Sugar Refinery; Tacoma Light & Water Company; Terre Haute Electric Street Railway Company; Union Switch & Signal Company; United Electric Light & Power Company; Vancouver Electric Street Railway & Light Company; Wellman Iron & Steel Company; Westinghouse Air Brake Company; Westinghouse Electric & Manufacturing Company; Wilmington City Electric Street Railway Company.

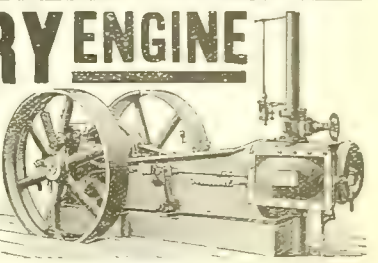
Over 3000 other users.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
Catalogue sent on application.

STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES: Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST.
HALF TONE PLATES SPECIALTY
CHICAGO.

DRY STEAM
FURNISHED BY
THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

"BE YE THE JUDGE."

HAVE YOU TRIED THE

ECONOMIC INCANDESCENT LAMP?

If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again*. Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

GEO. L. KIRKHAM, Manager. 1017 Chamber of Commerce, CHICAGO.

A MARVELOUS INNOVATION

THE THOMSON-HOUSTON ELECTRIC COMPANY

HAS REVOLUTIONIZED THE ELECTRICAL EQUIPMENT OF STREET RAILWAYS.

The Intermediate Shaft, Pinion and Gear have been discarded.

The Armature Pinion and Axle Gear are now inclosed in a dust-proof case filled with oil.

Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

The construction of the Armature avoids the possibility of a burn-out, except by malicious carelessness, and when damaged, can be readily repaired by a novice.

Don't make a mistake by contracting for Railway Equipment before seeing or understanding this marvelous machine.

Prices for Repairs, Parts and Supplies materially reduced.

Information, Prices and Literature furnished on application.

THOMSON-HOUSTON ELECTRIC CO.

CHICAGO OFFICE:
148 MICHIGAN AVENUE.

BOSTON OFFICE:
620 ATLANTIC AVENUE.

"WARD" ARC LAMPS.

A testimonial from a customer using 740 "Ward" Arc Lamps on ONE central station.

This is a larger number than the combined output of all other companies furnishing lamps for incandescent circuits.

READ THE FOLLOWING.

EDISON ELECTRIC ILLUMINATING CO.
OF BROOKLYN.

BROOKLYN, August 17, 1891.

THE ELECTRIC CONSTRUCTION & SUPPLY CO., New York.

GENTLEMEN: It might perhaps interest you to know the success with which the Ward Arc Lamp is meeting in Brooklyn. We installed, eighteen months ago, two (2) of your lamps and to-day have 740 connected to our low tension circuits. To show you that they give satisfaction it is merely necessary to mention that every day we are replacing high tension lamps and for no apparent reason, except that the light is steadier and more brilliant and that the consumer has control over each pair of lamps.

I think, from the results we are obtaining here, it would be to the advantage of every station supplying incandescent lights to add this new and profitable source of income to their system.

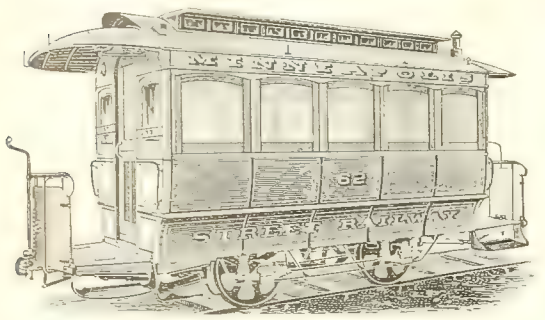
Yours truly, W. S. BARSTOW, Gen'l Supt.

REMEMBER WE GUARANTEE "WARD" LAMPS TO BE EXACTLY AS REPRESENTED.

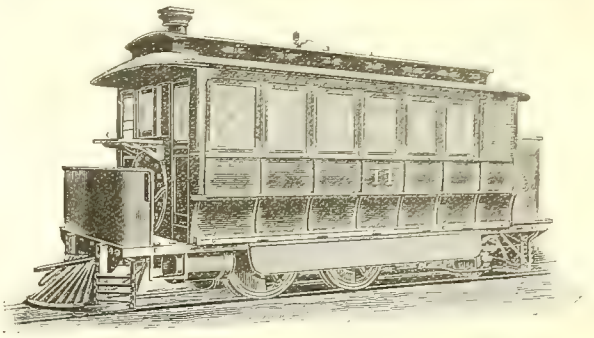
The Electric Construction & Supply Co.,

ESTABLISHED 1881.

Phenix Building, Chicago, Ill. Telephone Building, New York City.



STREET CARS



FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

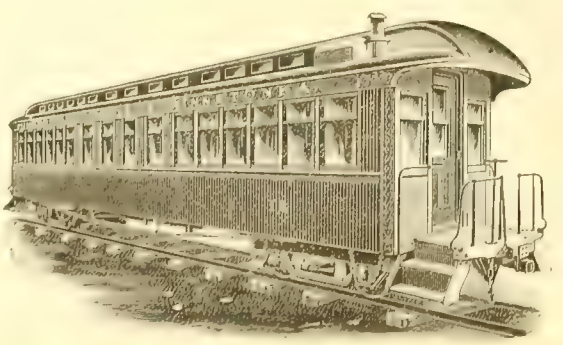
MINNEAPOLIS STREET RAILWAY CO.,

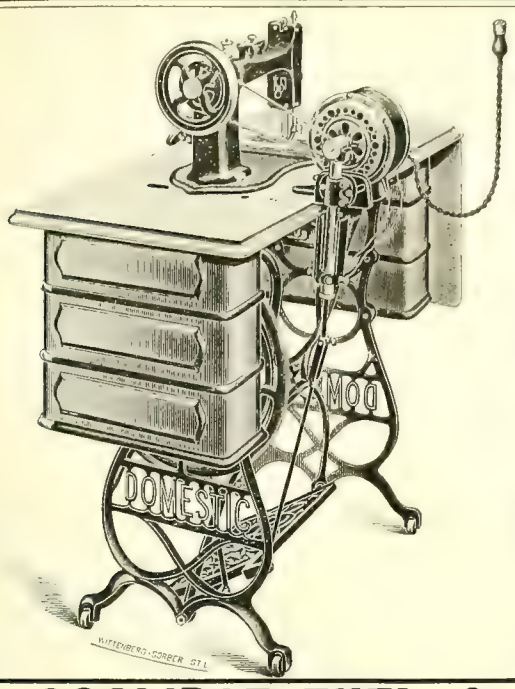
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





ALTERNATING CURRENT MOTORS
WITH SPEED REGULATOR

For Operating Sewing Machines, Jewelers' Lathes, Dental Engines, Etc.

We are now prepared to furnish one-eight H. P. Alternating Current Motors of high efficiency, equipped with a regulator for controlling the speed at will. Perfectly adapted for any light work.

WRITE FOR CIRCULAR AND PRICES.

LARGER SIZES IN COURSE OF CONSTRUCTION.

The Emerson Electric Mfg. Company,

Manufacturers of Electric Lighting and Railway Specialties.

513 and 514 ELM ST. - - - - - - - - ST. LOUIS, MO.

COOLIDGE FUEL & SUPPLY CO.,

RAILROAD CROSS TIES AND PILING.

CEDAR AND OCTAGONAL PINE POLES.

CROSS ARMS, PINS AND BRACKETS.

—MANUFACTURED BY—

J. R. CLARK CO., Minneapolis, Minn.

BEST MAST ARM IN USE.

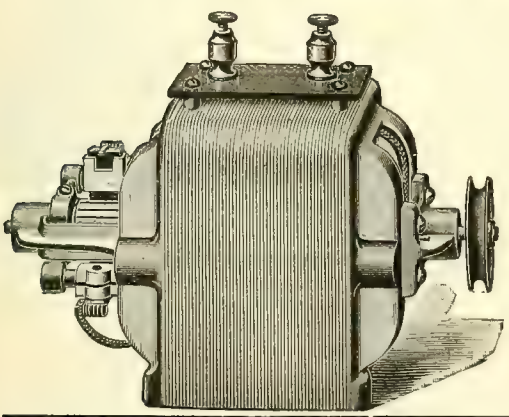
More Lamps Trimmed. No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRON TOWER CO., FORT WAYNE, IND.

SEND FOR New American Electrical Directory, just published; very complete lists. Invaluable for its information of Lighting and Railway Plants.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

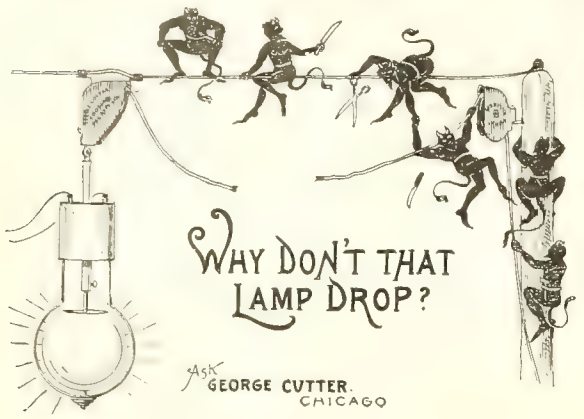
SEND FOR CATALOGUE.

Western Electric Co.,

CHICAGO, NEW YORK, BERLIN, PARIS, ANTWERP, LONDON.

ELECTRIC LIGHTING APPARATUS,
Arc and Incandescent Systems,
Automatic Regulation.

S-U-P-P-L-I-E-S.



GEORGE CUTTER,

333 "The Rookery," CHICAGO.

SAFEGUARDS FOR ELECTRIC LIGHT CIRCUITS.

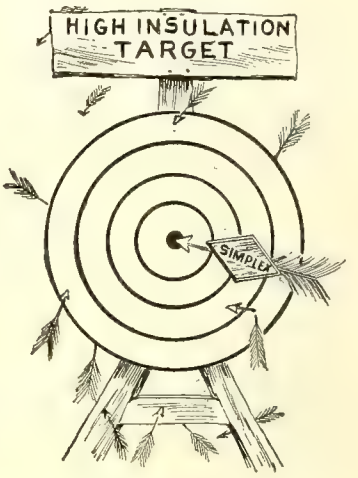
DOES IT PAY TO BE ON THE SAFE SIDE?

If you want
No leaks,
No falling lamps,
No dangerous shocks,

USE SIMPLEX WIRES,

Cutter's Lamp-Supporting Pulley,
Rubber Insulated Tools.

The insulating qualities of Simplex Braided Rubber Wire are there to stay. Prove it on your indoor circuits.



"A SURE HIT."

REMEMBER That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,
17 VIRGINIA ST., EAST SOMERVILLE, MASS.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

By Lieut. F. B. Badt and Prof. H. S. Carhart.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains Portraits and Biographies of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

WHAT THE PRESIDENT SAYS:

The Safety Insulated Wire and Cable Co.,

234 WEST 29th ST., NEW YORK.

GENTLEMEN:---

We have made a thorough investigation of the various cables [together with the records of the same] that have been submitted to us for use in our subway here, and we beg to state that we will accept your proposition for cables, laid and connected at the price named in your proposal.

Yours very truly,

The Brush Electric Light Co.,

(Signed) C. R. HUNTLEY, Gen'l Mgr.

President of the Electric Light Association.

PERKINS LAMPS

ARE STILL BEING USED BY

THE MILLIONS.

We are Western Agents for both of the above.

THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF ALL KINDS,

54 and 56 Franklin Street, CHICAGO, ILL.

A DEFINITION:

efficacious (ef i-kā'shus), *a.* [OF. *efficacieux*, equiv. to *efficace*, F. *efficace* — Pr. *efficaci* — Sp. *eficaz* — Pg. *efficaz* — It. *efficace*, L. *efficax* (*efficac-*), efficacious, < *efficere*, effect, accomplish, do: see *effect*, *v.*] Producing the desired effect; having power adequate to the purpose intended; effectual in operation or result.

To how many things which you use in **Your Work** can you apply that definition?

How many have the **Desired Effect?**

How many are **Adequate to the Purpose** intended?

How many are **Effectual in Operation** or result?

You will find **SHIELD BRAND** moisture-proof **WIRE** answering that description so fully that Mr. William Dwight Whitney must have had it in mind when he wrote the Century Dictionary.

The Electrical Supply Co.,

Corner RANDOLPH STREET and MICHIGAN AVENUE,

CHICAGO.

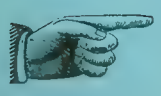
Factories: Ansonia, Conn.

TESTIMONIALS.

SUN ARC LAMP!

For Arc Circuits.

For Direct Incandescent Circuits.



ONLY Arc Lamp in the market that burns on an INCANDESCENT CIRCUIT **SUCCESSFULLY.**

SINGLY OR TWO IN SERIES.

READ THESE:

THE CHICAGO TRIBUNE,
EDITORIAL ROOMS.

CHICAGO, Sept. 2, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO.

GENTLEMEN:—We have been using your Sun Arc Lamps for photo engraving, and find them first-class in every respect. Have used several Arc Lamps, but find yours superior to all, and consider them second to none. Yours truly,

(Signed) LOUIS RASICOT,
Engraver.

THE DAILY INTER OCEAN.

CHICAGO, ILL., August 25, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO.,
195 to 207 S. Canal St., City.

GENTLEMEN:—We are using your Sun Arc Lamp, and find it the best Arc Lamp for Incandescent circuits that we know of. It is giving the most eminent satisfaction, and we take much pleasure in certifying to its merits. Yours very truly,

(Signed) THE DAILY INTER OCEAN,
Per D. LAPOINTE, Photo-engraver.

KNAPP ELECTRICAL WORKS,
54 Franklin St., Chicago.

August 27, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO., Chicago, Ill.

GENTLEMEN:—The Sun Arc Lamps which we are using on our Incandescent circuit are giving us the best results and we regard them as the best lamp of its kind in the market.

Wishing you continued success, we remain,

Yours truly,
(Signed) KNAPP ELECTRICAL WORKS,
Per M. A. KNAPP, Manager.

ROCKFORD ELECTRIC MANUFACTURING CO.,
Manufacturers of
ELECTRIC MOTORS, RAILWAY AND STATIONARY.

ROCKFORD, ILL., Sept. 2, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO., Chicago, Ill.

GENTLEMEN:—..... I started up the lamp and saw it in operation for several nights, and it worked very nicely, certainly better than any lamp I have ever seen in use on Incandescent Circuits. I hope to be able to send you other orders soon.

Wishing you much success,

Yours very truly,
(Signed) GEO. A. MAYO.

(**MORE NEXT WEEK.**)

Convince Yourself by Sending an Order for One or Two to us.

Great Western Electric Supply Co.,

201, 203, 205, 207 SO. CANAL STREET,

Selling Agents. **CHICAGO, ILL.**

Special Inducements to Supply-Houses.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

BAXTER

RAILWAY MOTORS,

SLOW SPEED.
NO INTERMEDIATE GEARING.
GEARS RUN IN OIL.

EXAMINE INTO THE MERITS OF THESE MOTORS
IF A *REDUCTION IN REPAIRS* IS WORTHY OF CONSIDERATION.

COMPLETE Railway and Power Plant EQUIPMENTS.

SLOW SPEED STATIONARY MOTORS For ARC and Incandescent Circuits.

BAXTER ELECTRIC MOTOR CO.,

WORKS AND GENERAL OFFICES. BALTIMORE, MD.

Long Distance Series Incandescent Lighting

—BY THE—

HEISLER SYSTEM.

HAS NO EQUAL

In the Economical Subdivision of the

ELECTRIC LIGHT.

No Transformers or Other Translating Devices.

We distribute the capacity of our largest dynamo on a No. 8 wire, and thus avoid the excessive cost of conductors as used for other methods of distribution.

Awarded gold medal at Paris Exposition, 1889.

Estimates furnished on application for the complete installation of plants in any section.

Write for price list of series lamps for use on arc light circuits. State for what current and system.

Correspondence solicited.

HEISLER ELECTRIC LIGHT CO.,

DREXEL BUILDING, PHILADELPHIA, PA.

Send for Circular.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, SEPTEMBER 26, 1891. No. 1.

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

The Minnesota Brush Electric Company

HAVE JUST BOUGHT

82½ MILES

of Arc, Incandescent and Power Cables

INVESTIGATION PROVED IT THE BEST.

OF THE Standard Underground Cable Co.,

New York. Pittsburgh. Chicago.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use.

Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,

20 CORTLANDT ST., NEW YORK.

GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,

"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

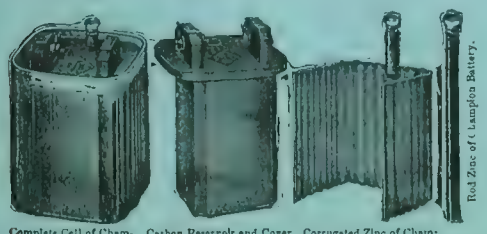
5 and 7 DEY STREET, NEW YORK,

MANUFACTURERS, IMPORTERS AND DEALERS IN

THE "CHAMPION" BATTERY,

Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.

THE TRADE WILL BE PROPERLY PROTECTED.



Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies

Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

New York & Ohio Company, WARREN, OHIO.

MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP

AGENTS

J. W. Peale, - - No. 1 Broadway, New York.
Electric Eng. & Supply Co., - - Syracuse, N. Y.
Central Electric Co., - - - - - - Chicago.
The Electrical Eng. & Supply Co., St. Paul, Minn.
St. Louis Electrical Supply Co., - - St. Louis.

CLOWER, HARRIS & CO.,

CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.

The Largest Electrical [illegible] Manufacturing House

Everything Electrical

289 ELM STREET. - - DALLAS, TEXAS

FOR SALE.

One 3 Horse Power Electric Motor.
One 6 Horse Power Electric Motor.

Both in excellent condition, having been used but little.

ERIE ELECTRICAL SUPPLY CO., ERIE, PA.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.

F. CAZENOVE JONES, Manager of Factories.

The International OKONITE COMPANY, LIMITED.

13 Park Row, New York.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

For Aerial, Submarine and Underground Use.

Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

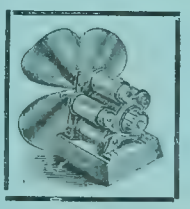
WRITE FOR PRICES ON

TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.

R. D. Nuttall Company,

Allegheny, Pa. New York.

THE 1891 ELECTRIC MOTOR AND BATTERY.

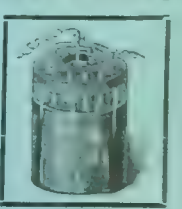


SIMPLE. DURABLE.
ECONOMICAL. EFFICIENT.

For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at

ONE-HALF PRICE.

Send for prices and descriptive pamphlets to

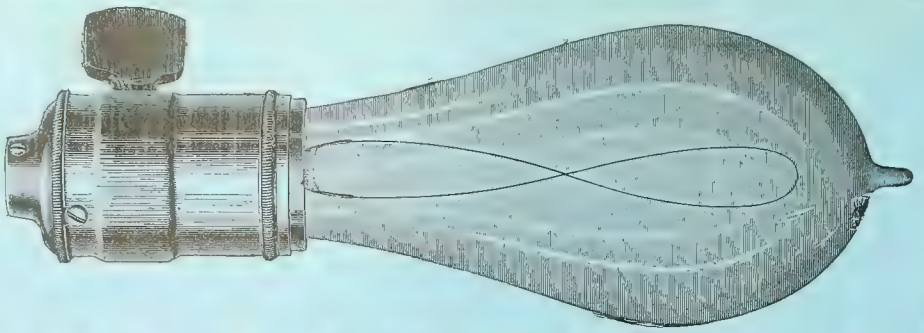


1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IMPROVED BALL ENGINES,

BUILT BY THE BALL & WOOD CO., NEW YORK.

W. B. PEARSON, Selling Agent. Home Ins. Bldg., Chicago, Ill.

LONG  LIFE

INCANDESCENT LAMPS.

SEE WHAT PURCHASERS SAY:

BURLEY HOUSE,
Belle Plaine, Iowa,

State of Iowa }
Benton County } ss.

I, B. B. Burley being duly sworn upon oath depose and say, that I am a resident of Belle plaine Benton County Iowa, and proprietor of the "Burley House" in said City, — That Sept. 20th 1889, the Wm A. Hunter Electric Company, placed a 32 Candle power — 52 volt incandescent lamp, of the Thomson-Houston System, on the porch at my said Hotel — That said lamp burned continuously for 4620 Hours, burning out July 15th 1891. —

B. B. Burley

Subscribed in my presence and sworn to before me August 10th 1891.

John H. Milner
Notary Public in
& for Benton Co. Iowa.

B. B. BURLEY,
Prop. BURLEY HOUSE,
Belle Plaine, Iowa.

Extract of letter from Manitou Electric Co., Manitou Springs, Colo.

DATED AUGUST 23, 1891:

"We have got T. & H. Lamps burning and giving good light that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston Lamps still burning that have burned 5,000 hours. The lamps were all I could ask. Have tried 'Sunbeam,' 'Edison' and other lamps made in Chicago, and the 'Perkins,' all of which are no good on earth."

MANITOU ELECTRIC CO.,
By C. F. TINGLEY, Manager.

THE IRON MOUNTAIN ELECTRIC CO., IRON MOUNTAIN, MICHIGAN, state that they have lost but 2 lamps in three months, with one thousand installed.

In the face of these Facts, why do you buy lamps that are of Short Life, Low Candle Power, and that quickly Blacken?

We make our own lamps and can furnish them at once

From 45 to 116 Volts,
From 6 to 150 Candle Power.

Write for Price Lists.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Avenue, BOSTON, MASS.

148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Accumulator Co., The.....xxviii
Abendroth & Root Mfg. Co.. —
Alexander, Barney & Chapin..i, iv
American Electrical Works.... xiii
Andrews & Co., A. H..... xxi
Baggot, E xiv
Bain Electric Mfg. Co..... xxiii
Ball Engine Co..... xxi
Ball & Wood Co., The i
Bernstein Electric Co.....viii
Blatz, L.....—
Borden & Selleck Co..... xv
Braun Illustrating Co xxi
Brownlee & Co..... xii
Brookfield, Wm..... xii
Brush Electric Co.....xviii
Butler Hard Rubber Co.....iv
Buxton, Geo. B xiv
C. B. & Q. R. R..... xxi
C. & C. Electric Motor Co.....xvi
Card E. Motor & Dynamo Co. —
Central Electric Co..... v
Chicago Electric Mfg. Co.....xiv
Chicago Electric Motor Co.....xiii
Clower, Harris & Co..... i
Chicago Insulated Wire Co... xvii
Colburn Electric Mfg. Co..... xiv
Coolidge, Fuel & Supply Co ...—
Consol. Elec. Mfg. Co., The..—
Cowles Electric Smelting and Aluminum Co.....xiv
Crocker-Wheeler Electric Motor Co..... xiii
Day's Kerite Insulation i
Densmore Typewriter Co..... xii
Dayton Globe Iron Works Co..xxi
Eastern Electric Cable Co..... xiii
Edison General Electric Co..... vi
Edison General Electric Co., Cable and Wire Department.....vii
Eddy Electric Mfg. Co..... xx
Electric Construction & Sup. Co.xxiv
Electric Merchandise Co..... xiv
Electric Secret Service Co..... xvi
Electrician Pub. Co. viii, x, xiv, xviii
Elec. Construction Co., The.... xiii
Electrical Engineering Co..... —
Elec. Eng. & Supply Co., The.—
Electrical Supply Co., The... xxvi
Elektron Mfg. Co..... xvi
Empire China Works..... xiv
Erie E'ectrical Supply Co..... i
Evans Friction Cone Co..... xvii
For Sale .....i, xiii
Foster, O. A.....i
Fort Wayne Electric Co.....xxviii
Freeman, Coleman & Co'y.... xiii
Globe Carbon Co.... xv
Great Western Elec. S. Co. viii, xxvii
Greeley & Co., The E. S.....i
Hale Elevator Co..... x
Hamill. S. M..... xiii
Heisler Electric Light Co.....xxviii
Hill Clutch Works viii
Hine Eliminator Co..... xii
Holmes, C. H..... xiii
Holmes, Booth & Haydens... .xvii
Hood, Wm..... x
India Rubber & Gutta Percha Insulating Co.....xxiv
Interior Conduit & Insulation Co. x
International Okonite Co..... i
Kartavert Mfg. Co..... xii
Keller & Degenhardt..... xii
Knapp Electrical Works..... xxv
Law Telephone Co..... xiii
Leonard & Co., H. Ward..... xiv
Leffel & Co., Jas..... xiii
Loud, H. M. & Sons Lumber Co..xiv
McLaughlin, James xiii
Mason, James H..... xiii
Milliken Bros.....iv
Minneapolis Street Railway Co.—
Monitor Electric Co..... x
Munsell & Co., Eugene..... xiii
Murphy, T. J..... xiii
N. W. T. H. Electric Co..... xix
National Carbon Co.....iv
National Electric Mfg. Co..... ix
N. Y. Belting & Packing Co....—
New York Insulated Wire Co....vii
New York & Ohio Co..... i
N. W. Elec. Specialty Co....—
Nuttall Company, R. D..... i
Ostrander & Co., W. R..... xiv
Paiste, H. T..... xii
Page Belting Co.....xiv
Partrick & Carter Co..... x
Payne & Co., Geo. W..... —
Pearson & Co., W. B.....xxi
Phoenix Glass Co..... viii
Pond Engineering Co xxi
Powell Co., The Wm.....—
Queen & Co..... xiii
Rockford Electric Mfg. Co..... xii
Sargent & Lundy..... xiii
Sawyer-Man Electric Co..... xi
Schieren & Co. Chas. A.....xi
Schoonmaker, A. O xii
Schuyler Electric Co..... ...viii
Short Electric Railway Co.....xii
Schultz Belting Co.....xiii
Sperry Electric Mining Machine Co..... xiv
Standard Underground Cable Co....i
Standard Paint Co..... xii
Stanley Electric Mfg. Co..... xxiii
Star Iron Tower Co..... —
Stearns Mfg. Co.....xxi
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co xv
Taussig, S.....—
Temple, J. C..... xv
Thomson-Houston Elec. Co..ii, xxii
Turner Brass Works..... xiii
Union Electric Mfg. Co., The... x
Union Electric Works.....iv
Union Hardware Co..... xi
U. S. Electric Lighting Co.....xi
Van Nuis C. S..... i
Vulcanized Fibre Co..... xv
Wanted xiii
Wenstrom Consolidated Dynamo & Motor Co., The xvi
Western Electric Co xxiii
Westinghouse Elec and Mfg Co—
Westinghouse Machine Co..... xxi
Weston Electrical Instrum't Co.. .xii
Williams Engine Works..... .xxi
Woodbridge & Turner Engineering Co xv
Woodhouse & Rawson, Ltd....—
Worthington, Henry R..... xii

CLASSIFIED LIST.

Accumulators.
Accumulator Co., The.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelting & Aluminum Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
N. W. T. H. Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co. The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Cars Railway.
Minneapolis St. Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Edison General Electric Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Keller & Degenhardt.
Leonard & Co., H. Ward.
McLaughlin, Jas.
N. W. T. H. Electric Co.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
National Electric Manufacturing Co.
N. W. T. H. Electric Co.
Rockford Electric Manufacturing Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Electric Specialty Co.
N. W. T. H. Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Standard Paint Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables, Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus, Electric
[illegible]

Motors.
[illegible]
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
Rochester Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works
Western Electric Co
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James.
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Type Writer Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Sperry Elec. Mining Machine Co

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

UNION ELECTRIC WORKS,

207 South Canal St., CHICAGO, ILLINOIS.

The **Best Electric Bell** in the market; Nickel plated Gongs; Double magnet, Platinum Contacts, side adjustments with set screw. The simplest and most durable Annunciator, all sizes, for elevators, hotels and offices.

WRITE FOR PRICES.

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class work

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

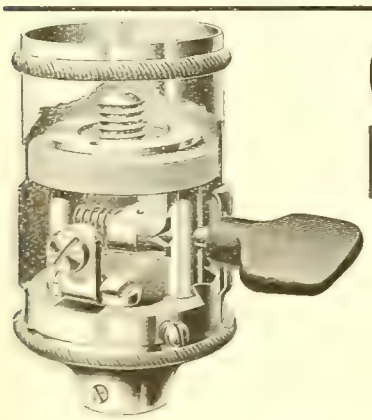
KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.



SOCKETS

TO FIT ANY LAMP BASE.

We are not the only concern that sells **SOCKETS**, but some of our customers say we are the only one that sells the **BEST.**

There is a similar rumor about our cut-outs, rosettes, and main and branch.

If you are in this city call and look at our display of station switches.

ALEXANDER, BARNEY & CHAPIN,

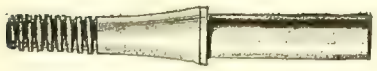
NO STAIRS TO CLIMB.

TRADE A.B.C. MARK

20 Cortlandt St.,

NEW YORK.

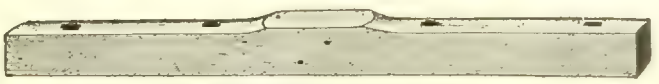
CONSTRUCTION MATERIAL.



STRAIGHT PINS.

BRACKETS.

CORNER PINS.



CROSS ARMS.

OUR ST. LOUIS BRANCH.

OKONITE

TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

OUR KANSAS CITY BRANCH.

OKONITE

TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OUR OMAHA BRANCH.

OKONITE

TRADE MARK.

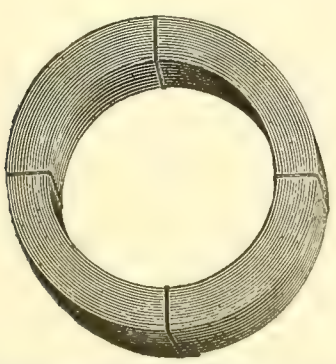
WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

OUR DENVER BRANCH.

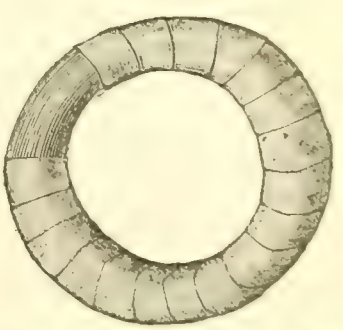
OKONITE

TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., Denver, Colo.



We are manufacturers of all these goods, and can quote lowest prices.



UNDERWRITERS' WIRE. **WEATHERPROOF WIRE.**

CENTRAL ELECTRIC COMPANY,

116 AND 118 FRANKLIN STREET, CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE COMPANY'S SYSTEM.

Edison

General

Electric Co.

EDISON BUILDING,

BROAD STREET,

NEW YORK.

Announcement!

WE ARE NOW FURNISHING:

INCANDESCENT LAMPS,
Of any Voltage to Fit any Socket.

ARC LIGHTING SYSTEM,
Embracing many New and Valuable Features, Notably Lamps that will Burn 7 or 14 Hours.

SLOW SPEED MOTORS,
From 1-12 to 1-2 Horse-Power. Most Economical and Reliable Small Motor Manufactured.

MOTORS,
Of any Capacity, from 1-2 to 210 Horse-Power. Highest Efficiency, Lowest Price.

FIXTURES, ELECTRIC AND COMBINATION GAS,
Being the most Complete and Artistic Line now on the Market.

WIRE AND CABLES,
Including the Famous Cables of Siemens & Halske, of Berlin.

ELECTRIC RAILWAYS,
Both Single and Double Reduction Motors.

ELECTRIC MINING APPLIANCES.
Percussion Drill, Diamond Drills, Locomotives, Hoists, Pumps, Fans and Coal Cutters.

GENERAL SUPPLIES,
Carried in Stock at Each District Office.

DISTRICT OFFICES.

CANADIAN DISTRICT:
Edison Building, Toronto, Can.

CENTRAL DISTRICT:
173-175 Adams St, Chicago, Ill.

EASTERN DISTRICT:
Edison Building, Broad St., New York.

NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.

PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.

PACIFIC NORTHWEST DISTRICT:
Fleishner Building, Portland, Ore.

ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.

SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga.

CUT-OUTS,
JOINTS,
DISTRIBUTING
BOXES,
ELBOWS
ETC., ETC.
CORRESPONDENCE SOLICITED.

THE NEW
SAFE-DUCT
AND
COMPLETE METHOD
OF
WIRING FOR ALL
ELECTRIC LIGHTING SYSTEMS.

"VULCA"

NEW YORK INSULATED WIRE CO. NEW YORK
MOISTURE-PROOF
VULCA
ELECTRICAL
WIRE-DUCT
NON-INFLAMMABLE
TRADE MARK

ELECTRICAL WIRE DUCTS.

AND CHICAGO.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

THE NATION'S CHOICE.

Grimshaw White Core Wire.

B. D. WIRE, TAPES AND COMPOUNDS.

ALL SUPPLY STORES KEEP THEM.

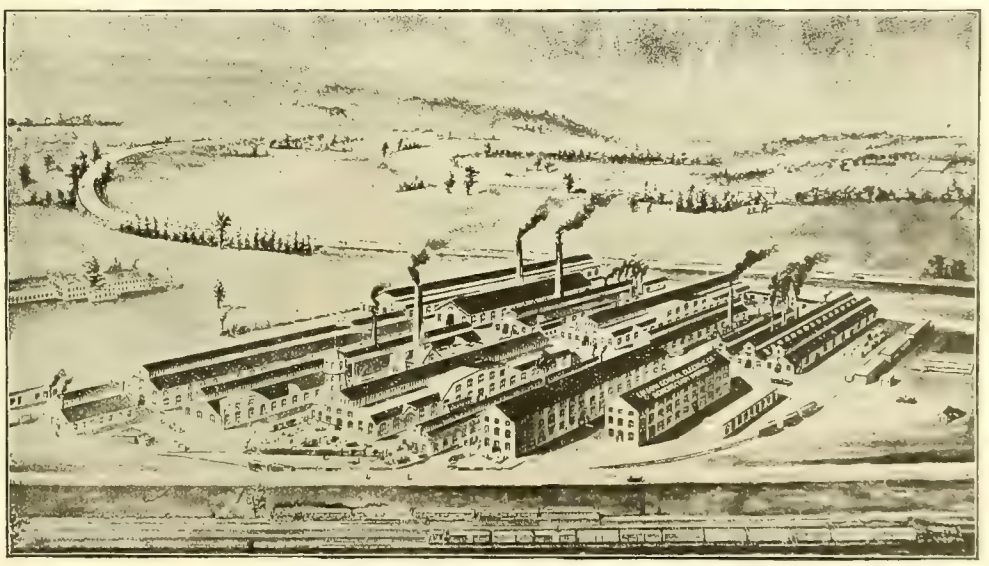
NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street, CHICAGO,

MAIN OFFICE: 649-651 Broadway, New York. GEO. H. MEEKER, Western Manager.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

BERNSTEIN ELECTRIC CO.

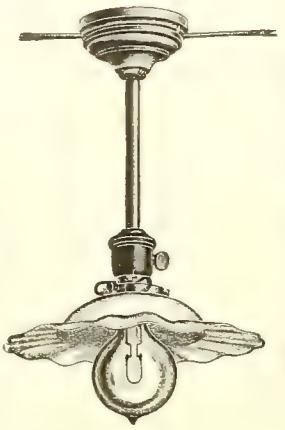
INCANDESCENT LAMPS

-FOR-

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.
SHULTZ BELTING CO.
Manufacturers of
SHULTZ PATENT
IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP
FULLED LEATHER BELTING
Shultz PATENT Leather Woven Link Belt
ALL LEATHER
NO IRON ROD OR HINGE OLD STYLE
LEATHER LINK AND IRON ROD BELT
AND ROPE TRANSMISSION SUPERSEDED
SAVE YOUR POWER. YOUR BELTS. YOUR MONEY.
BY COVERING YOUR PULLEYS WITH
SHULTZ PATENT
LEATHER PULLEY COVERING.
OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE
THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION
RAWHIDE LACE LEATHER AND PICKER LEATHER.

BRANCHES: 164 Summer St., Boston, Mass; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa; 60 W. Monroe St. Chicago. | St. Louis, Mo.

THREE GOOD BOOKS.

DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO, ILL.

ONE DOLLAR EACH.

HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
1[illegible] Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

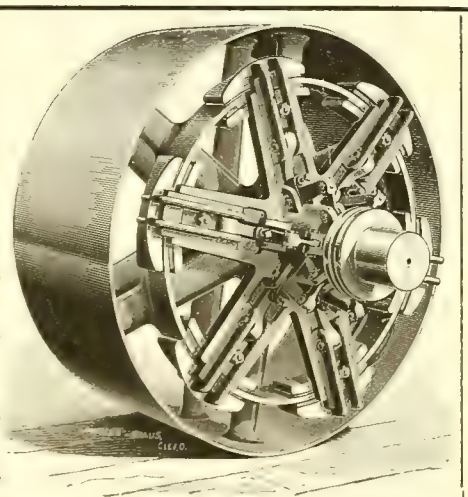
CHICAGO: [illegible] So. Canal St. MINNEAPOLIS: [illegible] Kasota Building.

KANSAS CITY: [illegible] and [illegible] Union Avenue.

ELECTRIC LIGHT PLANTS

[illegible]

Send for new Catalogue Power Transmission Machinery.

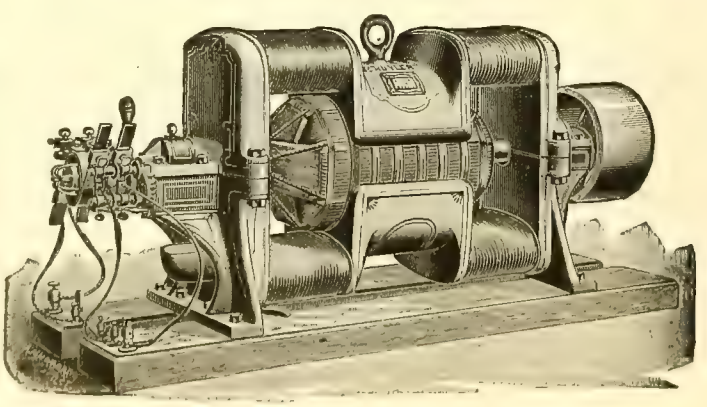


THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

PHOENIX GLASS CO
MANUFACTURERS OF
ELECTRIC LIGHT GLOBES ETC
THE LARGEST LINE OF
NOVEL & ARTISTIC PATTERNS & EFFECTS
729 BROADWAY N.Y.
SEND FOR CATALOGUE

THE NATIONAL TRANSFORMER SYSTEM

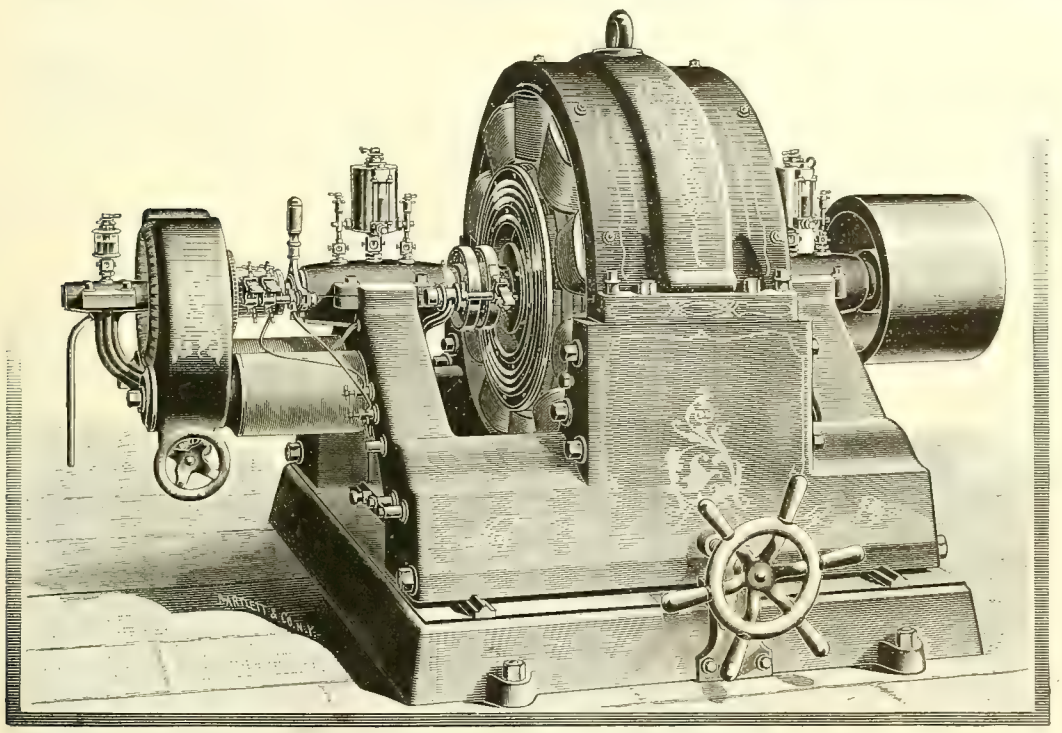
OF INCANDESCENT LIGHTING.

Florence, S. C., August 19, 1891.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.:

GENTLEMEN:—I write this to tell you of the wonderful performance of our Alternating Dynamo, which is a 750 lighter of your manufacture. Last night, while at supper, a cross got on our mains by their sagging on to a telegraph wire, and my engineer, who is a new man, ran the dynamo with the ampere meter needle clear on the end of the scale, which is about 80 amperes, or equivalent to approximately 1,600 lamps. It ran that way until it chocked down a 100 H. P. engine with 110 pounds steam, and then he sent for me. Strange to relate, the machine was not damaged a particle. The excessive current had melted all of the 4 fuses on the board, but the engineer had put in new ones and heavier ones, and had started up again. I consider that we have the only dynamo on earth that would stand such a strain and not be injured. I shall of course see to it, that a thing of this kind does not happen again.

[Signed] A. A. FORMAN, Supt. Florence Impvt. & Mfg. Co.



THIS IS THE MACHINE THAT WE BUILD.

Self-Contained Alternator. Capacity 1,000 16 C. P. Lamps.

SEND FOR CIRCULARS AND PRICES.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

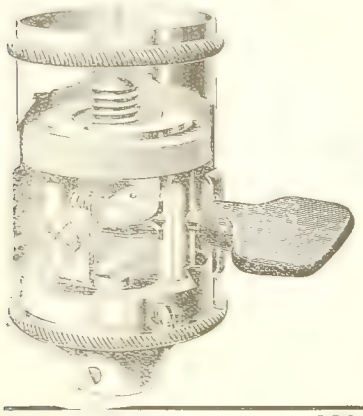
COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	DETROIT, MICH.,	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	DENVER, COLO.,	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	SAN FRANCISCO, CAL.,	National Electric Development Co.
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.	KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
SEATTLE, WASH.,	Chas. H. Baker & Co.	DULUTH, MINN.,	The Electrical Eng. & Supp'y Co.



"OF SOME THINGS ONLY THE BEST ARE WORTH HAVING."

WE GUARANTEE ALL GOODS

And will ship to central stations on approval—FREIGHT PREPAID.

The UNION ELECTRIC MFG. CO., Bridgeport, Conn.

NEW YORK: Alexander, Barney & Chapin.

BOSTON: The Eastern Electrical Supply Co.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

THE "JEWEL"

WM HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

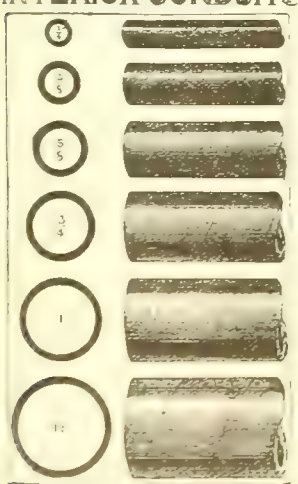
16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

THE INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Electrical Engineering Co., 320 Dearborn St., Chicago, Ill.
Southern Electric Co., Baltimore, Md.
Treat Dow & Co., 222 Sutter St., San Francisco, Cal.
E. Frank Johnson, Provident Bldg., Philadelphia, Pa.

MONITOR

CARBON

BATTERY

Unsurpassed in Strength and Durability.

LIBERAL DISCOUNT TO THE TRADE.

Write for Quotations.

G. A HARMOUNT, M'gr,

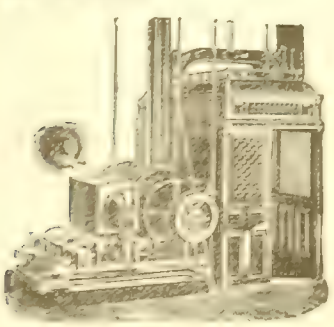
Monitor Electric Company

149 WABASH AVENUE,

. . . . Chicago, Ill.

Western Agents Alfred F. Moore's Wires and Cables.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

PASSENGER AND FREIGHT

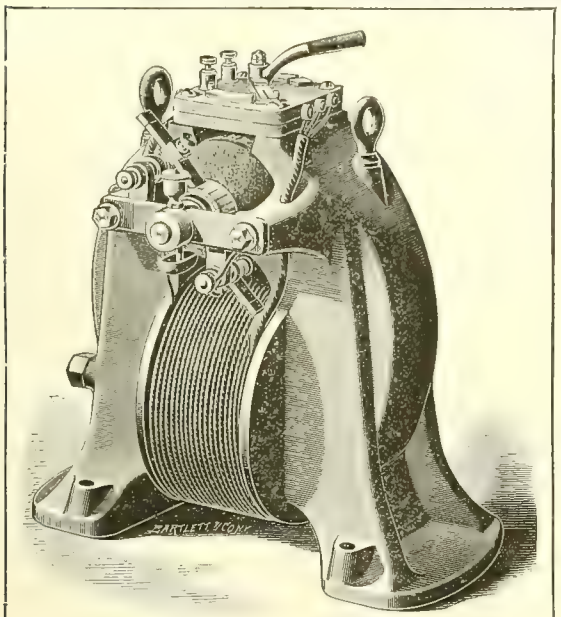
Hydraulic and Electric

ELEVATORS.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos. — Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

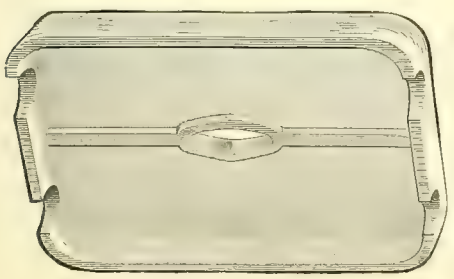
MOTORS and GENERATORS

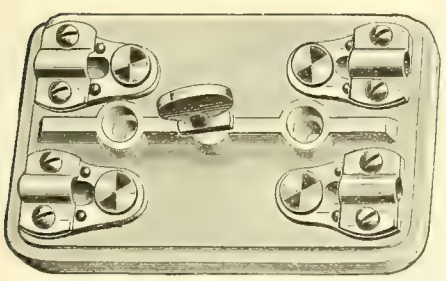
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

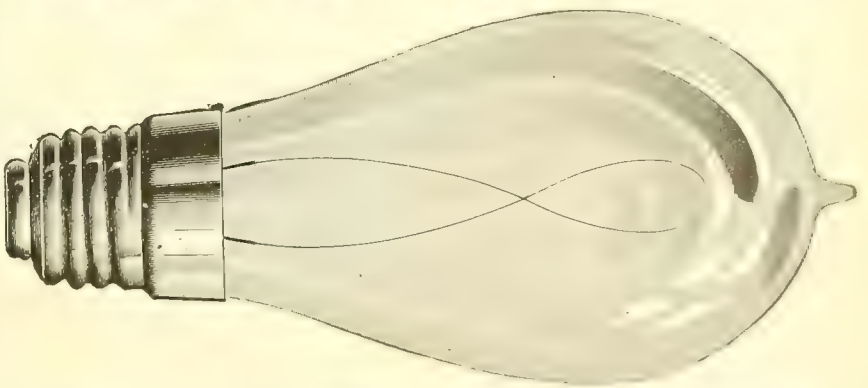
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

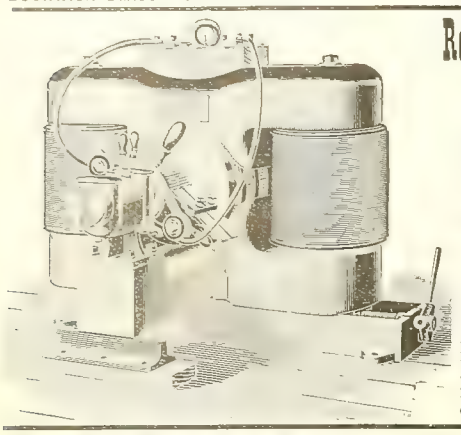
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway).

Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery. Chicago, Ill. 1201 Market St. Philadelphia, Pa.

See our full page advertisement in issue Sept 12, for illustrations, prices, etc.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

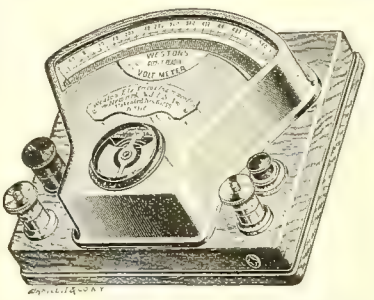
CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

KNOW WHAT YOU'RE GETTING!

HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

In a test of the best known "Separators" recently made at Cornell University this ELIMINATOR demonstrated percentages of efficiency over ALL competitors ranging from 11 to 39 per cent. The full report of test with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street, NEW YORK.

The "DENSMORE,"

The World's Greatest Typewriter,

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type-bar machines.

Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Steel throughout.

STANDARD KEY BOARD, with shift carriage for capitals. Call or send for catalogue.

"The best of all typewriters. The height of perfection. To buy any other than the 'DENSMORE' is to make a mistake."—C. T. BLUMENSCHEIN, Stenographer, National Park Bank.

We will appoint a reliable dealer in all cities as soon as possible, and in the meantime will ship machines on approval to parties having a good commercial rating.

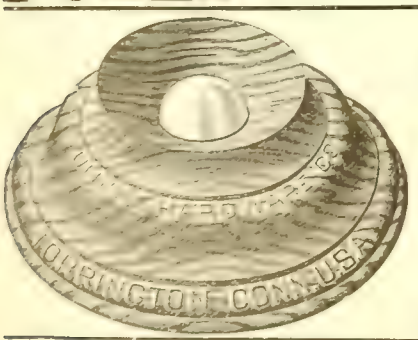
DENSMORE TYPEWRITER CO., 202 Broadway, New York.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

POLES CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.



—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

— AND —

95 CHAMBERS STREET, NEW YORK.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

P. AND B. Armature Varnish, Insulating Compounds, Insulating Tapes, Insulating Papers.

THE STANDARD PAINT CO.,

SOLE MANUFACTURERS,

2 Liberty Street, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, SEPTEMBER 26, 1891. No. 13

John N. Beckley.

The good looking gentleman whose portrait appears on this page is the newly-elected president of the New York State Street Railway association, which recently held its annual convention in New York city. Although the recipient of this honor has been connected with street railway enterprises but a few years, he has exhibited such an intelligent activity in furthering the interests of the Rochester Railway company, of which he is president, and has displayed so much zeal and energy in advocating the cause of electric railways, that street railway men and the electrical fraternity alike will commend the choice.

John N. Beckley is a lawyer by profession. He was born in Clarendon, N. Y., December 30, 1848, and attended school at the district schools of the neighborhood and afterward at the Brockport normal school and Genesee College at Lima, N. Y., now known as the Genesee Wesleyan Seminary. He did not graduate, however, leaving college at the close of his sophomore year. For a short time the young man taught school in Minnesota, and then he returned to Western New York and began to study law, settling in Batavia. In 1875 he was admitted to the bar, and after practicing a few years in Batavia, he removed to Rochester, where he found, as he had hoped, a wider field for his energies.

Mr. Beckley served for several years as city attorney of Rochester, conducting in that time many important actions. With other able counsel he defended the city in the famous "Honeoye millers' suit" growing out of the building of the new waterworks system in Rochester. After leaving the employment of the city, Mr. Beckley became a member of the firm of Bacon, Briggs & Beckley, which now, as Bacon, Briggs, Beckley & Bissell, probably does more law business than any other firm in Rochester. Mr. Beckley was first retained as attorney for the Rochester Railway company at the time of the purchase of the plant and franchises of the old horse car company, which preceded it. He conducted many delicate negotiations with marked ability and tact, and the present success of the company is largely due to his efforts. Mr. Beckley also became financially interested in the road, and is now its president. He is also vice-president of the Rochester Electric Railway company, president of the Merrimac Valley Street Railway company of Lawrence, Mass., a director in the Grand View Beach Railroad company and the Buffalo Railway company. In addition he is a considerable owner of street railway properties at Fall River, Mass., Bridgeport, Conn., and Paterson, N. J.

Mr. Beckley is a man of keen discernment, fine executive ability and ready tact. He is a good speaker and usually brings about the ends that he seeks to accomplish. He is married and has a pleasant home on Oxford street in Rochester.

JOHN N. BECKLEY.

Electricity at the World's Fair.

Hardly had Secretary Hornsby of the department of electricity brushed the traveling dust of the return trip from the Montreal convention from his clothes before he was packed off to Europe, and by this time he has nearly reached his destination. He arrived in Chicago from the Canadian metropolis on Sunday night of last week and on Thursday afternoon he was again on his way east to take ship at New York. He sailed at 4 A. M on the 19th on the steamship La Bretagne of the French line. From Havre the secretary will proceed at once to the electrical exhibition at Frankfort, and it is hoped that he will arrive in the German city in time to spend several days at the exhibition before it closes.

In the issue of September 5th the WESTERN ELECTRICIAN detailed the action of the executive committee of the directors, taken at the instance of Col. Clowry, chairman of the committee on electricity, requesting Director-General Davis to send a representative of the electrical department abroad to interest foreign manufacturers. Prof. Barrett, chief of the department, was unable to go, and so Secretary Hornsby was selected for the mission. It was considered important that the representative of the department should meet the electricians drawn together by the Frankfort exhibition, and as that display was to close on October 1st or thereabouts, the necessity for haste became apparent. The decision was not arrived at until the last moment, however, and Mr. Hornsby was not notified until the morning of the day on which he was to start.

This action is taken none too soon. The considerations leading up to it have heretofore been set forth in this paper at considerable length. There is no use in attempting to disguise the fact that foreign electrical manufacturers and supply dealers have thus far evinced complete indifference to the World's Columbian Exposition. Mr. Hornsby will endeavor to make clear to these gentlemen that it is to their interest to exhibit at Chicago and also the folly of abandoning the display, with its influence on Canadians, South Americans and Australians, entirely to the Americans.

That it is high time that some such missionary effort was made is shown by articles like the following from *Electrical Plant* of London.

The energetic steps that are being taken by the American authorities to insure the success of the forthcoming Chicago exhibition bring forcibly to mind the enormous odds against which the British manufacturer has to compete, the moment he sends his goods out of his own country. In no part of the globe, perhaps, does he find this state of things more oppressive than in the United States of America. Our own kith and kin, after a few years' residence there, seem to consider it to be their bounden duty to prevent the importation of goods from the old country. Import duties are increased from time to time, until they culminate in a [illegible] not only to kiss the rod but to assist energetically at its own execution [illegible] authority of high legal [illegible] to foreign workmen [illegible] cious concession certainly! But why this generosity? Because, forsooth, such workmen will come under the denomination of those who come to teach an unknown trade. In other words the foreigners (British and others) may, at immense cost, send their machinery and goods to the World's Fair; they will be permitted to show all their latest improvements, and their employes may teach the use of them to other natives; but, so far as we can see, there is an end of the matter. The enormous import duties will not be levied, as we understand it, so long as the exhibits remain unsold. That the exhibition will be a gigantic success, we do not doubt, but we venture to think English electrical exhibits will be conspicuous by their absence. Only high-priced works of art, or such objects [illegible] figures, can hope to be shown and sold with profit to British exhibitors.

While Secretary Hornsby is in Europe Electrical Engineer Keller will have charge of the office work of the department. Mr. Keller was out of town on his vacation at the time of the secretary's departure, but promptly returned in response to a telegram. Chief Barrett was also away, having left for Boston on Wednesday of last week.

Several changes have been made in the plans for the electricity building by the construction department at the request of Mr. Keller. The great central stairways have been abolished, and their place will be taken by eight staircases and eight elevators distributed in the corners and near the side entrances to the building. Four of the staircases will be 12 feet wide and four 15 feet. The space thus secured in the center of the building will be utilized for some brilliant lighting effect of a spiral or other form. There will be five main aisles extending throughout the length of the building with [illegible] cross passages. The center aisle will be 40 feet wide and the others 20 feet. It is calculated that one-third of the floor space in the building will be taken up by aisles, vestibules, stairways and elevators, leaving about [illegible] feet actually available for exhibits on the main floor and in the gallery.

While the foreign commissioners who came to the United States with the Butterworth-Handy party were in Washington they called on Postmaster-General Wanamaker who [illegible] them warmly. Mr. Wanamaker was one of the first promoters of the Centennial, and he [illegible] trouble experienced in getting foreign governments interested in '76, and expressed satisfaction [illegible] having less trouble. Sir Henry Wells [illegible] told the postmaster general that one of the main features of the British exhibit would be a showing [illegible] service, which is an auxiliary to the British postal service. He appeared surprised when Mr. Wanamaker [illegible] there was no such auxiliary in this country.

Director-General Davis has organized a cabinet of the chiefs of departments. Mr. Barrett was [illegible] the organization was effected although [illegible] member of the cabinet. Chief Sackett [illegible] partment was made secretary. Col. Davis said [illegible] meeting, that he hoped for good results. He [illegible] said we shall meet every [illegible] a weekly report to the executive committee of the directors. Each chief will announce at our meetings what he has accomplished during the [illegible] will be turned over to the executive committee in order that it may know just what is going [illegible]

Another feature of the meetings will be to promote harmonious action. The question of installing exhibits will shortly come up, and there may be then a difference in judgment as to where such exhibits belong. Questions of authority as between the jurisdiction of the different chiefs will also arise, and these matters, I believe, will be carefully adjusted through the weekly meetings of the cabinet."

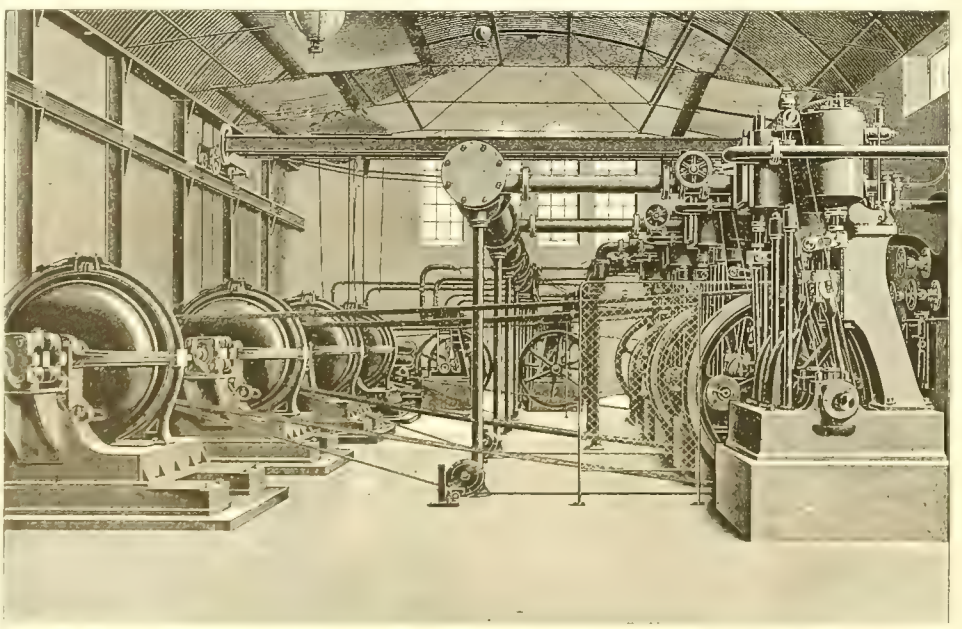
English Alternating Plant.

The spick-and-span plant shown in the accompanying cut is a portion of the installation at the Bath, England,

ADAMS DYNAMO AND MOTOR.

electric light central station, the picture being reproduced from *Electrical Plant*. The greater part of the generating plant was supplied by the Brush Electric company of Belvedere road, Lambeth. Both arc and incandescent lighting are furnished, but only the plant for the latter is shown in the illustration. The current for the incandescent lamps is generated by four Mordey-Victoria alternators, each capable of generating 75 kilowatts. Each of the alternators is excited by a Victoria exciter, driven direct from the end of the alternator shaft. Each alternator is driven by a Brush compound vertical open engine, cylinders 12 inch and 20 inch by 14 inch stroke, running at 180 revolutions per minute. The power is transmitted by a continuous length of 1¼ inch cotton rope, running eight times round the pulleys, the rope as it leaves the last groove being led back to the first groove by a guide pulley. The working tension of the alternators is [illegible] volts. The transformers are so arranged that the current at the consumers' premises may be either of [illegible] or 50 volts tension.

The engines exhaust into a [illegible] pipe, which [illegible] from the engine-room [illegible] The condensing arrangements consist of [illegible] combined air circulating [illegible] tain very economical results, as in addition to the engine [illegible]



ENGLISH ALTERNATING PLANT.

range I on each engine as well as on the alternator engines for closing the exhaust when the engine is standing.

Steam is generated by four 104 horse power Babcock-Wilcox boilers, which are connected to the main steam pipe in pairs, so that either of the pairs may run the whole of the engines. Six inch stop valves have been fixed in the main steam pipe, which is 6 inches in diameter, so that either pair of boilers may run the whole of the engines, or the steam pipe may be divided into two halves, so that one pair of boilers can supply one set, and the other pair the other set.

The working pressure of the boilers is 150 pounds per square inch. The feed pipe is so arranged that the feed from the main pump can be turned into either pair of boilers, or into all four boilers at one time.

Adams Dynamo and Motor.

In the accompanying cut is shown a dynamo designed by A. D. Adams of St. Paul. The machine is shunt wound and is intended for either generator or motor service.

The field magnet core is forged from the best scrap iron, and the pole pieces are either drop forged, from the same material, or cast from the best gray iron.

The armature core is built up with sheets of the softest charcoal iron, insulated with paper and canvas. Magnet spools are wound on a form of insulating material, both moisture and fire proof, and these forms are slipped over the magnet core after being wound. The commutator has a large number of segments. The machine weighs 750 pounds and is operated at a speed of 1150 revolutions. It has a capacity of 60 amperes at 115 volts.

Telephone Men Ahead.

It appears that the telephone people have, in one court at least, obtained recognition of their claim to exclusive use of the earth for a return circuit in highways where electric railways exist, and where their wires were strung first.

A press dispatch from Saratoga, N. Y., states that the Supreme Court has handed down a decision bearing upon the point. About two years ago the Watervliet Turnpike and Railroad company, operating a line of street railways between Albany and West Troy, sought to change its motive power from horses to electricity, using the single trolley system. The Hudson River Telephone company was then operating a telephone line between those municipalities. It claimed, by authority of its franchise, and from the possession of the ground with its electric line and currents, to be possessed of the sole authority to operate its [illegible] between the two places, using the earth as a return line. Upon [illegible] claim it obtained an injunction against the street railway company, forbidding the latter to use electricity in the manner proposed. The Supreme Court has declined to vacate the injunction. It should be added that the Supreme Court is not the court of last resort in the state of New York, and that the Court of Appeals may [illegible] in conformance with the findings of the [illegible] Saratoga county.

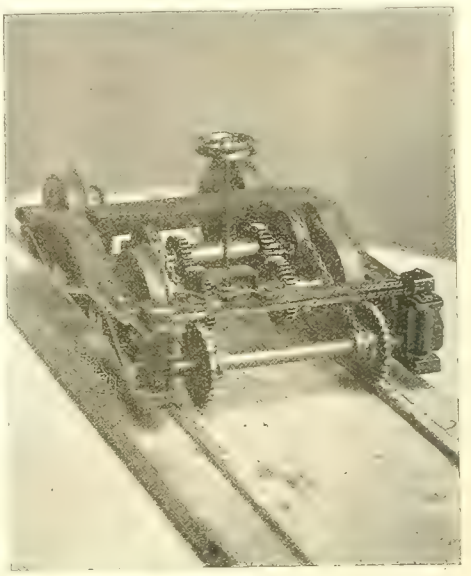
[illegible] has purchased the Saratoga electric railway [illegible] Troy to Saratoga.

Perry's Rotary Ice Cutter.

The accumulation of snow and ice on the rails and in flange grooves has added to the difficulties of the operation of electric railroads in the northern states. L. B. and W. H. Perry of Concord, N. H., have lately introduced a rotary rail cleaner and flanger.

As will be observed by reference to the illustration the cutters are driven from the axle of the car and are raised or lowered to the required position by a brake. They are made both with flangers and rail-surface cutters.

The experimental truck fitted up last winter and used



PERRY'S ROTARY ICE CUTTER.

on the Concord electric street railway was very thoroughly tested, and under all circumstances performed its work satisfactorily.

The cutters may be fitted to trucks already in use or can be used on a special truck or snow-plow.

The cut shows a truck fitted with flanger alone. There are different cutters for special work.

Electrical Litigation in St. Louis.

The St. Louis, Mo., Electric Power company began an action in the Circuit Court at that city last week against the Edison General Electric company to recover $80,450.12 as commissions due by the latter company to D. W. Guernsey and by Guernsey assigned to the plaintiff. It is alleged that the old Sprague company, on April 12, 1887, entered into a contract with Guernsey by which he was to receive a commission of 25 per cent. on a certain class of Sprague machines and 45 per cent. on another class and was to have the right of Missouri as his field of sale; that the company violated the contract by selling machines independent of his agency, and that subsequently it was absorbed by the Edison company. Guernsey assigned his claims to the plaintiff, who sues for commissions on all machines sold.

Coming to Chicago.

It is reported in the Chicago papers that the company manufacturing the Cobb wires and cables is to remove from Wilmington, Del., to a suburb of Chicago, taking the name of the Chicago Electric Wire company. It is stated that an immense plant at East Chicago has been bought, and in forty days the industry will be in running order, giving employment to 500 men. The capital stock of the reorganized company is $1,000,000, about 80 per cent. of which has already been spoken for, as, by the laws of Illinois, the subscription books cannot be opened until ten days after the license is received. A meeting of the stockholders will be called in three weeks and officers elected.

A Chance for a Wonderful Lighting Display.

Electric light men will view the stupendous Chicago building project depicted in the illustration shown on this page with more than the ordinary interest that the daring design excites in every one, owing to the opportunity it affords for lighting effects. As high as the Washington monument and provided with 1,200 windows, this cloud-piercing structure will present an appearance grand and imposing in the highest degree when lighted by electricity at night. It will undoubtedly contain the largest isolated plant in the world, and it is presumed that at least 20,000 incandescent lamps of 16 candle power will be needed. It is thought that about half of the vast basement will be taken up by machinery necessary to provide the power, heat and light for the great building, and the electric equipment will occupy no inconsiderable portion of this space.

This lofty edifice will be known as the Odd Fellows' Temple and the project has already attracted a great deal of attention. The Fraternity Temple association of the Independent Order of Odd Fellows has been organized to build it, and the task of raising the money is now under way. The site will probably be on the corner of La Salle and Monroe streets, Chicago, and it is estimated that the ground and building will cost $6,000,000. Adler & Sullivan, who designed the Auditorium, are the architects.

The architects, in describing the building, say: "In planning the proposed building it was soon found that there was no conflict between economic and æsthetic considerations. The broad base, covering the entire lot to a height of thirty feet above the sidewalk, was called for by structural, economic and artistic requirements, and from these jointly have also been developed the groupings and divisions of the entire external treatment. The bold breaks and deep recesses of the long facades serve at once to admit external light and air to the interior of the building and to give an interesting diversity of outline and an effective play of light and shade to the long street fronts. The discontinuance of the terminal bays above the tenth story prevents the casting of light-destroying shadows into the lower offices, and develops the second element of the progressive recessions from base to pinnacle, which constitute an important feature of the design. Structurally these terminal features serve as buttresses for the long arms of the cross, which is the typical characteristic of the plan, and from the center of which, buttressed in every direction, rises the noble tower which is the culminating feature of the structure."

The tower will, it is thought, serve as a landmark for the country within a radius of sixty miles around Chicago, and will be visible from Michigan City, La Porte, Aurora, Elgin, Waukegan and intermediate points. This tower, while of the utmost artistic and symbolic significance in the design, will possess a marked economic value. It will contain one hundred and thirty two offices above the roof level of the building, and from its location becomes the center of approach and communication for the entire building. Chicago readers will gain a vivid idea of the size of the whole structure when it is stated that the tower itself will be as large as the Tacoma building. Within it will be eighteen elevators, and four main staircases. And as the former become less in number in the higher parts of the building their places will be taken by offices, so that there will be in addition to the one hundred and thirty-two offices in the upper or free standing part of the tower also sixty corner offices in the intermediate parts of the same.

It is intended that twenty-four lodge rooms and public halls of various dimensions shall occupy the third, fourth, fifth, sixth and tenth stories, the great drill hall occupying the whole of one end of the tenth story and measuring nearly eight thousand square feet in area. The remainder of the building will be available for business purposes. The entire number of rooms available for rental, exclusive of the halls and lodge rooms, will be 1,110, and their aggregate area will be over 250,000 square feet, while, including lodge rooms and public halls, the area inclosed (exclusive of wall, partitions, corridors, etc.) will be 350,000 square feet.

The concentrations of immense loads incident to the construction of this building render necessary unusual precautions in the construction of the foundations, and consultations held by the architects with eminent engineers,

CHANCE FOR A WONDERFUL LIGHTING DISPLAY.

the structure, there will be at-

sonry and skeleton construction required for successful resist-

which so high a building will necessarily be exposed.

feet high. The project has

Fellows.

Runaway Horses Stopped by Electricity.

The first public exhibition and test of the Holson electrical apparatus for stopping runaway horses was given in Chicago last Saturday afternoon on the lake front at the foot of Jackson street. The test was a successful one and fully satisfied those who witnessed it, that a new and valuable application of electricity had been discovered.

The apparatus is very simple and does not appear to be other than an ordinary set of harness. A small dry battery, the case being about 6x6x3 inches, is located under the driver's seat. From this through the lines or along the pole or shaft of the vehicle extend wires to small metal electrodes placed within the nostrils of the horses —n[illegible] the nose, but in a tough, wet fold of skin and hair within the nose, so that no irritation is caused. Connection is also ma[illegible] the driver's seat, and one inside the carriage.

A. B. Holson, the inventor, [illegible] erful team of chestnuts, one [illegible] away earlier in the week, and the other was feared for its savage disposition. Allowing [illegible] Mr. Holson [illegible] animals were given their heads. They started on the jump and [illegible] Mr. Holson pressed the button, [illegible] mild shock was administered at the end of the nose. The horses, surprised at this unexpected sensation in front at once threw themselves on their haunches and tried to back away from the [illegible] they could overcome the forward motion of the carriage they came to a standstill.

The inventor claims that the apparatus will not cause the slightest injury to the horses. During the experimental work he and his assistants have taken the full current from the battery hundreds of times without harm.

It is stated that the Schenectady, N. Y., Street Railway company [illegible] at a cost of $[illegible].

THE CONVENTION

Of the New York State Street Railway Association at New York City.

[illegible] annual meeting of the Street Railway Association of the State of New York was held in the Hotel Metropole, New York city, on September 15th. Following is a list of the names of the members and visitors:

MEMBERS AND VISITORS.

Barr, Thomas C.	Philadelphia, Pa.
[illegible], John N.	Rochester
Beers, Edwin	Brooklyn
[illegible], John M.	New York
Cannon, Duncan B.	Brooklyn
[illegible]	New York
Curtiss, Frank	New York
Delaney, Wm. H.	New York
Fairchild, C. B.	New York
Field, C. [illegible]	Buffalo
Foster, John S.	New York
Graham, Benjamin	Rochester
[illegible], Daniel [illegible]	New York
[illegible]	New York
Kenfield, F. L.	Chicago, Ill.
Kruesi, John	Schenectady
Landon, E. T.	New York
Law, George	New York
Lawless, Edward J.	Paterson, N. J.
Lewis, Daniel F.	Brooklyn
Linch, George W.	New York
[illegible], H. H.	Buffalo
McIntyre, L. H.	New York
McLean, Thos. H.	New York
McNamara, John W.	Albany
[illegible], J. H.	New York
Martin, T. C.	New York
Monroe [illegible]	Chicago, Ill.
Masson, Milton I.	New York
Minary, C. K.	Rochester
Partridge, John N.	Brooklyn
Perrine, Lewis	Trenton, N. J.
Perry, F. L.	Chicago, Ill.
Price, Charles W.	New York
[illegible], W. J.	Brooklyn
[illegible], G. Hilton	New York
Stump, C. E.	New York
Taltavalt, J. B.	New York
Taltavalt, T. R.	New York
Thompson, Henry	New York
Valentine, Johnson L.	New York
Watson, Henry M.	Buffalo
Wyman, C. Densmore	New York

PRESIDENT LEWIS' ADDRESS.

President Daniel F. Lewis called the convention to order. After the calling of the roll the first order of business was the address of the president, which follows:

The convention about to be held is the ninth in the history of this association; to it I have the great pleasure to welcome the delegates. I trust when we adjourn it will be with profit in greater knowledge of the details of the business which we daily study, and in which we are all so deeply interested.

It has been decided that as much of the time of the present session as possible be devoted to the subject of improved motive power, and as cable power has been quite fully discussed by this and the American association in the past, and as greater progress comparatively has been made in electrical power, this subject has been referred to able hands and will doubtless be treated in a manner to be of great value and service to you.

The past year has been one of prosperity to the street railway companies of this state; it has been comparatively free from severe snowstorms; it has been free from epidemics among horses; the receipts from passengers show a good average increase; no adverse legislation of a general character was effected, and last but not least, no labor disturbances have taken place. In referring to the latter I feel that the heated experiences of the past few years have been of great benefit; the outcome has established a basis [illegible] employes of street railways should labor, and especially so, as to the number of hours which should constitute a day's work, and also the proper compensation therefor; it has also brought capital and labor closer together in having the employes better enlightened on this subject; in 1885 and 1886, the years the [illegible] railway employes [illegible] one side of the question; they did not understand the relation capital and [illegible] of mind [illegible] capital could [illegible] placed [illegible]

[illegible]

[illegible] of taxes which they pay annually to the cities and state.

I shall appropriate as little of the time of this meeting as possible to this address, but before closing I desire to refer to a matter of vital importance to this association; it is, its membership and strength.

You will no doubt recollect that, in accepting the office of president one year since, I referred to this subject, and requested that each representative endeavor to induce other companies to join us, and in that way encourage a larger attendance at meetings, and better results generally.

I am sorry to say that the membership is no larger than it was in 1890, and in view of this the executive committee has considered a remedy, and will offer an amendment to the by-laws which, if adopted, will, I trust, have the desired result.

It is very well to meet as we do annually and discuss the various current topics which affect the operation of our railways, but there is other work which this association is capable of doing if its membership embraced a large majority of the surface railway companies of this state, as it should.

For many years (except the past two, when we were very kindly treated) bills have been introduced in the Legislature which have affected, or would affect the interests of street railways in all parts of the state, and at times very seriously so; and I may ask, who looks after such legislation? In answer, I can say that when it is looked after at all, it is done by the companies in the large cities. But is this right? Should not the smaller companies contribute their share of labor and attention? Are not their interests quite as great in proportion as any other company's? Are not their interests as dear to them? Should a small company take refuge under the protection of a large company because it is large, and not render a service which is at its command? They should be glad, because they are small and comparatively weak, to render any assistance they can, in order that their share might be done in behalf of the protection they get and need.

The late Mr. Forshay, at a meeting in New York in 1884, in addressing you, said: "We cannot over estimate the value of combined action," and likened it to the first feeble wire stretched across the East River, which a child could break, but which made a part of a combination of wires afterward supporting the great New York and Brooklyn Bridge, and the great volume of traffic over it. So it is in our case; if a small fraction only of the companies of this state participate in the labors and responsibilities of this association, it will not meet the requirements in the support of its interests any more than the first feeble wire would in the support of the great East River Bridge, while a vigorous and hearty co operation on the part of all the railway companies of the state would render the service and support we desire, and should have.

The street railway interest, I fear, is not aware of the power behind it; if the gentlemen representing it would only stop for a moment, and think that the solid vote of their employes and the vote they could command, would often turn the majority of the state one way or the other at elections, they would then comprehend what it might be capable of doing in emergencies. I refer to this only to show that any very radical action which the legislature might undertake, and which might cripple companies to a point where the employes would be seriously affected, would result disastrously to any party in case a political issue should be made of it, and anything so radical might very likely be so engineered if the proper management were at hand.

Every street railway in the state has its friend or friends in the legislature, and if this association will recruit, and make itself strong in numbers, the officers could, by notifying its members of any danger at Albany, surround it with the necessary help at all times to secure proper protection, which is all we desire in this direction.

The following report of the executive committee was next presented:

REPORT OF THE EXECUTIVE COMMITTEE.

During the year two members have withdrawn viz., the Central City of Syracuse and the Lockport companies.

It was ascertained that while the management in both cases desired to retain the membership of their companies, it was considered that the annual dues of $35 (which far exceeded a whole day's gross receipts of one company) were more than they could afford to pay.

The executive committee, therefore, considered it a duty resting upon it to devise a plan whereby, if possible, all the small companies in the state might be induced to become memb.rs of the association. As the result of its careful study of the question, the committee submits an amendment to the by-laws and offers for adoption the following resolution:

Resolved, That Article XV. of the by-laws be amended so as to read as follows:

[illegible] Members [illegible] annual gross receipts from passengers shall [illegible] $[illegible] shall pay an admission fee of $[illegible], and annual [illegible]. Members whose annual gross receipts [illegible] less than $[illegible] shall pay an [illegible] dues of $[illegible] payable [illegible].

It is confidently expected that making the fees nominal, as proposed, will bring into active co-operation with us, nearly, if not quite, all the companies concerned. The [illegible] which will result from such a consummation cannot be over estimated.

[illegible] with us, and always will be in greater or [illegible]. For his sake, however, we devoutly hope [illegible] power for street cars, his days, not years, [illegible]

[illegible] receiving its full share of attention, as is [illegible] transformation into cable roads of the [illegible] business thoroughfares of the me[illegible]

[illegible] during the year, [illegible] that of a [illegible] and that is electric [illegible] power.

[illegible] the Third avenue and the Broadway and Seventh avenue demonstrate the courage of their convictions by launching out upon an expenditure of millions, most of us must perforce make haste slowly; and we, therefore, turn our attention to electricity. The people want an improved motive power; *i.e.*, an improvement over horses; and surely the most brilliant and magnetic, the loftiest and most promising motive power, based upon what we see and hear, is electricity. Thus it comes to pass that your committee has arranged for the preparation of another report upon electric motive power for street surface railways, by the president of a company whose lines are operated by this subtle and withal fascinating power. Participation in the discussion of this subject by men eminent on the surface as well as overhead has also been arranged for.

The mutual benefit associations connected with several of the member companies, the organization of which we were pleased to notice a year ago, have continued to do their work altogether satisfactorily, and with most gratifying results to all connected therewith. These societies have been the means of bringing the officers and employes of the companies into closer and friendlier relations; and whatever will succeed in bringing about such a happy state of things is to be commended.

As we look out upon the future, judging by the recent past, we become optimists, while we realize the fact that the world is growing better. Even as nations have come to settle their differences, not by the sword, as formerly, but by international councils of peace, so labor and capital have both learned wisdom by experience, at least, so far as the street railway industry is concerned; and all matters of difference which may, and inevitably must, from time to time, arise between employer and employe, will be adjusted amicably by the parties interested. The motto about which we used to hear so much, "An injury to one is the concern of all," has given place to a higher and nobler sentiment: "An injury to either is the concern of both."

We take occasion to express our sincere appreciation of the courtesy and hospitality of George Green, Esq., who is really the host on this occasion and whose guests we are.

In bringing this brief report to a close, we would give expression to our profound gratitude to God, that while the year has been one of excessive mortality in the community, death has not marred our charmed circle.

TREASURER'S REPORT.

The treasurer's report was presented and showed the following financial transactions during the year:

Receipts	$1,097.64
Expenses	959 48
Balance	$138.16

REPORT OF THE COMMITTEE ON ELECTRIC MOTIVE POWER FOR STREET RAILWAYS.

BY JOHN N. BECKLEY.

Last May I received a letter from the president of this association asking me to prepare a report to be read at this meeting "on any subject covered by the range of electric motive power for street surface railways." In that letter, the president, seeking to lure me to my destruction, stated that many months would yet elapse before the next meeting of the association, and closed by expressing the hope that I would oblige him personally by complying with his request. I have been in so many situations where I have found it necessary to call upon my friends to oblige me that I could not find it in my heart to deny the president this request, especially as my promise, if made, was to do something months hence. I attached a string to my promise in the concluding part of my letter of acceptance, in which I stated that I did not see how I should get time to prepare anything worth the hearing, but that I would do my best.

I expected, when I agreed to write something for your consideration, that I would have an opportunity before preparing what I had to say of talking with the president of this association, and of obtaining from him some suggestions upon which I might hang the slender thread of my thought. That pleasure, by reason of his and my business cares and engagements, has been denied me, and only the other day I was brought up with a round turn by a letter from the secretary reminding me that I had agreed to prepare a paper for this meeting upon the subject of "Electric Motive Power for Street Surface Railways." The reminder that the time had come for the fulfillment of my promise was almost as disagreeable to me as an electric shock administered by a five hundred volt current, but the unpleasant features of that situation were considerably modified by the statement that the secretary, or some one acting through him, had been kind enough to formulate and put into quotation marks for me a definite subject for my paper. The fact that the subject is deeper than any well, and wider than any church door is, to be sure, a little embarrassing. I am encouraged, however, to say what little I can upon this very comprehensive subject by the knowledge that, while I know really very little about it, yet there may be some others engaged in the street railway business who have had less experience in the operation of street surface railroads by means of this unseen and wonderful force called electricity.

The subject which has been given to me is many sided. I shall endeavor to throw out a few suggestions, based upon some study of the problem of street railroad transportation and upon a little experience. If, in what I shall say, I am able to furnish one or two texts for discussion, I am sure there are those present who, by their discussion of the texts, will furnish all of us with valuable information and food for thought, and thereby my purpose will have been attained.

Most of us are engaged throughout all the working hours of each day in the performance of duties which leave us little time for reflection upon, and study of, the broad questions suggested by the subject which has been given to me. We all know that the tendency of modern

American life is toward the concentration of vast masses of people in our towns and cities, and that this urban increase is somewhat at the expense of the agricultural communities. We also know that the American workman, as well as the American business and professional man, is seeking to locate his home some distance away from the section of his town or city where his business is transacted, or where his work is done. Every householder has, or desires to have, at least a little patch of lawn or garden about his home, to obtain which he must locate some distance from the business or manufacturing center of the town or city where he lives. To the average man, however, this is not possible, except as he can have some means of communication with that business or manufacturing center, at low cost to him. But as towns and cities grow, and distance becomes more and more an element to be considered, it becomes necessary that the citizen should have not only facilities for cheap transportation for himself and the members of his family, but that he should have means of rapid intercommunication. Out of the needs of modern city and town life grew the horse railroad. The development of cities and towns brought with it the necessity for quicker transportation. The American intellect, ready to meet every emergency, set itself at work to devise some method of quickly transporting the people of the great cities of the country, and so far as the great cities are concerned, practically solved the problem presented by inventing and building cable railways. It was soon found, however, that while cable railways answered the purpose for which they were designed in cities like Chicago and Philadelphia and New York, they would not do in smaller cities, except in isolated cases where vast numbers of people were required to be moved daily over a comparatively short mileage.

Five years ago the only street surface railways which were in successful operation anywhere in the United States were horse and cable railways. Within that five years more than 4,000 street cars have been electrically equipped, and to-day more than 3 000 miles of track in 300 cities and towns in this country have been constructed, on which these electric cars are run with satisfaction to the people, and, in the main, with profit to the companies operating them.

The development of the street railway has had as much to do with the growth and prosperity of the towns and cities of this country as, or perhaps, more than, any other one thing. The transportation of people by street railroads is most intimately connected with the social and business life of the people. Nearly 500 cities in the United States have street railway systems in operation. More than 800 corporations are operating street railways in such towns and cities. As many as 30,000 street cars, horses, cable and electric, are to day running upon the 8,000 miles of street railroads in this country. In these cars, and on these tracks, are carried as many as 3,000,000,000 of people yearly, or fifty times the entire population of the United States. When we consider that the number of people carried by all the steam railroad companies in all of the states of this Union last year is estimated at less than 500,000,000, and that more people are carried on the street surface railroads in the city of New York, in a year, than are carried by all the steam railroads of the state in the same period we come to have some conception of the immense importance to the people of the rapid, efficient and safe service of street cars in the rapidly growing cities and towns of this wonderfully prosperous country. Think for a moment of the daily loss to the people of any city where horse cars are run at from four to six miles an hour, as compared with operation in the same city of electric or cable cars, running from six to twelve miles an hour. Consider the immense increase in the value of property in our municipality, caused by the introduction of rapid transit. Consider the wholesome influence upon the people of every community where the husband, or other head of a household, is able, by means of facilities of quick transportation, to take his midday meal with the members of his family. The best thought of this time may well be expended upon this great question of furnishing quick, safe, cheap and comfortable transportation to the people whose lot it is to dwell, as dwell they do in such vast numbers, in the towns and cities of this land.

The problem which is presented to the street railroad man of to day must be considered, not simply with reference to the populations as they now exist, but with reference to the great increase of population which is certain to come. There are seventy-four cities in the United States which have a population in excess of 40,000. The total population of these seventy four cities, as shown by the last census, is nearly 13,000,000, and the average increase of population in these cities during the last decade was nearly forty seven per cent. In this state there are twenty-eight cities having a population in excess of 10,000, and a total aggregate population of nearly 3,500,000. The average increase in the population of these cities, in the past ten years, has been more than thirty-threeper cent. For all these growing towns and cities in our own state, and throughout the country, what can electricity do as a motive power for the operation of their street railways?

We, who have had to do somewhat with the change of the system of operation of street surface railroads from horse to electric power, know that we have now passed beyond the experimental stage, and beginning to tread upon ground which seems firm under foot. We hear, now and then, fears expressed by doubting Thomases as to whether the motors are going to last, as to whether the repair bill is not going to wipe out all profit, and as to whether the great expenditure which has been, and is being made on our railroads, may not be thrown away, because some new and wonderful principle is to be discovered which will enable our railroad companies to operate their roads with commercial success by means of storage batteries. We find in some communities so great a prejudice against overhead wires that railroad companies are unable to obtain the necessary franchises and privileges, the granting of which would result in giving those communities the benefit of rapid transit with electricity as motive power. Hour by hour, however, experience is teaching all doubters that the problem of rapid transit for cities has been solved, and that the trolley has come, and come to stay.

As this convention is held in the city of New York, where as yet the people have not had a practical demonstration of the merits of the trolley system, it may not be inappropriate to look at this question from the point of view of the New York citizen, and to meet, if we may, some objections which are here urged to the trolley system, so called. I have read with some interest much that has apppeared in the great New York dailies with reference to the horrible condition of things which exists in towns and cities where the trolley system is used for street car propulsion. Our friends over in Brooklyn have been endeavoring since the last meeting of this association to educate their townsmen upon this matter, and with at least a reasonable measure of success. To them, and indeed to all of us, the facts which are perfectly well known have become trite from iteration. Everybody knows that a rapidly moving car, whether the propelling force is furnished by horses, by steam power exerted upon a steel rope, or by electricity, will hurt, and perhaps kill, the person with whom it comes in contact; but the rapidly moving car is essential to rapid transit. An electric car can be stopped as quickly, indeed more quickly, than can a cable or horse car running at the same rate of speed. Collisions occur with one sytem of transportation as much as with another, but we contend, so far as the danger question is concerned, that the only danger to life or limb from the operation of electric cars comes from the possibility of collision with persons or vehicles, and that there is no danger from the electric current itself propelling the car. As I have stated, electric cars have been operated during the past year on more than 2,500 miles of track, and, although millions of people have been carried upon these cars, no instance can be given of serious injury to any person by reason of shock caused by the electric current. We contend that the electric pressure used in the propulsion of street cars is below the danger limit. We know that a railroad operated by electricity is a pleasant railroad to ride upon. The cars are started and stopped on such a railroad easily, and without jerking. On such a railroad we do not see horses frequently struggling beyond their strength to start a loaded car or to haul it up a grade. As we ride on such a railroad, we experience a sense of exhilaration as the car swiftly and safely speeds along, and unless our attention is specially called to the trolley wire overhead, we do not even realize that it is there. Only last week many people who reside in the city of New York had an opportunity of observing some of the advantages of propelling cars by electric power under hard conditions. Those in attendance upon the Republican state convention at Rochester indulged, in the evening after the nominations had been made, in an impromptu celebration in front of the leading hotel of that city. The street in front of the hotel was completely blocked with people listening to the speeches and admiring the fireworks. The electric cars were however, kept moving throughout the entire evening, and as several of the lines in operation in the city passed in front of the hotel, it was necessary for the cars to feel their way through this vast crowd. During the time of the celebration between forty and fifty cars passed through the concourse of people, moving, if need be, at a snail's pace, backing when necessary by the reversal of the current, and without in the slightest degree injuring a single person. Cars drawn by horses could not have gone through the crowd in safety. I believe that every person who witnessed that sight, no matter how prejudiced he may have been before, was convinced that the operation of street cars by electric power is safe.

There is, however, one objection, which is urged with great insistance, especially in the city of New York, to the trolley system, and that is to the trolley wire itself There is not the slightest danger in putting up or maintaining the trolley and necessary feed wires if the work is done in a proper manner, and if reasonable care is exercised in their maintenance, except as these wires are made dangerous by the telephone, electric light or telegraph wires placed above them. If the telephone, telegraph and electric light companies would take as much pains in putting up and maintaining their wires as do the electric railroad companies, there would never be any occasion for complaint, so far as danger is concerned, and then the only objection which could be urged to the maintenance of the necessary wires to operate electric cars would be their so called unsightliness.

It must be conceded that poles, however shapely, and wires, however well put up, do not improve the appearance of city streets, but quite the contrary. But experience has shown that except as poles be set and wires strung, electric roads cannot be made a commercial success, and therefore without poles and wires electric railroads will not be operated. Hence the question presented to the people of a city where the population is not large enough to sustain a cable railroad on a given line is this: Shall we have rapid transit by electric motive power and waive the sentimental objection to the maintenace of a few light wires eighteen or twenty feet above the surface of the street, or shall we have slow transit by horse power with its many disadvantages and disagreeable accompaniments, and be rid of the wires? The question is being answered almost every day in the towns and cities of our country in favor of electric rapid transit.

The question is often asked by officials of street railroad companies who are contemplating making a change from horse to electric power, what is the cost of operation of an electric railroad, as compared with the cost of operating a horse railroad? I propose to state some experience which electric railroad companies have had upon this subject, and to answer the question as well as I can.

You have undoubtedly all seen the census bulletin prepared by Mr. Cooley upon the relative economy of electric, cable and animal motive power for street railways. Those of you who have seen this bulletin and studied the tables which Mr. Cooley has prepared must have felt that, so far

[illegible]

the average cost of operating the ten cable railways is, in [illegible] as the total average cost of road and equipment per mile of [illegible] electric power, in round numbers, $40,000, and with animal power, in round numbers, $71,000. There is little value, however, to be attached to comparisons of this character. Everybody knows that it costs less to construct and equip a horse railroad on a given line than an electric railroad, and that it costs very much more to construct and equip a cable railroad than an electric railroad. Of course, in determining the question of economy in operation, the first cost of construction and equipment is a very important element for consideration, as well as the actual cost of maintaining and operating the railroad, whatever the motive power, when once completed. It seems more profitable to avail ourselves of comparisons which have been made by a surface railroad company operating a part of its system by electricity, and a part by horse power. Fortunately we have gone far enough in electric railroading to be able to obtain sufficient facts to enable us to make an intelligent and trustworthy comparison.

The company which has had the greatest experience as to these matters is the West End Street Railway company, of Boston. That company has published a statement showing its earnings and expenses both with the electric and the horse car system, for the months of April, May and June of this year. I ought perhaps to state that, as it seems to me, the conditions involved in the consideration of these questions are so diverse in different cities that the only proper basis of comparison of cost of operation is the cost per car mile. It is quite common for the street railroad officials to consider this question of the relative cost of operation on the basis of a percentage of gross receipts. It will be readily seen, however, that this basis of comparison is necessarily misleading and inaccurate. The other basis is not exact, but approaches at least approximately to exactness. The total expense, as shown by the West End company, for motive power, car repairs, damages, wages of employes and all other expenses per mile run with electric power, during the three months mentioned was as follows:

April	21.75 cents.
May	22.3[illegible] "
June	2[illegible] "

The total expense per mile run with horse power, for the time mentioned, was as follows:

April	24.54 cents.
May	24.1 "
June	23.52 "

Earnings upon the two lines, during the period under consideration, with the two systems, was as follows:

April—Electric	34 05 cents.	Horse	31.77 cents.
May— "	33.43 "	"	34.22 "
June— "	42 71 "	"	33 85 "

It will be observed that the earning power of the electric cars is considerably in excess of that of the horse cars, and that the expense per car mile is considerably below. The West End company states that the electric cars of this company are run on the longer and less remunerative lines. If this be true, the showing made is very greatly in favor of the electric car from a commercial standpoint.

Permit me to refer to the experience of the company at Rochester, with which I am connected. In the month of May last the Rochester Railway company operated forty-four eighteen-foot vestibule electric cars. The gross receipts from passengers riding on these cars during the month was $37,053, or 23.15 cents per car mile for a mileage of 159,567 miles. The total expense of operation of these cars for that month was $18,332, thus leaving a net profit of $18,721. The total cost of operation per car mile was 11.4 cents, and the [illegible] was therefore 12 11 cents. It may be observed in passing that the operating expense was a [illegible] of the gross receipts.

The cost of operation was divided as follows:

Motive power	2.8 cents.
Car repairs	[illegible]
Conductors and motormen	4.9
Other expenses	3

During the same period the company operated sixty-two horse cars, all of them without conductors. Most of the horse cars were one-horse or bobtail cars. The total cost of operating the horse cars, without conductors, during this period was about ten cents [illegible] receipts per car mile were but little above twelve cents.

In the month of June the Rochester Railway Company operated fifty four electric cars [illegible] electric cars earned each per day $[illegible] per car mile, and the total expense of operating them per day was $[illegible] or 11 cents per car mile. The cost of operation per car mile was divided as follows:

Motive power	2.40 cents.
Car repairs	[illegible]
Conductors and motormen	[illegible]
Other expenses	2
Making a total per car mile of	[illegible]

The cost of operating the horse cars during the same [illegible]

(Continued on page [illegible])

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - Editor and Publisher

J. B. O'HARA, - - -
L. L. PERRY, - - - Associate Editors.
W. E. KEILY, - - -

J. L. BAKER - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK

W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers, in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

[illegible] With portrait ... 185
[illegible] World's Fair ... 185, 186
[illegible] Plant. Illustrated ... 186
[illegible] Motor. Illustrated ... 186
Telephone Men Ahead ... 186
[illegible] Illustrated ... 186
[illegible] in St. Louis ... 187
[illegible] ... 187
A [illegible] Lighting Display. Illustrated ... 187
[illegible] by Electricity ... 187
[illegible] New York Street Railway Association—
[illegible] ... 188
[illegible] Address ... 188
Report of the Executive Committee ... 188
[illegible] ... 188
[illegible] Motive Power for Street Railways, by John N. Beckley, and Discussion ... [illegible]
[illegible] ... 192
[illegible] ... 192
[illegible] ... 192
[illegible] Illustrated ... 192
Queen's New Portable Galvanometer. Illustrated ... 192
[illegible]
[illegible]
[illegible]
[illegible]
[illegible] Illustrated ... 194
[illegible] ... 194
[illegible] ... 194
[illegible] Lighting Con-
[illegible]
[illegible]
[illegible]
[illegible]

DEPARTMENTS.

[illegible] ... 197
[illegible] ... 197
[illegible] ... 197
[illegible] ... 197
Telegraph ... [illegible]
[illegible]
[illegible]
[illegible]

[illegible]

position to aid the big exposition in every way possible. The choice of Mr. Sunny as chairman of the committee on World's Fair was a fortunate one, as that gentleman's position as a director of the exposition will enable him to secure immediate attention for any suggestions or requests that the National Electric Light association may have to make.

WHAT constitutes "good earth" as a ground conductor for lightning discharges? This is a question that has often excited discussion in electrical circles, and the problem of securing efficient protection from shocks of atmospheric electricity will probably continue to attract the attention of scientists for some time to come. Mr. Walker, whose paper is presented in this issue, endeavors to account for the freaks of lightning by well-known electrical laws, and holds to the conservative view that a good "ground," preferably a mass of metal plates buried in the earth, attached to conductors, still constitutes the best protection.

IT is strange that while many leading electrical engineers have doubts of the practicability of operating trains for long distances by electricity prominent steam railway men themselves are becoming converted to the belief that electricity is destined to succeed steam on the railroads of the country. Thus no less an authority than John M. Toucey, general superintendent of the New York Central & Hudson River Railroad company, is said by the New York *Continent* to believe "that in less than ten years electricity will take the place of steam on railroads. He will not be surprised to see, in less than that time, the largest and swiftest trains on the Central controlled exclusively by electricity, and run with a speed equal to, if not greater than, that of the present day." This conviction should be encouraging to Mr. Sprague and other electricians who have stoutly maintained that long distance transportation by electricity would prove itself a commercial success.

BY the time this issue of the WESTERN ELECTRICIAN reaches its readers a representative of the department of electricity of the World's Columbian Exposition will be rapidly approaching the port of Havre, where he will disembark and proceed to do his utmost to interest the European manufacturers of electrical goods in the World's Fair. J. Allan Hornsby, the secretary of the department, has been selected to perform this delicate mission. He is a young man of boundless energy and unfaltering persistence, and will undoubtedly kindle an enthusiasm akin to his own in the breasts of many of the foreigners. He has a great field before him, and we hope he will be entirely successful. But, as we have before pointed out, it will require no little effort to eradicate from the minds of the European manufacturers the impression—erroneous, as we believe—that they have nothing to gain by showing electrical machinery at Chicago. To be forewarned is to be forearmed, however, and Mr. Hornsby did not leave the United States without being fully informed of the prevailing sentiment in England and on the Continent. We hope that he will be enabled, in some degree at least, to change this impression. In any event, he cannot fail to return without valuable suggestions for the betterment of the exposition.

THE telegraphers are evidently preparing for another strike, and they are endeavoring to perfect an organization for this purpose. It will be remembered that the Brotherhood of Telegraphers last year undertook this work but was unable to accomplish anything owing to decisive measures on the part of the telegraph companies. The leaders of the movement were discharged and it was thought the organization had been abandoned. Now, however, it appears the work of enrollment has been going on in secret, and the assistance of the Order of Railway Telegraphers secured. In fact it appears that there is now no distinction between the two organizations, and that the next move will be to enlist the support of the Federation of Railway Employes, and then declare open war on the companies. Heretofore, the Order of Railway Telegraphers has professed to be opposed to strikes; at least it has declared that it would not sanction a strike, and on this ground it claimed the companies had no right to interfere with the organization. The officers of the order, however, have frequently shown an inclination to foster discontent among the members, and the companies have checked these incipient outbreaks, but not without considerable commotion among the members, who claimed the companies were endeavoring to oppress them. It now appears that [illegible] of Telegraphers was professing not to sanction strikes, its leaders were organizing the operators throughout the country, and they are now preparing, with [illegible] of the order, to engage in a strike. [illegible] grievances exist wherever an immense number of men are employed by one corporation, and as a rule the employes may depend upon the public to support their demands for redress, but where the organization does not take the public into its confidence it cannot hope for hearty support.

A GENTLEMAN bearing the name of W. H. Massey has been writing to the London *Times* on the subject of electric lighting in that city, and one of his assertions, quoted in the English electrical papers, will be read with interest on this side of the Atlantic. In speaking of the relative positions of England and America, Mr. Massey said that when in the United States last winter he was surprised to find that "even then in London alone there were more incandescent lamps than could be heard of in five of their largest cities (including New York) all put together." This a very loose and indefinite statement, and, as it stands, can carry little weight. If our English visitor had given the names of his American cities, with the number of lamps in each, and then set opposite the total the number with which London is credited, his figures would have been interesting and entitled to critical examination. But as it is, without having the statistics of the English metropolis at hand, we have not the slightest doubt that Mr. Massey's statement is entirely incorrect. It is well known that, compared to arc lighting, incandescent lighting is carried on to a greater extent in England than in this country, while the larger unit system suffers in a corresponding degree. But we are nevertheless confident that, in respect to the actual number of incandescent lamps, London will not prove greatly superior to an equal area in population in this country. Of course, in comparisons of this character, the immense size of the English city should be taken into consideration.

JOHN N. BECKLEY'S paper at the New York street railway convention is an important contribution to the discussion of the relative merits of the various systems of street railway traction now in use, in that it is the candid expression of the opinion of a keen and practical man of affairs. Mr. Beckley lays no claim to the possession of a theoretical knowledge of the subject. Until within a few years he devoted his whole time to the practice of his profession—that of the law—in Rochester, New York, and, like nearly all young lawyers, he took considerable interest in politics. At this time he would probably have greeted with an incredulous smile the statement that within five years he would be president of one of the most successful electric street car systems in the country, and president of the Street Railway Association of the State of New York as well. After his retirement from the position of city attorney of Rochester, Mr. Beckley became the junior member of the legal firm of Bacon, Briggs & Beckley, and when a syndicate of wealthy capitalists bought out the old Rochester City & Brighton Railroad company, he was chosen as the attorney for the new company, which was incorporated as the Rochester Railway company. For this position he was peculiarly fitted by reason of the intimate knowledge of municipal affairs that his years of experience in the city hall had given him, and he was very successful in securing concessions from the common council necessary to justify the large outlay that the change to electric power involved. Mr. Beckley became more interested in the company as time advanced until he was elected to the presidency, still retaining his membership in the law firm. He is also one of the officers of the Rochester Electric Railway company, a distinct corporation that operates an electric line from Rochester to Ontario Beach, a distance of seven miles.

While these changes were in progress Mr. Beckley actively applied himself to the study of the practical phases of electric traction as compared with other systems, and the result of his observations is given in the paper read in New York last week. This "report," as it is called, is eminently sensible and well sustained, and bears evidence of the author's legal mind and discriminating intelligence. Mr. Beckley has the valuable faculty of putting things in a convincing way, both as a writer and as a speaker, and his paper is an able presentment of the advantages of the electric railway as demonstrated by actual experience. The one tenable objection to electric lines in crowded cities—the unsightliness of poles and wires.—Mr. Beckley disposes of in this fashion: "Shall we have rapid transit by electric motive power and waive the sentimental objection to the maintenance of a few light wires eighteen or twenty feet above the surface of the street, or shall we have slow transit by horse power with its many disadvantages and disagreeable accompaniments, and be rid of the wires? The question is being answered almost every day in the towns and cities of our country in favor of electric rapid transit." That is the whole thing in a nutshell.

[Continued from page [illegible].]

month per car mile was [illegible] cents, and they earned [illegible] 37 cents per car mile. These illustrations are fairly indicative of our experience in Rochester month by month. My experience in the operation of street railroads has convinced me that the most economical system of operation is the electric system. I have not, in the statements which I have now made, taken into consideration the greater fixed charge in the operation of an electric railroad as compared with a horse railroad, due to the much greater cost of the former; but in arriving at the conclusion which I have above expressed, due consideration has been given to this element of increased cost. We know that when a horse railroad is changed over and operated by electricity, the receipts are very largely increased. It is safe in any case to say that the increase in gross receipts will be at least fifteen per cent., and the average increase is probably as high as thirty per cent. Some of this increase is undoubtedly due to the greater mileage which the cars make, and still more is due to the cleaner, more rapid and more comfortable transportation of the people.

We have reached the conclusion also that the bugaboo, which formerly somewhat frightened us, of the cost of maintenance and renewals of electric motors, need frighten us no longer. We have had motors in constant service on one of the first electric lines equipped in this country, namely the line extending from Rochester to Charlotte, and these motors seem as efficient and in every way as satisfactory as they did the first month they were operated. We have of course renewed various parts of the motors, and we have replaced gears which have worn out, the expense of which has gone into the cost of maintenance. But the motors are still there, doing their work, and likely, with proper care and renewal of parts, will be doing their work ten, and even twenty years from to-day. The cost of maintenance and renewal of parts has not been so large as to carry operating expenses up to anywhere near the expense of operating the same number of cars, at the same mileage, by animal or cable power.

Those who propose to substitute electric for horse power will make a great blunder if they attempt to put in cheap construction or material. We who have gone into the matter have learned that the track upon which it is proposed to operate electric cars should be of girder or T rail, of not less weight than fifty pounds to the yard of T, and sixty-two pounds to the yard of girder rail. The weakest place in the track is, of course, at the joint, and no cheap contrivance at that point should on any account be permitted. With girder or T rail construction it is, it seems to me, a uselesss expense to lay a continuous supplementary wire. The rails should, of course, be well and heavily bonded at the joints with iron, not copper, wire and cross connection of rails be frequently made. Where tram rail track is used, I think a continuous wire should be laid and connected with the bond wires.

The overhead wire cannot be too well put up. Cheap devices should never be used because they are cheap. The best and strongest are none too good. In putting up the feed wire and putting in the ground wire return to the generators, do not spare copper. I am convinced that much that we have heard about the inefficiency of generators and motors is due to trying to get too great a quantity of current through too small a quantity of copper. In the power station do not make the units too large. Accidents will happen as long as machinery is run, and an accident to a 500 horse power plant is serious, while you can keep your cars or most of them moving, if one or two or three small engines breaks down. The same rule, of course, holds as to the generators.

Always put in a condensing steam plant. One large item of expense of operation is the coal bill. Cut that down at least forty per cent. by erecting condensing engines. The first cost is, of course, a little more, but your stockholders, as they examine your statements of operation in the years to come, will say you were wise in your day and generation.

Locate your power station as near as may be in the center of your system, but above all, if possible, on a stream large enough to furnish all the water you require for the boilers and condensers. City water, where your consumption runs into the millions of gallons fast, is expensive.

It seems to me a mistake to equip a car body of greater length than eighteen feet, and I think a sixteen-foot car is better still. During the hours of the day when travel is heavy, it is easy to pull a trailer, and when traffic is light, you are not then using up your power in hauling around a great lumbering double truck structure practically empty.

A great many companies have had trouble with their motors. The chief reason for this trouble has been that their have been too light mechanically and too economically built electrically to stand the strain. All the manufacturing companies have learned their lesson, and to-day most of the motors put upon the market are strong enough mechanically and electrically to perform, under proper conditions, the work expected of them.

The managers of electric roads, if they are to be made successful, must learn that the greater earning power is no excuse for extravagant management, and that the difference between success and failure is often a narrow one. Everything depends upon taking a stitch in time. A loose belt, an imperfect connection, any one of forty little things, may result in serious damage and consequent financial loss. I do not know of an electric railroad anywhere where the overhead single trolley system is used which ought not to be successful. I know of some which have not been. In some cases cheap construction accounts for failure, and in some others careless management or reckless extravagance is the cause of the failure. The scrap heap about an electric car barn or machine shop often tells a significant story. In intelligent supervision and painstaking watchfulness is found one great secret of commercial success in this business, as well as in most others.

Every manager should keep a [illegible] go [illegible] make up operating expenses an[illegible] for management should carefully study these statements month by month with a view of lessening the expense of each item. An intelligent and careful examination of the cause of accidents to parts of a motor will often be the means of preventing the recurrence of trouble in the future.

So far as possible, motor men, as well as conductors, should be made to understand the mechanism of the machines which propel their cars and the function of each part. Thereby they are made ready to act promptly and intelligently in case of trouble with a motor.

The directors of some companies, because of their desire to make handsome returns to their stockholders, have paid out in dividends money which ought to have gone back into the road. The proper policy to pursue in all cases is the building up and bettering the plant out of earnings, so far as necessary, even at the expense of cutting down dividends.

The field in which we are working is a great one. There is in this field abundant opportunity for the intelligent, progressive and sagacious business man. The primary object which the management of a street railroad seeks to attain is business success, but success in that direction cannot be had without great resulting benefits to the people of the community served by the railroad operated. We should not lose sight of the fact that we are engaged in a work the successful performance of which builds up communities, aids business enterprises, and makes the life of the people in those communities better worth living.

DISCUSSION.

It was moved, and the motion was carried, that the report be printed forthwith, and, with copies of the address of the president, be distributed to all street railway companies in the state.

The President then declared the subject of electricity open for discussion, and invited representatives of electrical equipment companies to participate.

Charles A. Benton, representing the Rae system, addressed the delegates briefly. The system, he said, was unique in itself. The company manufactured a single motor made in three sizes, 15, 30 and 40 horse power. The peculiar advantage claimed for the system is that it gives to both axles a traction on the rails, which cannot be secured by any other system. He said that the company was the smallest represented at the meeting, and the most recent in the field; but he could state with justice to the system that it had made in some places a respectable record.

C. C. CURTIS (Short system): When this convention met in Rochester last September the Short company came before you and made some very strong promises as to the showing that would be made when the road in Rochester was started. What that showing has been you have heard in the very able report that has just been read. The question in which you are all vitally interested is the question of repairs—repairs to your motors, repairs to your lines and repairs to your generators. In the city of Rochester there has been kept day by day an accurate record of the motor and generator repairs. That road started running last November, and giving it eight months of run, through the winter months—the hardest months in the year—up to the first day of August, the average cost of repairs per car mile was four mills. This is a very fine showing, as I think every gentleman who has kept a similar record will admit. The report just made gives the total repair account. That repair account as given month by month by Mr. Beckley will, of course, include the repairs of the line, generators, motor, rail, etc. When I say four mills per car mile, I mean only the repairs on the generators and the repairs on the motors; that is, the electrical repairs. In Muskegon, Mich., where we have been running about a year and a half, our record shows two mills per car mile. We have two new motors to offer to you. We are prepared to give you the double reduction motor or the single reduction motor, and the low reduction motor. You know how great and excessive the repairs of gears is. One of the gentlemen who was on the floor of this convention stated to me a month ago that, in his judgment, if our gearless motor was really what we claimed for it (and we are prepared to back up our claim with strong guaranties) it would save his company seventy-five per cent. of the repair account. If this is true, no road should be equipped without looking carefully into the merits of this Short gearless motor. The armature of this motor is hung on a sleeve. This sleeve surrounds the axle. The weight of the motor is thus distributed over the whole motor frame and not on the axle of the cars. There is an air space of about three-quarters of an inch between the axle of the car and the inner circle of the sleeve on which the armature is hung. By removing four bolts you take off the two lower wheels and raise one end of the car and you roll out your armature and the car axle. You are, no doubt, more or less familiar with its construction. Should a bobbin burn out, it can, because of its peculiar construction, be repaired for from two to three dollars. As you may know, these bobbins are only about three-quarters of an inch deep and surround the outer circle of the armature. They are not connected, and should one burn out, it does not interfere with, or necessitate the burning out of, any of the others. The hue and cry has been raised that the gearless motor is a very nice thing, theoretically, but in practical operation it is going to take an enormous amount of current. I have a report of the test made in Cleveland, Ohio, about two weeks ago, by Mr. Johnson, with whom, no doubt, many of you are acquainted. It was a trial between one of his cars and one of the Short gearless motor cars. These two cars ran over the Brooklyn street railroad line, running about twenty minutes apart, doing commercial work. The gearless car checked up some eighty passengers, and the single reduction motor, which Mr. Johnson was running, checked up forty-seven. The car ran for about two hours and a half, and we have the half minute readings. The report and the readings show that the single reduction motor takes twenty-four [illegible] ators.

[illegible] tion of our car motors. The bobbins are separately wound [illegible] from displacements.

[illegible] company): Being connected with an electrical company, possibly I [illegible] roading part of it, outside of the purely electrical apparatus. But, unfortunately for some of our customers, they have had to come to us for assistance; and through our rendering assistance we have, perforce, had to come into the operation and management of a number of railroads throughout the country. Therefore, in a certain sense, we do understand something about the operation of electrical cars, and what they are doing and what they are supposed to do, and what the public and the officials of the railroads want them to do. Mr. Beckley's paper was exceeding[ly] interesting. He [illegible] broad and wholesome way. I think on the whole it was one of the broadest papers on the subject I have ever listened to. Our company endeavors to do what it does do well. It went into the field early. It struggled hard to produce a motor to meet all of the conditions that were to be imposed upon it; and I tell you these conditions were severe. It is not only a lack of knowledge on the part of the railroad officials, but a deep-rooted prejudice on the part of the public against the electric system that we had to meet. Then again, I am sorry to say, we did not get the support we should from the builders of the other portions of the railroad equipment. They did not evince a spirit of accommodation, to see if they could help us in the combination of their manufactures and ours. I am glad to say, however, that matters in this respect have very much improved. We have put our motors under almost every style of car that is built; they have been used with almost every style of truck that is built, and on almost every kind of road that is built. We have them in the hottest climes, away in Brazil; and in colder countries, as in Vancouver or Maine. I believe that you are all acquainted with our product and it does not need any extended remarks of mine to describe it in detail. We manufacture every part of an electric system. We are constantly endeavoring to so arrange and harmonize the whole of the overhead parts that we will have a complete system. We are doing the same with all of the apparatus on the car—lightning arrester, reversing switch, trolley poles and bars—motors, fuse-boxes and the controlling mechanism. We are happy to have all suggestions from railroad men possible. I believe firmly in the single reduction motor. We have in the neighborhood of 1,200 of them in operation. We have been manufacturing them since the first of last February, having made them to put out upon some small roads for experimental purposes last summer. We are also making experiments with gearless motors, etc.; but I believe that we should pin our faith to that which we know is absolutely satisfactory. We are building our generators large, and are now furnishing generators of of two hundred and fifty and three hundred-horse power. We are also building some of four and five hundred-horse power. The four hundred horse power motor will quickly be put in operation. We are at present making tests with it at the factory. In every respect, from the details of the overhead system down to all of the electric parts of the car, we produce them all. I want to impress this fact upon you, that you have not to come to us for a motor, and then go to some one else for the overhead part, and [illegible] There is another thing which interests all of you gentlemen, and that is the question of [illegible] electric cars have not earned the reputation they should have in regard to handling snow, and that electric roads are still dependent, to a great extent, upon [illegible] muscle of men in removing snow; but that is not entirely so. Our company has endeavored to [illegible] broom sweeper which will demonstrate that electricity is absolutely self-contained in every respect. I would like the convention to hear Mr. Barr, of our company, who represents it in that respect.

MR. BARR (Thomson-Houston company): [illegible] has gone thoroughly into this question of snow cleaning devices. Some of you may know that last year we [illegible] a machine—a snow sweeper [illegible] has done excellent work [illegible] There were some defects in [illegible] we have tried to remedy [illegible] view [illegible] last year made a trip [illegible] personally inspected [illegible] learn, which were used as street [illegible] and [illegible] for sweeping streets [illegible] obtained, four [illegible] general [illegible] not familiar with the machine we had last year, that it was a brush of rattan set at an angle of sixty degrees, revolving in front of a frame driven by a motor by means of sprocket chains. In a light sugar snow, that brush gave good satisfaction, but in a heavy wet snow [illegible] would clog, and served rather to [illegible] the snow on the

rail and make it [illegible] and therefore rendered it impossible for the wheel to get traction. The sprocket chain is always a source of trouble and annoyance. The lines that we laid down to follow were, first, to do away with the rattan broom, and second, to get a positive drive for the cylinder. We have built a broom with steel teeth. It is supported from thirty-six inch four hundred pound wheels, on a Bemis box. The wheels are driven in the same way as with cars—placing the motors on the axles. We are using single reduction motors for them. The cylinder is set at forty-five degrees of the track, extending completely across, and is hung from a rocker shaft. The motor counterbalances the blade of the broom around that shaft, and is geared directly through spur gearings to the flyer. The main feature of the flyer is that it has a series of blades. The best description of it is to refer you to the paddle-wheel of a steamer, only of smaller diameter, having the blades cut at the center, to allow the spur gearing for the driving. These blades are of steel plate, about a quarter of an inch thich, and there are eight of them on each flyer. To the back of the blades are bolted steel brushes, the brushes being made of flat steel wire, cutting edgeways. These brushes are adjustable, and ordinarily their surfaces project from five-eighths to one and one half inches beyond the blade. The blade does the major part of the work. It breaks the heavy snow and will actually cut ice. The steel brush does the rest of the work. It sweeps the road clean and if allowed to remain long enough in one place, will cut the ice as well. The motor driving the broom or brush is independent from the motors driving the car, so that the sweeper can be propelled in a light snow at a speed sufficient to keep it ahead of any of the cars on the line. If you should meet with heavy snow or ice on the track, the sweeper can be slowed down, the brush still keeping its normal speed. By doing this, these brushes, being made of steel or wire, will actually cut the ice clear down to the rail. The whole thing is very novel, but it has done good work. We have experimented some with a new machine, somewhat different from the old one. Where the latter only had four blades, the new one has eight; the old one was set at sixty degrees angle, the new one at forty-five; in the old we used the sprocket chain, in the present the spur gearing; we had a ten horse power motor but now we have a twenty-five; in the old one the blade made eighty turns a minute, in the new one it will run up to one hundred and fifty turns a minute. We are building several of these machines, one of which we shall have on exhibition at the convention at Pittsburg.

H. H. Grannis (Westinghouse Electric & Manufacturing company): There is one point touched upon by Mr. Beckley in his very interesting paper, attention to which, I think, has given us success in the manufacture of street railway motors. I refer to his allusion to the point of mechanical construction in the motors. I will not occupy your time to any extent, but will go into history for a moment to tell you what the Westinghouse company has done since it began manufacturing street railway motors. Our first motor was constructed a little over a year ago, and put in operation July 4, 1890, in Pittsburg. It was the old type double reduction motor, all the parts inclosed in cast iron frames. All shafting was run parallel at all

[illegible]

Formerly it was a wooden shaft with brass contact strips screwed to the shaft. We found that was not quite as durable as we wished, and we are now making them of asbestos and brass. If they do wear at all, it makes very little difference, for they are practically indestructible. We are manufacturing and selling many of these motors. In the first year of our business career, we have put machines on about seventy different roads, which we think is about as good a record as any company can show for the same length of time. In April we commenced to get out a gearless motor, and have been operating that motor since May in Pittsburg. It has exceeded our most sanguine expectations, and we will be ready in a few days to ship. We have not said much about it for the past three or four months, for the reason that the single reduction motor did better than we expected. They are giving satisfaction wherever they are used. We therefore determined to wait and test the gearless motor thoroughly. This we have done, and to-day we stand before you with two motors to offer single reduction and gearless. Personally, I express a preference for the gearless. I was interested the other day in reading on the subject of the underground railway in London, where electric traction is used, that the motor for the purpose of moving the trains had its armature mounted directly on the axle, which is the plan used by us. In that way, we need not have any devices communicating power to the wheels. We do not require any special wheels; any standard wheels will do with our system. The gearless motor has been running in Pittsburg for some months. I have no doubt many of you gentlemen will be there next month, and you will have an opportunity to see it in all its details. We are manufacturing, as other companies are, different sizes of motors, somewhat larger than have been manufactured in the past; up to two hundred and fifty and five hundred horse power.

C. J. Field, of the Field Engineering company, next addressed the meeting. He urged the railway officials to always insist on the best class of construction work. This class of work always brought the largest return in the long run. Always get the best of everything. The result would be a reduction in the repair account and operating expenses; and the wisdom of getting everything of the best would eventually become manifest.

C. D. Shain (Edison General Electric company): I would like to call the attention of the convention to our double and single reduction motors. We make the single reduction motor in sizes from 15 to 30 horse power. Many roads adopt different size motors. It will be remembered that some years ago, when we commenced the manufacture of electric motors, they were from 5 to 10 horse power. At the present time many of the roads are using very long and heavy cars, and many gentlemen do not think it necessary to put in more than 15 horse power equipment on such cars. The result is a general disappointment all around, as the 15 horse power motors are too light for the purpose. Where large cars are used, sufficient power must be provided. We make a full line of electrical supplies of every description for street railway work, and we shall also present to street car men this winter a snow plow and sweeper combined.

C. C. Bowen, of the Multiple Distributing Station Electric Railway company, also addressed the meeting, and then the electrical discussion came to a close.

Dues From Small Companies.

The recommendation of the executive committee, that the by laws be amended so that companies whose annual gross receipts from passengers are less than $100,000 may be admitted to membership upon the payment of $5 as annual dues, was adopted.

Election of Officers and Adjournment.

The president appointed John N. Partridge of Brooklyn, Henry M. Watson of Buffalo, and John W. McNamara of Albany, a committee to nominate officers and report a place for the next meeting.

The following named officers were elected for the ensuing year:

President—John N. Beckley, Rochester.

First Vice-President—Thomas H. McLean, New York city.

Second Vice-President—George Law, New York city.

Secretary and Treasurer—W. J. Richardson, Brooklyn.

Executive Committee—President and secretary, and Daniel F. Lewis, Brooklyn; C. Densmore Wyman, New York city; Charles Cleminshaw, Troy.

Saratoga Springs, N. Y., was selected as the place for the next meeting of the association, which will take place on the third Tuesday in September, 1892.

The meeting then adjourned.

All in attendance at the convention were photographed in a group in front of the hotel just before luncheon. After luncheon, the party, as guests of the retiring president, [illegible] went for a drive through Central Park and along the Riverside drive to High Bridge and Fort [illegible].

In the evening George Green, proprietor of the Hotel Metropole, tendered a complimentary banquet to the [illegible] in attendance at the convention [illegible] were invited. About fifty gentlemen composed the party. [illegible] although everything [illegible] thoroughly enjoyable was bountifully provided. There was some brief speech making [illegible] before [illegible] o'clock the gath[illegible].

Small Motors Operating Light Machinery.

[illegible] a view of the new [illegible] motor introduced by the Emerson Electric Manufacturing company of St. Louis for operating sewing machines [illegible] light machinery, such for instance as dental [illegible]. A special feature of the arrangement is the regulator, which is attached by a connecting rod with the treadle of the sewing machine.

When the treadle is pushed down it cuts in the current in a suitable manner and at the same time relieves the brake from the pulley wheel, allowing the motor to run. The further the treadle is pushed down the faster the machine will run, and by varying the position of the treadle up or down any desired speed whatever can be attained. When the treadle is released the current is cut off and the brake goes against the wheel, thus stopping it very quickly. The brake is a very important part of the regulator as, it makes the machine respond instantly to any change in the position of the treadle. The company has also arranged the same motor and regulator especially for dentists' use on a suitable tripod with standard for attaching the dental engine.

Queen's New Portable Galvanometer.

QUEEN'S NEW PORTABLE GALVANOMETER.

Queen & Co., Philadelphia, have brought out a new type of galvanometer, shown in the cut. The galvanometer itself is an astatic one, fibre suspended, of which the needle is automatically lowered, and its weight taken from the fibre by simple closing of the lid. The galvanometer is set in such a way that it can be rotated about its vertical axis so as to bring the plane of the coils in the plane of the magnetic meridian. The control magnet, seen in the cut, is adjustable in the length of its supporting tube, and can also be rotated about it; if it is not desired to use the magnet it can easily be removed, being held by two spring clips to the galvanometer proper, and held in the fittings placed in the lid for that purpose. In the bottom of the containing box are placed six chloride of silver cells connecting with a series of small blocks on the right; a plug allows these blocks to be connected so as to use one or any number of these cells in series. By means of a small switch seen at the left and back the galvanometer and batteries can be thrown into the same circuit, or by changing the position of the switch into different circuits. In the latter case the galvanometer and battery can be used in the ordinary way for ordinary Wheatstone bridge work, while in the former arrangement by applying two of the four terminals seen to a circuit, an immediate deflection of the needle will be the result of a complete circuit.

Electricians Entertained at Quebec.

After the adjournment of the National Electric Light association, and after the famous trip on Richelieu River, about fifty of the delegates and members visited Quebec. They were guided by A. J. Corriveau and Manager Mohr, of the Quebec Electric Light company. On Sunday they were taken in carriages to the citadel, over the Heights of Abraham, and through the city generally, visiting the Basilica and other points of interest.

On Monday the party drove to the Montmorency Falls. On the heights above the falls is the ancient building which a century ago was the home of the Duke of Kent, the father of Queen Victoria. The visitors were welcomed by Mr. and Mrs. Hall, who now own this beautiful place. Lunch was spread, and a delightful hour was passed with the hospitable gentleman and lady.

From the veranda of this house one looks over the mighty St. Lawrence River, which here is two miles wide. The waters of this river furnish inexhaustible power which is utilized for the running of large mills, and also for operating the Quebec electric light station.

This wonderful water power is controlled by Hall & Price. The water is conducted from above the fall in large pipes to the mills and to the electric light station. In this station are sixteen dynamos, supplying the current for

300 arc lights, and two 750 light machines for incandescent lighting. Over twelve hundred miles of conductors are in use. More dynamos are being built for this station, the present supply being inadequate to meet the demand.

On Monday evening the party returned to Montreal. On behalf of the members remaining in Montreal an elegant gold headed cane was presented to Mr. Corriveau by A. F. Mason. The following letter accompanied the gift:

A few of your many friends, members of the National Electric Light association, desire to express their appreciation of your successful efforts to make their visit to Canada a joyful one. They will ever remember your untiring labors in their behalf, culminating in the Quebec and Montmorency Falls trip, which has been the climax of eight days of rare enjoyment.

No words, and certainly no material gift, could adequately represent our sentiments, yet we are unwilling to leave you without some token that, in days to come, may recall to your mind the happiness you have been instrumental in conferring upon us.

We therefore beg you to accept, as slight token of our esteem, the walking stick which the undersigned are commissioned to hand you.

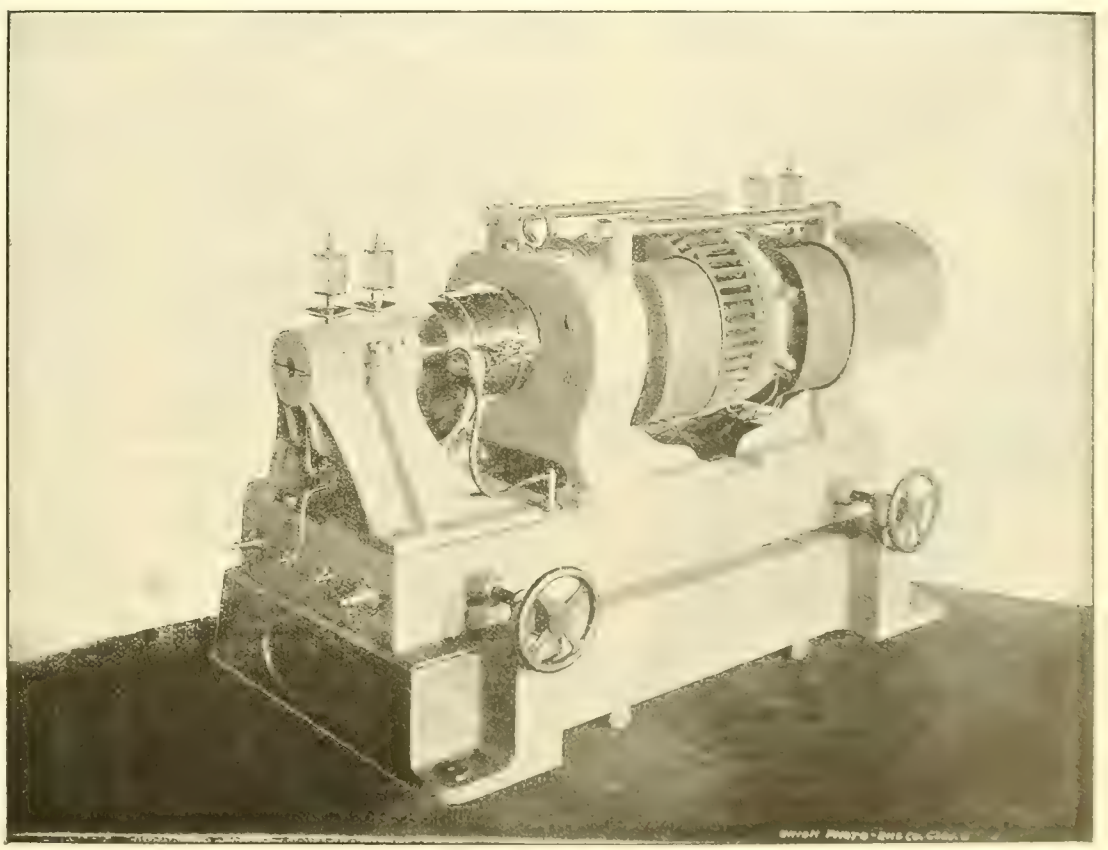
The letter was signed by W. J. Morrison, A. F. Mason and W. J. Hammer, committee.

Brush Generator and Motor.

For some years electricians have been working on the line of apparatus for power transmission. The Brush Electric company has had this matter in mind for a long time but has not been fully satisfied with the results obtained until S. H. Short, now the company's chief electrician, submitted designs for the apparatus shown in the accompanying illustration.

The generator shown is capable of furnishing 100 horse power at its pulley. It is what is termed the closed coil armature type. The core of the armature is made up of thin sheet iron wound on a foundation ring and firmly riveted. The edges of this ring are then milled out slightly so as to allow for the bobbins of wire. The wires leading from the armature to the commutator are carried along the shaft and are very carefully and thoroughly covered so as to protect them from dirt, or damage of any kind. The bearing on the commutator side of the dynamo is placed outside of the commutator so as to allow a clear way for the connections between armature and commutator. These generators are very compactly built and the ventilation obtained is excellent. Any part of the machine can be inspected without disarranging other parts, and in case of accident the armature or magnets can be removed quickly and repaired with little trouble. Any one of the armature bobbins can easily be rewound without disturbing the remaining bobbins.

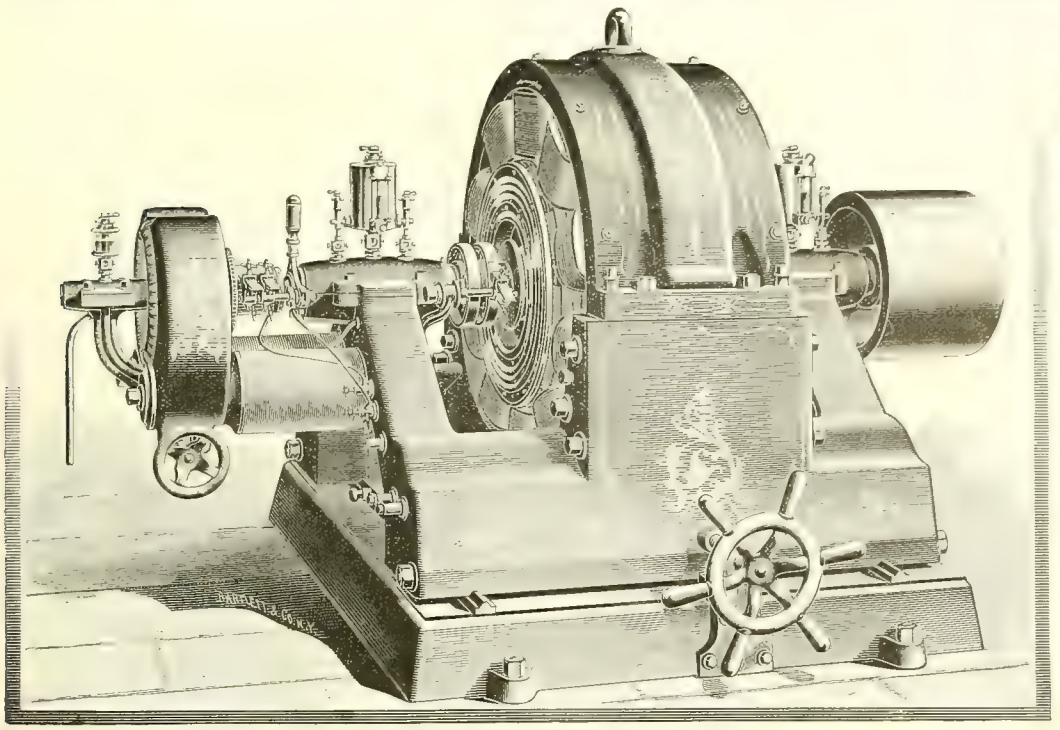
The construction of the motor is very similar to that of the generator. It requires no outside governor of any kind. It is so built as to take care of its own regulation. The generators and motors will be wound for an electro motive force of 1,000 volts, thus allowing the carrying of power over a considerable distance by means of a comparatively small wire. The new type of commutator with which both motor and generator are fitted runs with practically no spark, so that there is no trouble at that usually troublesome point.



BRUSH GENERATOR AND MOTOR.

The Oswego, N. Y., Street Railway company is to change its motive power from horses to the trolley system.

National Self-Contained Alternator.



NATIONAL SELF-CONTAINED ALTERNATOR.

hand screw and hand wheel the distance between

and the exciting current varied between wide

little adjustment is required, the dynamo being

trifling change in exciting current with wide variations of load. There are no resistance

machine. The alternator armature contains a minimum of iron, consistent with good efficiency, and remains remarkably cool under a

machines are rated with a liberal factor of safety in regard to carrying capacity, making it possible to ten[illegible] to an extent of 50 per cent. or more, without serious consequences. The machine has ten poles, and when driven at a speed of [illegible] revolutions per minute will produce a potential difference of 1,000 volts.

London-Paris Telephone.

Experience is proving the telephone between London and Paris a big success, scientifically, commercially, and financially. Electricians say there is no telephone circuit in London, or in England, that works so clearly and perfectly. The tariff is eight shillings, or $2, for three minutes' use of the wire, and the average number of calls during the past few weeks has been fifteen an hour during the busy part of the day, and about 108 a day. From records kept of actual business transacted, it is estimated that messages are sent between London and Paris at the rate of five words for two cents, an enormous reduction on the regular telegraph cable rates.

Automatic Detector of Fire-damp in Coal Mines

Ventilation only is necessary as a protection against the deadly effect of coal gas or fire-damp in mines; but if the ventilation is to be carried on, not only with sufficient effect to guard against accidents in cases where a large amount of fire-damp suddenly makes its appearance, but also economically it is necessary to know the exact percentage of fire damp present in the different galleries. With this in view, the firm of B. Egger & Co. in Vienna has constructed an automatic electrical device, as shown in the

AUTOMATIC DETECTOR OF FIRE-DAMP IN COAL MINES.

accompanying cut, with the purpose of signaling to the operator of the ventilating machinery the percentage of fire-damp in the atmosphere of the different branches of the mine, that he may direct his air blast with increased force to such places as especially need ventilation.

The principle of this apparatus is founded on the law of gravity, and the difference in weight between atmospheric air, the specific gravity of which is 1, and that of fire-damp (CH_4), the specific gravity of which is only .55, is utilized. In accordance with this idea the arrangement of the apparatus is as follows: On a balance lever *H*, Fig. 1, is attached a hollow copper cylinder *B*, counter-balanced with weight *Q* on the other side. The cylinder is air tight and filled with pure atmospheric air. It has a loose fitting lid *D*, Fig. 4, resting in a groove filled with oil, the object being to allow the inclosed air to expand or contract in accordance with the temperature and density of the surrounding atmosphere. To the lever *H* is further attached a contact arm *U* having five vertical plungers playing into a corresponding number of small

[illegible]

increases, the cylinder will increase in weight, compared with the surrounding atmosphere, sink down and break the contacts at *U*, one by one, in accordance with the amount of gas present. The drops of the annunciator will show up the corresponding number, and the pens of the register will describe a curve on its cylinder, showing the time the fire-damp made its appearance, its density and duration. If by increasing the air blast the fire damp gradually disappears, the balance of the detector will again obtain its equilibrium and the annunciator and register will be restored to their original position.

It is claimed that this balance detector can be adjusted with such accuracy as to report even a small percentage of fire damp. An alarm bell can be joined into circuit, so as to automatically call the attention of the ventilator man, and an additional register can be operated on the same circuit and placed in the superintendent's office in order to control the service. The apparatus has been introduced in one of the Austrian coal mines, and is reported to give satisfaction. The cut was reproduced from *Elektrotechnische Zeitschrift*.

Hart Switches.

The Hart double pole switch, which has just been put upon the market by the Hart & Hegeman Manufacturing company of Hartford, Conn., possesses many excellent features. Durable construction, quick rotary movement in one direction, positive action, the switch plates being locked in position until they are under the control of the actuating spring, large contact surfaces and unusually long brake for the diameter of the switch are some of the claims made for this device. The length of brake in the fifteen ampere double-pole switch, illustrated herewith, is three inches, the outside diameter of base being two and seven-eighths inches. The length of brake increases with the size of the switch, until in the hundred ampere switch it is six and one-half inches. The one hundred ampere switch is mounted on a slate base six inches square, provided with clamping devices or binding posts which will take wire up to 0000 B. & S. or a flat bar up to three-eighths by three-quarters inch and are so arranged that the wire or bar may be brought down the face of switch-board or enter clamps from back of board without bending it in either case. This feature facilitates neat and rapid construction. The long brake and quick action allow the double-pole switches of all sizes to be used on railway or power circuits of five hundred volts and on primary alternating circuits of one thousand volts.

New Mather Quadripolar Motor.

The new four-pole motor recently brought out by the Mather Electric company of Manchester, Conn., is illustrated in the accompanying cut. While embodying the essential features of the ring type, it can be more readily insulated against the high potentials required for power service. One of the essential features of the old type was a field magnet having the form approximately of the magnetic lines of force and consisting of one piece. In the new type the cores of the field magnet are straight, permitting the use of coils of wire that can be wound separately on a machine, while the rest of the magnetic circuit is practically a ring and the whole, including the cores and pole pieces, is cast in one piece without a joint.

The four pole machines are designed for an output of 20, 30 and 40 horse power, while the motors built for lesser capacity have two poles. Drum armatures are used in all the machines. In the four-pole machines the winding is such that the current has but two paths through the armature wires, and by a special method, devised by Prof. Anthony, no two wires having any great difference of potential are brought near each other.

Wisconsin Electric Club.

The second annual banquet of the Wisconsin Electric Club will be held at the Plankinton House, Milwaukee, on October 6th. A general attendance of the members is earnestly urged.

The Illinois [illegible] say that a singular complaint comes from the fire insurance companies. It relates to [illegible] in the farming districts on live stock, due, as reported by the farmers, to lightning in connection with [illegible] wire fences. Most of the animals killed in this [illegible] were near the wire fence at the time, and it is supposed [illegible] a conductor of electricity in a degree sufficiently large to increase the risk of such insurance.

Is "Earth" of any Value as the Termination of a Lightning Conductor?[1]

By Sydney F. Walker.

Students of Dr. Lodge's researches and lectures on the subject of lightning and its efficient discharge will remember that one of the great points he first made in his able attack upon the old methods was, that "earth" was of no value whatever. The utmost that he would allow after the British Association meeting at Bath was that "earth" might not be a bad thing. In one of his first lectures on the subject he pithily summed up the argument thus: "Why need lightning make any trouble over a few feet or a few yards of earth, when it has already come through several miles of air?" It must be confessed that, put in this way, the argument looks convincing. It has been the writer's opinion, however, from the first that "earth" played a very important part indeed in the matter of the effective discharge of a thunder cloud, but that the whole thing turned upon the question what is "earth" for a lightning flash? In a previous article he has endeavored to show that proper "earth" is by no means a simple matter, even when we know to a very much larger extent what we are dealing with than we do in the case of a highly charged cloud discharging to the buildings or other objects below it. For the first time in his 17 years' experience the writer has felt our pressing want of knowledge of what electricity is. When we are sending an electric current from London to Manchester to work a telegraph apparatus, there we know that, whatever that current may be, and whether the conductor be a metallic wire, as we view it, or an elongated elastic bag, as Dr. Lodge's latest theory of electricity would picture it, some path having the same properties as the wire by which the current went to Manchester must be provided to bring the same current back to London, or the apparatus at Manchester will not work. The current may go around by Glasgow, Douglas, even New York, or by any route that nature provides, but come back it must, subject only to the conditions of Ohm's law. But with a thunder cloud apparently there is no such necessary connection. We see the cloud, dark and ominous—in this country, at any rate—gathering overhead; we see

HART SWITCHES.

the flash; we hear the roar, and sometimes we find that some chimney has been struck and thrown down; sometimes a monarch of the forest has been riven in two, leaving a blackened trunk in place of the previously healthy tree; sometimes, again, an innocent sheep or an ox, or even a man receives the flash and may fall dead. Apparently there is no connection here with "earth" or "ground" as we understand it in connection with the distribution of electrical currents for useful purposes. The vagaries of lightning—how it strips a man's foot off, leaving the other sound, how it prefers to go through a brick or stone wall to running down the conductor provided for it, etc.—will be fully dealt with in another place. The question now proposed to be discussed, is merely this one of what effect "earth" has on the discharge. Seeing the apparently uniform behavior of lightning, the idea of the earlier electricians that all that was required was to provide a safe path to a safe earth is hardly to be wondered at. Apparently the lightning flash always seeks "earth," though it may be by way of the body of an animal, or the mass of a building, so that all that should be required should be to give it plenty of room in transit and a comfortable bed on its arrival. As the writer pointed out in the discussion on the subject at Bath, the problem involved in the safe discharge of a thundercloud is closely analogous to that involved in dealing with the huge reservoirs which supply our large towns with water. If the water is allowed to overcome its dam, it pours down the valley, carrying all before it. If it is made to dribble down, it not only does no harm, but is useful. A lightning conductor may be said to fill the same office that a channel made for the water leading directly to the sea would, if it were possible and so arranged that the whole of the water in the reservoir could be allowed to run harmlessly down this channel immediately there were signs of the dam being likely to give way.

The idea of discharging a thunder cloud is taken evidently from the old idea mentioned in the previous article on this subject—viz., that Mother Earth is a reservoir of infinite capacity for electricity, just as she is for water. Immediately this idea is given up the apparent use of "earth" is gone. So far as can be seen, there is no return path necessary when a discharge from a cloud kills a man or shatters a chimney. Lightning surely knows its own way about, and if it does not require "earth" in such a case, why provide "earth" at all? Further, Dr. Lodge professes to have discovered cases in which buildings have been struck which were properly protected by lightning conductors of the most approved modern type. On this point, however, there is a difference between Dr. Lodge and those who uphold the old form of lightning conductor.

[1] From the London *Electrical Engineer*.

At the Bath meeting Dr. Lodge was challenged to give any instance where a building had been struck when fitted with a conductor properly fixed, properly pointed, and properly "earthed."

In his reply, Dr. Lodge palpably begged the question. "Whenever a building was struck," he said, "electrical engineers always declared that the conductor, if it had one, was not a proper one, or was not properly 'earthed.'" Though this answer practically admits defeat on the professor's part, it is hardly satisfactory to allow the matter to rest there. We want to know why these cases occur, and though Dr. Lodge may not be able logically to defend his position, we are still very much obliged to him for raising the whole question, and for throwing the light he has upon it. This action has taken the whole thing out of the old rut in which it had laid for so long. The question comes back then to this, what office are we to say that earth now fills with our enlightened views of conductors, and of the part that earth plays as a conductor? Is it correct, as Dr. Lodge asserts, that it performs no useful office; that it perhaps leads the lightning discharge into places where it may do real damage that would otherwise be avoided? Unfortunately, the conductor, and even its earth terminal, do lead lightning currents often into places where damage results. In the writer's opinion, however, earth does perform a useful office in connection with the discharge of lightning, even in view of our advanced knowledge of the subject.

What is a thundercloud but a huge generator of electricity? a frictional or hydro-electrical machine on an enormous scale? Is not the reason, too, that no discharges take place under certain conditions, while they are frequent under other conditions, merely that the resistance of the circuit in the one case is so great that no discharge can take place, while in the other it has been reduced to within such limits that a spark can pass at some point? Consider the conditions a little closer. When do lightning discharges usually occur? Is it not when the atmosphere is full of moisture, drawn from the ground below by the intense heat of summer? and does not the same cause tend to reduce the resistance in another way—viz., by lessening the distance between the clouds and the earth, the heavy mass of vapor tending to pull it down? Next consider what happens when a cloud becomes charged. The writer is afraid that, with all due respect to Dr. Lodge, he must leave the elastic bags to take care of themselves, and revert to the reasoning that is common in other branches of electrical science. If a cloud becomes charged then, work is done upon it. It is capable of doing work in return, and will do that work if favorable conditions arise. Further, if a cloud, or one part of a cloud becomes charged, say positively, it is implied that a negative charge exists elsewhere. Would it not be better to put this fact in the practical form in which electrical engineers are accustomed to deal with phenomea comprising the creation or the expenditure of electrical energy, and say that an e. m. f. is created between certain parts of the cloud and other objects; probably other portions of its own mass being included in the phenomena. If the e. m. f. existing between a point in the cloud and any point in surrounding objects be sufficient to overcome the electrical resistance opposed to it, then a current passes, varying in form according to the conditions present; such, for instance, as the rate at which the opposing resistance is lowered, etc. Probably minute, harmless, possibly health giving, electric currents are always passing between cloud and cloud, and from individual clouds to the earth. But in order that a current shall pass, we know that the whole resistance of the circuit must be such as will allow of its passage, not that of one small portion. It is well known that a shock of high voltage may be taken from a frictional or induction machine without danger, where the same voltage applied to the body from a dynamo used for electric lightning would cause instant death. The explantion is, that though the resistance of the body is the same in the two cases, or nearly so, that of the other portions of the circuit—in particular the internal resistance of the machine itself—is enormously greater in the one case than in the other, so great in fact, as to absorb or use up a large portion of the e. m. f. generated before any current reaches the external circuit. Electrical engineers know what it means to have a dynamo or a battery whose internal resistance is out of proportion to that of the apparatus to be worked. Take for instance, a battery of 10 cells, each having an internal resistance of 10 ohms, while that of the line and apparatus outside is one ohm. As we know, we practically get no current from such a combination; and we should get none from it if we had 100 or 1,000 similar cells. And so it is with the Holtz machine, and with the thundercloud.

But what is the circuit which governs the discharge of the thundercloud? It is assumed that the cloud acts only as one plate of a condenser or Leyden jar, the earth forming the other; that the cloud, once charged, may be looked upon as cut off—just as one may charge a Leyden jar and have done with it. Obviously, this is an incorrect description; and it is only fair to Dr. Lodge to mention that in his experiments he does not appear to take this view. It is evident, of course, that a charged cloud fills the same, or nearly the same, position with regard to surrounding objects that a frictional machine does. It is a generator, and at the same time it forms one side of the condenser, of which the earth and other clouds form the other. But it must not be forgotten that while there is an inductive connection—if it may be so termed—between the cloud and surrounding bodies, there is also a conductive connection, and that the office of the inductive connection is only to determine the positions of strains, or of e. m. f.'s,

Consider, again, what happens when a charged cloud sails over a particular portion of the earth's surface. Probably, during its motion, its charge is being increased by friction with the atmosphere. We know, also, that, assuming one extremity of the cloud to be charged positively, the earth and other objects near will be charged negatively. At any rate, there is an e. m. f. existent between them, similar to that existing, say, between the terminals of a dynamo; and if we examine surrounding objects, we shall find that they display characteristics which we associate with a charge of a certain name, opposite in character to that of the inducing body, the cloud. But, assuming this to be correct, how did the charge reach the objects named? We know, for instance, that the nearer objects will be more highly charged than those more remote, and we know that this charge means—unfortunately this is where we want a little more light. At any rate, we do know that the induced charge, whether positive or negative, has only been allowed by conduction from surrounding objects. That is to say, when, in obedience to the inducing force exercised by a highly charged thunder cloud, the top of a factory chimney, say, becomes positively electrified, or there appears a difference of potential between it and not only the cloud, but surrounding bodies on its own side of the condenser dielectric, this state has been arrived at by means of electric currents passing from these surrounding bodies, and possibly from the cloud itself, to the chimney-top. When also, owing either to the departure of the cloud, or to its whole or partial discharge, the strain in relieved at that particular point—in other words, the difference of potential is lowered, and a redistribution takes place—this also will be by means of currents of electricity, as we understand them. Further, when a discharge between a thunder cloud and an object attached to earth takes place, be that object a mill chimney, a royal palace, an oak, or an animal, the discharge, be it harmless or disastrous, must be by means of one or more electric currents, taking the term in the sense in which we now understand it.

The point whether a Leyden jar discharge or a lightning discharge be by continuous or oscillatory currents in the writer's opinion hardly affects the question. If the discharge is oscillatory, it will be so because, under certain conditions, an opposing e. m. f. is created in the process of first discharge, which in turn delivers its current along the path or paths open to it. Nor can the question whether a conductor of large sectional area offers the resistence that Ohm's law would dictate, or offers a higher apparent resistance owing to induction within itself, affect the argument. It may at once be acknowledged that a copper rod or rope, or tape may be considered for the purpose of the passage of an electric current through its mass, as composed of a bundle of rods of infinitely small sectional area, and it is obvious that if this is so, and there is no reason to question the premise, the current passing in each of these rods or wires acts inductively upon those passing in all the others, and in such a manner as will resist their passage; because, as we know, each current creates around it a series of circles of magnetization within which the others would be inclosed, and these resent, so to speak, the entrance into them of another current creating magnetic fields of a similar name. Further, we know, by the laws of magneto-electric induction, that these effects, giving rise to apparent resistence, are proportional to the current strength, other things being the same. We know, also, that in all these cases the current strength depends upon the e m. f. available, and inversely upon the resistence of the circuit. In other words, the whole thing depends upon the difference of potential between the cloud and the top of the conductor, and inversely upon the resistance of the path or paths chosen, *nolens volens*, by the discharging current, so that we come right back to our initial question—What is the path of the discharging current? and what part does "earth" play in the discharge? The apparent increase of the ohmic resistance of any lightning conductor, owing to magneto-electric induction within itself, would really appear to be too small a matter, considering the magnitude of the figures involved, to have any serious bearing upon the question. Here it may be well to state another problem for solution. It is the problem of which the question, "What part does 'earth' play in a lightning discharge" forms a part. It is, what is necessary to protect building, electrical instruments, such as telephones and dynamos, or trees and animals from being struck by dangerous lightning discharges. The answer is, in the writer's opinion, that the e. m. f. available for driving a current through the body to be protected must be reduced below the dangerous point, or below that at which either a dangerously powerful heating or shocking current, or a dangerously powerful spark, can be delivered throught the circuit of which the body to be protected forms a part.

It is obvious that this end may be accomplished in two ways only—viz, by interposing in the circuit which it is designed to protect a high resistance, or by shunting the circuit by means of a conductor of such low resistance, that the shunted current lowers the e. m. f. at the terminals of the body or instrument to be protected below the danger point. Possibly an example taken from practical electrical engineering work will make this clear.

Suppose that you have an electrical pumping plant which is being worked at an e. m. f. in the mains of 300 volts or thereabouts, and you wish to run incandescent lamps on the same circuit; you have only 100-volt lamps, and the problem is therefore to use these lamps without overheating them. The problem, of course, is a very simple one. You either use three of the lamps in series, or where you cannot use three lamps together within any reasonable distance, you introduce an artificial resistance between one main and one terminal of the lamp. In either case you use up the surplus 200 volts by introducing the additional resistance, reducing the e. m. f. at the terminals of the lamp to the figure you require, 100 volts, thereby only allowing the proper current to pass through it. But you might also have accomplished the object by causing a large current to pass through the mains and through another branch circuit, the current passing being of sufficient magnitude to reduce the voltage at the terminals of the lamp to the same figure as above—viz., 100 volts—by reason of the charge made upon the initial e. m. f. present for the passage of this current through the mains, in opposition to their electrical resistance.

[illegible] the shunt current is passing, will be only 100 volts.

The above is, of course, only a hypothetical case, though it might occur under such conditions as the waste of [illegible] of the large magnitude described, and the shunt circuit might [illegible] Such a case might also arise from defective engineering. The example, whether hypothetical or practical, illustrates the two methods that rule for protecting life and property from the current of a high tension supply, or from lightning.

The first method, the introduction of an artificial resistance into the circuit, is that usually adopted by attendants upon high-tension dynamos, when they place a piece of dry wood near the machine to stand upon while they are oiling, etc., when the machine is running. The second plan is the one that has hitherto been adopted almost universally in the matter of lightning conductors, but which, as the writer understands the matter, Dr. Oliver Lodge says is wrong.

The first plan is also obviously one that could be adopted in case of being caught in a thunderstorm. If one knew where to stand upon a piece of close rock, which itself stood upon ground that did not hold moisture readily, one would have accomplished the object sought after—viz., by introducing an artificial resistance into the circuit, lessened the chances of a dangerous current passing through one.

It will be evident, however, that whichever plan is chosen the return path is a matter of considerable importance. In the example that has been chosen the return path is a cable or other conductor; and the question will arise here, Is a return path necessary in the case of lightning? The writer maintains that lightning requires a path for redistribution of its charge, for the expenditure of its stored energy, just as much as either an electric light supply system requires one, or a frictional electrical machine does. But consider, first, what would be the effect of having a return path of high resistance in the case where you propose to take off a powerful shunt current for any purpose. Your high resistance return path will prevent your doing it, because you will be unable to get the necessary strength of current through.

It must be remembered that in dealing with protection from lightning the two classes of cases must be kept quite distinct. If an object is already protected, by the fact that from its position a high resistance is offered to any current that can be sent through it from a thundercloud, it requires no other. But, on the other hand, if the object to be protected stands in such a position that the natural resistance offered to the current that would be sent through it from a thunder cloud is not sufficient to protect it under all circumstances, and it becomes necessary to protect it by the other plan, then the high resistance of the return path is an obstacle in the way of accomplishing this. And it is here that the necessity for good, very good earth, appears to the writer to come in.

What is the return path, or, if it be preferred, the path for redistribution of the charge on a thunder cloud? The charge would, as already stated, probably be formed in the process of the formation of the clond itself, and by friction with the atmosphere as it sailed over the earth. Whence did this charge come? Evidently principally from the moisture in the surrounding atmosphere, a little from the air itself. But the fact of a charge of electricity having been taken from the atmosphere between the cloud and the earth would cause a current from the earth, and from buildings, animals, chimneys, etc., producing the phenomena we know to exist [illegible] site name on those portions of the earth's surface, and the objects upon it, immediately under the cloud. When a redistribution takes place it can only be by means of currents passing through the conductors present. The method of redistribution will, of course, depend upon the conditions ruling at the time. Thus the effect of the discharge of one cloud might be [illegible] ence of another, and the discharge of the cloud might take place, not to any object upon the earth, but to another cloud, in which case quite a different set of conditions would be set up. Again, the cloud might not discharge at all in the neighborhood where it was generated and where it acquired the major portion of its charge.

In any case, however, whatever the cause of the redistribution, it could only take place by conduction. Now, consider, if this true, what it means. It does not mean that only metals, or the inside of chimney shafts, or wet trees, or animals will take part in the redistribution, but that these and every other body which lies in the path of the e. m. f. present will take its proportion of current according to Ohm's law— [illegible] resistances. It should be mentioned here that there will probably be electromagnetic induction between different portions of the [illegible] passing through the earth, rocks, trees, or any other body, just as there will be [illegible] through a lightning rod. There will also be electrolysis set up at different points [illegible] f.'s, and the current passing [illegible] the final e. m. f. available for overcoming the resistance of that path, after allowing for these counter e. m. f.'s, just as the current passing in an electric motor would.

Now it will be [illegible] crust takes part very largely in this redistribution or discharge, whichever it is called, the current passing [illegible]

two things only the surface contact between the principal conductor leading to the ground.

Thames, or the Mersey; the resistance offered by the river to the discharging or redistributing current must be small, provided the contact made between it and, say, the end of a conductor leading to it is large. On the other hand, the resistance offered by a hard, impervious rock will be light, But, as is well known, if the contact with the river is very small, the resistance offered to the current may be high; while even in the case of a hard rock, if we could obtain a large enough surface contact, the resistance might be reduced to moderate dimensions.

But how does this affect the question of the lightning discharge? In the writer's opinion the question is affected by these matters, because in all cases of discharge or redistribution, it is along these paths that the current which carries out the redistribution must flow.

There is a difference of potential between one end of the cloud and one part of the earth, but there is also, by reason of that difference of potential, a further tension between the same part of the earth and neighboring portions, and no matter how the result may come—either by sparking from the cloud to some object on the earth's surface, by sparking from cloud to cloud, by silent discharge between cloud and surrounding objects, or by the cloud moving on—whenever a redistribution does take place it necessitates currents passing between the parts of the earth, or the objects on it, that are at different potentials, and these currents must pass through the earth's crust, the objects on it, and through the surrounding atmosphere in accordance with the laws already stated.

Now examine the case of a lightning conductor attached to a high building or to a mill chimney. What position does it occupy with reference to the charged cloud overhead?

It is perhaps as well to explode the old idea that the conductor is able to attract all the charge to itself. The lightning rod forms merely one of many paths open to the discharging or redistributing current. Each of the chimneys of the building, with their soot linings, forms another part. The stone or brickwork of which the building or chimney is composed forms other paths, mainly on account of the moisture held in them.

If the lightning conductor is able to protect the building to which it is attached, it will be because the additional path formed by it for the discharging current has reduced the e.m.f. available below the point at which it can do other mischief.

But if it is to do that, obviously it must be arranged to carry the largest possible current away. Obviously, also, the only way in which this can be accomplished is by making the conductor form a portion of a path of low resistance, and how is this to be done except by connecting it by means of a large surface contact with the mass of the best conductors to be found in the earth's crust where the conductor joints it—in other words, by making good earth as electrical engineers understand the term.

The lightning current will not mind ploughing up a few yards of earth when it reaches ground, but there is no reason that it should be allowed to do so if it can be avoided, as it can by making a good earth connection.

A good earth would, of course, mean, if available, the bed of a river, wide and deep, connection being made to the water by means of a large metal plate. But, it is replied, if good earth, as you call it, will do the trick, why are buildings struck where the conductors have good earth? Why is a poor sheep struck in the open, standing upon wet ground? Surely he is making good earth? What about side flashes also? Where does good earth come in there. The answer is and it will be better to face it at once, that unless the number of conductors is much multiplied, in the case of large buildings such as those making good earth, and, if possible, a separate earth, unless the bed of a large river is available, it is impossible to absolutely insure protection from lightning. But while it is impossible to insure absolute protection from lightning, just as it is impossible to insure immunity from many other things, the one thing that will tend, and the only thing that will tend to protect from lightning is the multiplication before described, all the conductors being well

It is obvious, of course, that where good earth is obtainable fewer conductors are necessary than where it is

e.m.f. present between the cloud, or the conductor

kin.

conductors, and apply the high resistance method to the gas-pipes and other possible recipients. Place them as far from the path of discharge as you can.

The case of animals and trees being struck in the open field arises from the fact that there is no discharging path near, and therefore a dangerous e.m.f. is present, the actual path of the discharge being determined by special conditions in each case.

The remedy would be here, as in other cases, to fix a number of conductors about a field where animals grazed during thunder weather, always getting as good earth as possible. A similar plan would probably protect valuable plantations of forest trees.

In conclusion, the writer would point, in confirmation of his views, to the comparative immunity of towns from the effect of lightning discharges, and he attributes this immunity to the fact that so many paths are open for the discharge of the thundercloud. Most of them have a high resistance, and do not make good earth, but their infinite multiplication gives the same result, even to the good earth, in another form. Suppose, for instance, the resistance of the column of smoky hot air, soot-lined chimney, fire-grate, and foundation together amount to 1,000 ohms, a thousand such paths will bring the resistance to only one ohm; while in the case of a very large city, the combined resistance of all the paths open to the discharging current would be very small indeed.

The writer would also point to the fact that though lightning has frequently been seen in the workings of a mine, and has often pulled down colliery chimneys, and done damage at the pit bottom, no damage has ever been done by it in the mine itself, the coal, rails, etc, acting as conductors to distribute the charge, and the damage done at the pit bottom being due to the sudden break from a conductor of low resistance to one of high resistance, without good surface contact—without, in fact, a good connection to earth.

The writer has not touched upon the static side of the question, but it is obvious that most of the remarks given above apply equally, whether the matter be looked at from the electrostatic or electro-dynamic point of view. Each conductor, each body that will or does conduct, not only does so, but it dissipates a portion of the charge from the electrostatic capacity of the condenser or condensers, of which it forms a part; and this is surely an argument for getting the conducting surface to which the discharging current is conveyed as large as possible. That is getting good earth.

It should perhaps be noted that the office of *good* "earth" would be very well filled by the congregation together of a number of large masses of metal, in more or less good connection, electrically speaking, such as a large town built entirely of iron—a thing which may perhaps one day come to pass. Failing this, however, our next best substitute is the earth's crust, solely on account of its large proportions, and this is only available where we can get good connection to the principal conductor in it, the moisture that is always present.

American Street Railway Association.

The rate of a fare and a third has been allowed to delegates and all others, including members of their families, in attendance at the tenth annual meeting of the American Street Railway association, which will be held in Pittsburg, Pa., October 21 to 23, 1891, by the following associations, namely: Boston Lines Passenger, Central Traffic, New York and New England Passenger, Southern Passenger and Trunk Lines; also on the Chicago & Alton railroad from all points in the state of Illinois. Michigan is excepted from the Central Traffic association. This covers nearly all the territory of the United States, with the exception of that controlled by the Western Passenger association.

Consolidation of Telegraphers' Societies.

The third annual session of the grand lodge of the Brotherhood of Telegraphers was held in St. Louis last week, Grand Master Telegrapher Mortimer D. Shaw presiding. At the second day's session Eugene V. Debbs, of the Brotherhood of Locomotive Firemen, made an address. He pointed out the methods and advantages of amalgamation of the Order of Railway Telegraphers and the Brotherhood of Telegraphers. Mr. Debbs is a member of the supreme council of the federated railway orders, to which the amalgamated body will be admitted. After a conference between the grand officers of the two organizations, a report favorable to the amalgamation was presented and adopted.

Chicago Amateur Electric Society.

The first regular meeting of the society was held at the Grand Pacific Hotel on Thursday evening, Sept. 17, about fifty bright young men being in attendance. The organization was completed by the election of an instructor, the balance of the officers having been provided for by the [illegible]. The president is W. F. Bopp, [illegible] and the secretary is E. G. [illegible] Chicago Telephone company.

After such societies have been organized throughout the [illegible] a report shall be made to a [illegible] to be known as the American [illegible], which organization has also been perfected by the election of O. E. Cozzens of the *Amateur Electrician* as president, and E. G. Carter of the Electric Supply company as corresponding secretary.

CORRESPONDENCE.

New York Notes.

NEW YORK, Sept. 19.—The Rapid Transit commissioners have at last given up their summer outings, and now seem more inclined to settle down to work and give to the public something definite in regard to the construction of the Broadway line. The reports of the four consulting engineers have been handed in, but no immediate decision will be given. Mr. Steinway said that the reports received had given the commissioners much important light upon the rapid transit problem, and that they would be of great value in deciding upon methods of construction. Daily sessions will begin next Tuesday for the consideration of the reports, and perhaps by the end of the week some of the plans may be made public. The two plans under consideration are those of W. E. Worthen and W. B. Parsons, the former's plan involving the construction of four tracks on one level, and the latter's favoring double decked tunnels, with two tracks on each deck. It is probable that a combination of the two plans will be recommended by the commission.

A general meeting of the Telephone Subscribers' Protective association of Baltimore was held in that city on Wednesday to take steps to inaugurate its fall campaign against the Chesapeake & Potomac Telephone company. It will make its main contest before the legislature, and in the meanwhile will do all it can to decrease the number of telephones in use in the city. The contest is over an increase of price for telephone service.

David G. Weems of rapid transit fame will have to look to his laurels. The New York Central railroad has made a trip from this city to Buffalo, upon which a mile was run inside of fifty seconds. It is intended to provide a swift service for travel, and it is expected that this company will run the fastest train in the world. It is to average at least 55 miles an hour for about 441 miles.

The scheme which was proposed some time ago for electric street railways which shall open up the interior of Staten Island is rapidly taking shape. It is stated that the old bankrupt Staten Island Belt Line street railway will soon be equipped with the electric system.

At the opening of the Brooklyn Jockey club races at Gravesend on Monday a very curious spectacle was witnessed in the war between the race-track keepers and the Western Union Telegraph company, which was actively endeavoring to get the news for the pool-sellers in the city. All imaginable sorts of devices and signs were brought into play in order to convey to confederates outside the results of each race as it was run. The results of some races were sent away from the tracks by carrier pigeons, others by motions made with palm-leaf fans and straw hats. Pinkerton's detectives were kept very busy looking out for the many dodges and games which were being worked upon the Jockey club officials. The Jockey club came out ahead, though.

The fifty-ninth meeting of the American Institute of Electrical Engineers, and the first of the present season, will be held at 12 West Thirty-first street, New York, on next Tuesday evening. A paper will be presented by Prof. Harris J. Ryan of Cornell University, "On the Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo-electric Machinery."

A great many novel things emanate from New York, but an incident of life in this great city that occurred on last Monday is of more than usual interest. The story is interesting. Not because it was about an employe of an electrical company, the Mutual District Telegraph company, but because it was about a messenger boy who was different from all other messenger boys. Christopher Murphy is his name, and the tale should go on record in a Chicago paper, for such boys usually turn up sooner or later in a western city.

Murphy was sent to cash a check, and return with the money. There are two villains in the story, and these accosted the lad as he entered the bank. "What have you got there, sonny?" asked one of the suspicious-looking gentlemen. "Oh, I've got a balloon. What did you think I had?"

This was the first chapter.

In the second Murphy is attacked and robbed.

But the future Chicagoan makes his mark in the last. Accompanied by one of Inspector Byrnes' staff, the boy pursued the villains and brought them to justice.

Somebody said the telegraph company would reward Murphy, but there is no authentic information relative to the correctness of the rumor. F. L. P.

PERSONAL.

W. P. Swarts, M. E., for several years with Fraser & Chalmers, Chicago, is now general superintendent of the New Jersey and Pennsylvania Concentrating Works at Ogden, N. J.

The friends of Harry W. Turner, manager of the Helena, Mont., office of the Northwest Thomson-Houston Electric company, are congratulating him on his marriage to Miss Mamie N. LeBeau, which occurred on September 7th in St. Paul, Minn. Mr. and Mrs. Turner will make their home in Helena.

NEW INCORPORATIONS.

Electric Construction company, Roanoke, Va.; capital stock, $300,000; electric railway construction.

Peninsular Electric Light and Power company, Newport News, Va.; capital stock, $100,000; electric light and motor power.

Oswego Electrical company, Oswego, Kan.; capital stock, $50,000; to supply light and heat by electricity through or by electrical appliances.

Algiers Ice Manufacturing company, New Orleans, La.; capital stock, $50,000; to manufacture ice and operate waterworks and electric lights.

Harvard Electric Light and Power company, Harvard, Ill.; capital stock, $15,000; furnishing electric light, heat and power; A. E. Young, Harvard, Ill.

Fredonia Electric Light, Heat and Power company, Fredonia, N. Y.; capital stock, $30,000; manufacture and use electricity for light, heat and power.

Rowe Manufacturing company, Portland, Me.; capital stock, $500,000; to manufacture and deal in electric lamps of all kinds; Clarence Hale, Portland, Me.

Field's Electric Light company, Morris, Ill.; capital stock, $15,000; to furnish electric light to the inhabitants of the city of Morris; E. L. Clover, Morris, Ill.

Kensington Electric Street Railway company, Kensington, Allegheny county, Pa.; capital stock, $12,000; operating a street railway; Henry Alles, Pittsburg, Pa.

Shawnee and Stratisville Light company, Shawnee, Ohio; capital stock, $25,000; furnishing electricity for light, heat and power; D. L. Sleeper, Athens, Ohio.

Madisonville Electric Light and Power company, Madisonville, Ohio; capital stock, $30,000; furnishing electric light, heat and power; F. R. Lindsley, Cincinnati, Ohio.

Carthage Electric Light & Power company, Carthage, Ill.; capital stock, $10,000; to purchase, erect, maintain and operate an electric light and power plant; John F. Scott, Carthage, Ill.

Dayton Fan and Motor company, Dayton, Ohio; capital stock, $20,000; manufacturing, purchasing, selling and dealing in ventilating fans, water and electric motors, etc.; W. Belville, Dayton, Ohio.

People's Gas and Electric company, Chillicothe, Mo.; capital stock, $50,000; to locate, construct, purchase and maintain gas and electric works in the city of Chillicothe; S. B. Hovey, Chillicothe, Mo.

Randall Street & Electric Car Manufacturing company, Kittery, Me.; capital stock, $50,000; manufacturing and dealing in street and electric railway cars; William F. Miller, 13 Doane street, Boston, Mass.

Portsmouth Electric and Power company, Portsmouth, Ohio; capital stock, $10,000; constructing and operating a street railway and furnishing electrical power in Portsmouth; Floyd L. Smith, Portsmouth, Ohio.

Defiance Light and Power company, Defiance, Ohio,; capital stock, $100,000; supplying gas and electricity for fuel, light and power; constructing an electric street railroad, etc.; W. H. Hubbard, Defiance, Ohio.

J. C. Chambers Electric Sanitarium and Supply company, Detroit, Mich.; capital stock, $50,000; manufacture and sale of electrical, medical and surgical supplies and appliances; J. C. Chambers, Detroit, Mich.

Waterloo Electric Light and Power company, East St. Louis, Ill.; capital stock, $10,000; build and maintain an electric light and power plant and waterworks in Waterloo, Ill.; Daniel Noyes Kirby, 421 Olive street, St. Louis, Mo.

Elgin Electric Heating company, Elgin, Ill.; capital stock, $10,000; to manufacture machinery, implements and apparatus for applying heat for mechanical purposes and heating by electricity; Botsford & Wayne, Elgin, Ill.

Dow Adjustable Light company, Boston, Mass.; capital stock, $5,000; to manufacture, buy, sell and deal in adjustable drop lights, electrical appliances, mechanical appliances, mechanical and artistic novelties and useful productions.

Thomson-Houston Electric Light and Power company, Sharon, Mercer county, Pa.; capital stock, $30 000; manufacturing and supplying light, heat and power, etc., to the borough of Sharon, Mercer county, Pa.; A. W. Williams, Sharon, Pa.

Holekamp, Grady & Moore Instrument company, St. Louis, Mo.; capital stock, $10,000; to manufacture and deal in physicians' supplies, surgical and electrical instruments, etc.; Rudolph Schulenburg, Sixth and Market streets, St. Louis, Mo.

City of Oklahoma Light, Manufacturing, Canal and Water Power company, Jersey City, N. J.; capital stock, $150,000; to manufacture light and either illuminating or heating gas; Frank L. Clark, 43 Montgomery street, Jersey City, N. J.

Washington Illuminating company, Washington, Ia.; capital stock, $50,000; operating gas and electric light plant in Washington, Ia.; E. E. Everson, Washington, Ia.

Citizens' Electric Street Railway company, Zanesville, Ohio; capital stock, $150,000; constructing and operating a street railroad in Zanesville and vicinity, to be operated by any motive power selected by the company; R. H. McFarland, Zanesville, Ohio.

ELECTRIC LIGHT.

An electric light plant is talked of at Towson, Md.

It is proposed to put an electric light plant in the capitol building at Charleston, W. Va.

Contract has been let for the erection of a building for the city electric lighting plant of Wheeling, W. Va.

Wires have already been laid down by the Siam Electric Light company in Bangkok, and it is reported that the arrangemgents for lighting will shortly be completed.

The Watsonville, Cal., Electric Light & Water company will increase its plant by purchasing a Thomson-Houston 650 light incandescent machine and an engine and boiler of 50 horse power capacity.

Comptroller May has notified City Electrician Barrett of Chicago that the part of the city appropriation set aside for extending electric lights is exhausted, and that no more posts can be put up until more money can be had.

The Newnan, Ga., Light & Power company has closed contracts for an Edison plant with capacity for 600 incandescent and 40 arc lights. The company has a 15 year contract to light the city at not less than $2,800 per year.

St. John, N. B., is said to be the most brilliantly lighted city in Canada. There are five central stations, employing the Thomson-Houston, Brush, Fort Wayne and Edison systems. The rates are low, and electric lights are very generally used. The city corporation has also a plant of its own.

It is worthy of note that naval search lights of French make hold the highest rank the world over and command an almost exclusive use in all the great navies. The famous firm of Sautter, Lemonnier & Co., of Paris has ceased to exist in name, although its successor, Sautter, Harle & Co., maintains its reputation. This firm has sent to the exhibition at Moscow the most important collection on view in the section devoted to electricity and its application.

According to the *Buffalo Courier*, James F. McElroy of Albany, N. Y., has devised a new dynamo for train lighting. This machine is designed for attachment to the forward axle of a locomotive, current being supplied from secondary batteries when the train is stationary. It is claimed that the whole machine will not weigh over 300 pounds, and will be completely incased in an iron jacket, so that snow, rain, or dust will have no effect on it. It will run for weeks, it is said, without any attention whatever, and will require only a little oiling occasionally.

ELECTRIC RAILWAYS.

Operations will begin soon for the erection of an electric road at Kokomo, Ind.

It is stated that an electric road will be built between Carrollton and Sparta, Ky.

The North and South street railway of Rome, Ga., will, it is reported, be changed to the electric system.

The Austin, Tex., Rapid Transit Railway company has increased its capital stock from $200,000 to $350,000.

The people of Cairo, Ill., are greatly pleased with their new electric railway, which is operated on the Westinghouse system.

It is said that the cable cars of San Diego, Cal., are supplied with electric push buttons, by which the gripman is notified when to stop.

The Baltimore Union Passenger Railway company has, it is stated, completed the equipping of two miles of its road with the Thomson-Houston electric system.

The North Baltimore Passenger Railway company has, it is stated, secured the entire line of the Powhatan street railway, and proposes operating part of the road by electricity.

The Market Square and South Side railway of Knoxville, Tenn., is to be extended to Middlebrook Park, a distance of five miles. Electricity will be used as the motive power.

The New Orleans & Carrollton Railroad company will again petition the city council of New Orleans for a franchise to operate its Carrollton line by the overhead electric system.

The Chattanooga, Tenn., & Northside Street Railway company has, it is stated, commenced the extension of its electrical railroad to the foot of Walden's Ridge at Morrison Springs.

The survey of the proposed electric road from Ione City, Cal., to Sutter Creek, a distance of twelve miles, has just been completed. This line will connect all the principal towns along the "mother lode" in Amador county.

In answer to the recent demand of the citizens in the West End, Pittsburg, an electric road is to be built from that section to the heart of the city. It is expected that

large suburban district.

very proud of that city's electric railway system. To a

Transit Railway company, of Dandridge, Tenn., has been chartered with W. F. Park, president; J. D. Robinson, of Knoxville, general manager, and C. C. Willis, engineer.

menced surveying the route. The road will, it is understood, be operated by electricity. The capital stock is $200,000.

the eight months ended July 1, 1891, has been issued by the Rochester, N. Y., Railway company. From the records it appears that in the eight months three cars cost nothing for repairs; 33 cars cost less than $5. each, averaging $2.49; 16 cars cost between $5 and $10, averaging $6.90; three cars cost between $10 and $15, averaging $12.92; seven cars cost between $15 and $20, averaging $17.05; 2 cars cost between $20 and $25, averaging $22.02; 4 cars cost between $25 and $30, averaging $27.11, and 3 cars cost over $30, averaging $36.72. The average of the repairs properly chargeable to cars is $8.97 or $.0009 per car mile. The cost of material is $21 46 per car or $.0022. This is a remarkable record, and is creditable alike to the Short company, whose system is used, and to the Rochester Railway company.

Theodore Bacon, a leading member of the bar at Rochester, N. Y., and a member of the famous Bacon family of Connecticut, had this to say of electric railways in France to a Rochester *Post-Express* reporter: 'One is at Bresse. It is half a mile long and has one car, which is run by a storage battery. The road is experimental in character and does no business worth mentioning. The other road that I saw is a beautifully equipped and largely patronized one at Cleremont-Ferrand in the province of Auvergne. It employs the overhead system and extends to two of the suburbs. The gauge is narrower than that of our roads and the cars are shorter and lighter. It differs from our system in many respects, but the differences for the most part are too technical to be of interest to any one but a specialist." Mr. Bacon, it may be mentioned, is a member of the same law firm as John N. Beckley, the newly elected president of the New York State Street Railway association.

Following is a list of the roads equipped entirely or in part by the Short Electric Railway company, of Cleveland, O.: Watervliet Turnpike & Ry. Co., Albany, N. Y.; Battle Creek Street Ry. Co., Battle Creek, Mich.; Braddock Electric Ry. Co., Braddock, Pa.; Bristol Belt Line Ry. Co., Bristol, Tenn.; Coney Island & Brooklyn R. R. Co., Brooklyn, N. Y.; Broadway & Newburg Street R. R. Co., Cleveland, O.; Brooklyn Street R. R. Co., Cleveland, O.; South Covington & Cincinnati Street Ry. Co., Covington, Ky., Georgetown & Tenallytown Ry. Co. Georgetown, D. C.; Harvey Transit company, Harvey, Ill.; Fred T. Evans, Hot Springs, S. Dak.; Huntington Electric Light & Street Ry. Co., Huntington, W. Va.; Citizens' Street R. R. Co., Indianapolis, Ind.; Jamestown Street Ry. Co., Jamestown, N. Y.; Johnstown Passenger Railway company, Johnstown, Pa.; Lincoln Street Ry. Co., Lincoln, Neb.; Central Passenger Railway Co., Louisville, Ky.; Muskegon Railway Co., Muskegon, Mich.; Pittsburg & Birmingham Traction Co., Pittsburg, Pa.; Pittsburg Traction company, Pittsburg, Pa.; Schuylkill Electric Railway company, Pottsville, Pa.; Rochester Electric Railway Co., Rochester, N. Y.; Rochester Railway company, Rochester, N. Y.; West End Street Railway company, Rockford, Ill.; Lindell Railway company, St. Louis, Mo.; Wilkesbarre & Wyoming Valley Traction Co., Wilkesbarre, Pa.

TELEGRAPH.

At the last meeting of the Western Union directors a regular dividend of 1¼ per cent. was declared. The report for the quarter showed an estimated surplus of $680,207, with a total surplus of $12,097 948. C. P. Huntington, who rarely appears at these gatherings, was present.

The United States steamer Albatross will at once proceed to make surveys for a cable from San Francisco to Honolulu. In view of the unsettled condition of affairs on the Hawaiian Islands the need of telegraphic communication with San

It is reported from Halifax, N. S.,

been received from Canso, which stated that the cable between

between the points above mentioned is that owned by the French Atlantic Cable company. The company denies the truth of the statement.

News

assembled at Lung Chow in the Chinese province of Hunan

telegraph

men were driven over the boundary. A society has been

the watch. Great apprehension is felt by the inhabitants of the border districts in Hupei.

According to

[illegible] for [illegible] and costs for the non-delivery of a telegram [illegible] Union company. The plaintiff gave a dinner party and supplemented one of his invitations by a telegraphic notification of the hour. The guest [illegible] and explained the fact by stating that he had not received the message. The suit against the company resulted.

TRADE NEWS.

Catalogue No. 1 of Post & Co., 215 and 217 West Fourth street, Cincinnati, manufacturers of and dealers in electrical supplies, is useful, comprehensive and conveniently gotten up.

The New York Insulated Wire company, through Geo. H. Meeker, its western manager, is now shipping from its store, 78, 80, 82 Franklin street, quantities of Vulca wire ducts, elbows, couplings, and the well known Grimshaw white core wires, etc.

F. P. Little & Co., Buffalo, have just closed a contract with the "Broezel" House of that city for wiring for 800 lights, including two arcs, two Thomson-Houston dynamos, 300 and 500 lights capacity, one 30 and one 50 horse power Rice automatic engine, with the construction of the plant complete.

The Gould Manufacturing company, Seneca Falls, N. Y., has issued a new catalogue of triplex electric pumps and applications of electrical pumping. This is not presented as a complete treatise, but is intended to embody a representation of this company's standard triplex electric pumps and their most common applications. Attention is called to tables of tests of triplex electric pumps and motors showing actual power consumed, relative efficiency, etc., under different operating conditions.

A branch office of the Electric Gas Lighting company of Boston has been opened at room 20 Lakeside building, Chicago. Charles E. Lee, formerly with the Great Western Electric Supply company and well known to the trade in the West, will have charge of the office. The specialties of the company include its own electric gas lighting apparatus, the Tirrell gravity drop and the new Hub needle annunciators, the Victor, Champion, Standard and Success electric bells, and a general line of electrical supplies, including the Samson (French) battery, which is said to be the most powerful and enduring open circuit battery in the world. Mr. Lee will gladly answer all inquiries made in person or by letter.

There are but few electrical men now-a-days who do not use the typewriter to a greater or less extent. It has become a necessity in almost every office, and as a matter of course the appearance in the market of a new machine excites interest. It has been known for a considerable time that the Merritt Manufacturing company of Springfield, Mass., was experimenting with a new type of machine, which was intended to retain most of the advantages of the pioneers in the field, while such defects as had been developed in practical operation were avoided. The moving spirit in the new enterprise was known to be the Densmore family, which in the early history of the Remington machine, and one or two of its rivals, had taken an important part in aiding very materially the development of the typewriter idea. The Densmore machine is in fact an evolution, a first cousin, so to speak, of the Remington. It has the same style of key-board, including the double letter arrangement, or "upper-case shift." The letters are arranged practically the same, while the letter and line-spacing devices are similar. This typewriter is also made with the Caligraph style of key-board, to accommodate those who are accustomed to that machine, the only difference in the machines being in the size and shape of the frame, and the length of the type bars. There are, however, [illegible] the machine a good many new devices and radical departures, which cannot here be specified in detail, but are nevertheless worthy of a careful [illegible].

BUSINESS.

The Star Iron Tower company of Fort Wayne, Ind., [illegible] Grand Rapids, Mich.

[illegible] Rookery, Chicago, the [illegible] H. T. Paiste of Philadelphia, [illegible] Manufacturing company, Windsor, Conn., have tastefully decorated their office with [illegible] a handsome [illegible] Washington street. On the West Side the firm has a large ware-[illegible]

[illegible]

ELECTRICAL PATENTS.

459,013. Telegraphic Transmitting Apparatus. Morris Martin, Malden, Mass.

459,024. Mounting for Motors of Electric Cars. Sidney H. Short, Cleveland, O.

459,070. Electrically Heated Wristband Ironer. Willis Mitchell, Malden, Mass.

459,088. Electric Light Fixture. Edwin T. Greenfield, New York, N. Y.

459,100. Incandescent Electric Lamp. Edward P. Roberts, Cleveland, O.

459,089. Insect Guard for Bedsteads. Adolph Muller, Adorf, Ger.

459,090. Controlling Mechanism. Charles P. Pratt, New York, N. Y.

459,091. Mechanism for Dampers or Similar Valves. John V. Stout, Easton, Pa.

459,127. Electrode for Chairs. George W. Overall, Memphis, Tenn.

459,143. Electro Therapeutic Truss. Hugh W. Matthews, Chicago, Ill.

459,144. Electro Therapeutic Belt. Hugh W. Matthews, Chicago, Ill.

459,168. Support for Electric Conductors. George H. Winslow, Pittsburg, Pa.

459,205. Telephone Receiver. James H. Howard, Medford, Mass.

459,213. Hook or Crotch for Telephone Receivers. James H. Howard, Medford, Mass.

459,214. Telephone. James H. Howard, Medford, Mass.

459,219. Electric Switch. Lewis D. Castor, Philadelphia, Pa.

459,222. Electrically Operated Brush. Frederick A. Lehmann, Washington, D. C.

459,229. Electric Elevator. Harry H. Blades, Detroit, Mich.

459,236. Process of Purifying Brine. Caleb G. Collins, Kearney, N. J.

459,266. Hanger for Incandescent Lamps. Paul J. Chassagne, Akron, O.

459,321. Fuse and Detonator. P. Ward and E. M. Gregory, London, Eng.

459,323. Electric Contact Apparatus. Christian Weuste, Duisburg, Ger.

459,366. Armature for Dynamo-Electric Machines or Motors. Robert Lundell, Brooklyn, N. Y.

459,267. Commutator Brush and Holder. Robert Lundell, New York, N. Y.

459,368. Commutator Cylinder and Method of Making the Same. Robert Lundell, New York, N. Y.

459,378. Electric Conductor. Edwin D. McCracken, Alpine, N. J.

459,385. Flexible Electric Conductor. Hosea W. Libbey, Boston, Mass.

459,422. Dynamo Electric Machine and Motor. Elihu Thomson, Lynn, Mass.

This invention relates to a construction of field magnet and armature cores for dynamo electric machines or motors, and the [illegible] of the invention is to secure the advantage of directing the magnetism through the field-core or through both together in such a way that the line of magnetic force shall pass in a direction more nearly diametrically across the armature, and be less subject to diversion from this course by the circulation of currents in the wire around the armature-core than has hitherto been the case in such machinery.

459,423. System of Electrical Distribution. Elihu Thomson, Lynn, Mass.

The principal object sought to be secured by this invention is virtually a changed relation of the effectiveness of the two armature windings, which are inductively related to each other on the core. These armature windings normally would bear a relation which would produce a certain potential in one circuit from a given potential in another circuit; but under load these relations would have to be varied somewhat, in order to compensate for the drop in potential both in the machine itself and in the mains. Thus, for example, should the windings be of equal potential or of equal effective length under certain conditions, when the conditions of load were changed these windings should become of greater or less effective length relatively one to the other, and this cannot of course be done by adding sections of wire. It must be done by adding magnetic value to one winding and not to the other or reversing a magnet [illegible] which has been operating one direction on one of the windings.

459,425. Motor Car Fender. Edward Tiemann, Chicago, Ill.

459,442. Till Alarm. Henry Garrett, Dallas, Tex.

459,447. Fibrous Carbon Battery. James H. Robertson, Ruthford, N. J.

[illegible]

459,447. Telegraph Apparatus. William E. Sloan, John J. Hughes, Orrin S. Reed, Chicago, Ill.

459,465. Electric Switch. Boyd W. Allen, Boston, Mass.

[illegible]

[illegible] Trolley Wire Connection. Robert J. Caldwell, [illegible]

[illegible] Method of Making Plates for Secondary Batteries. [illegible] Philadelphia, Pa.

459,508. Dynamo-Electric Generator or Motor. John [illegible], Mo.

[illegible]

459,509. Conduit for Electric Wires. Henry W. Johns, New York, N. Y.

This invention relates to a new and useful insulating tube or conduit for electric wires intended especially for interior work, and it consists in making a seamless flexible braided, knitted or woven tube of a fireproof material, and so treating it that it shall be water-proof, and preferably lining and covering it on the inside and outside, one or both, so that the wires may be easily introduced, and also that the exterior may be hard and firm, presenting a surface which may be readily painted or otherwise decorated.

459,510. Electric Arc Lamp. Edward R. Knowles, Brooklyn, N. Y.

This invention relates to improvements in electric arc lamps of the class which is universal in its application—that is to say, lamps which are practically and efficiently operative on either an arc, an incandescent or alternating current circuit, as commonly known, or, in other words, what is electrically known as direct and alternating current circuits.

459,514. Incandescent Electric Lamp Socket. John O. Phillips, New York, N. Y.

459,523. Cable Box for Electric Wires. Jasper N. Keller, Newton, Mass., John A. McCoy, Somerville, Mass.

459,535. Secondary Battery. Wm. L. Silvey, Lima, O.

459,536. Method of Manufacturing Hose. Chas. F. Simon, Bristol, R. I.

459,560. Cut out. Frank Bryan, London, England.

459,572. Commutator-Turning Device. Arthur K. Bonta, Hoboken, N. J.

459,588. Trolley Wheel. George E. Lewis, Seneca Falls, N. Y.

459,591. Electric Alarm System. John P. McMahon, Jersey City, N. J.

The essential parts of the system are, first, a main circuit having grounded branches in the protected building and in the central office with suitable receiving instruments, which may be in the central office; second, a signal box located at the building protected; third, a circuit controller which may be of the push button or other similar type of thermostats, such as are shown in this patent; fourth, the system of wires connecting the circuit controllers with the signal box and with the central office.

459,596. Mineral Drilling Machine. Elmer A. Sperry, Chicago, Ill.

459,605. Electric Push. John F. Wollensak, Chicago, Ill.

459,610. Dynamo-electric Machine. Edmond Desroziers, Paris, France.

The object of this invention is to produce an armature for multipolar dynamo-electric machines either of the disk or drum form.

459,615. Annunciator. Foster Ritche, Highland Park, Ill.

459,633. Railway Signal. Henry C. Horstmann, Naperville, Ill.

The object of this invention is to provide a new and improved electric signal for railway block systems arranged in such a manner that a train entering a block causes the display of visiable signals throughout the entire block, the signals indicating the direction of the train.

459,663. Apparatus for Working Punkas. Henry E. Walter of London, England.

Claim one reads:

"The combination of a pendulum, a punka connected therewith, an electro-magnet, a toothed arc of magnetic metal with its teeth in proximity to the magnet poles, and contact mechanism for completing a circuit through the coils of the electro-magnet as the magnet poles approach the summits of the teeth, and for breaking the circuit as the poles are receding from them."

459,678. Electric Motor. John W. Davis, J. B. Farrington, New York, N. Y.

459,681. Electric Belt. Christian H. Dorenwend, Toronto, Canada.

459,686. Insulator. Clarence L. Gerrard, Columbus, Neb.

This invention relates generally to insulators, and more particularly to trolley wire insulators for electric railways.

459,689. Slide-Shoe Trolley. Sidney H Short, Cleveland, O.

459,690. Rheostat for Electric Motor Cars. Sidney H. Short, Cleveland, O.

This invention relates to the construction and arrangement on the car of the rheostat or resistances, of which more or less is brought into circuit through the instrumentality of a contact-board for regulating the intensity of the current supplied to the propelling motor or motors.

459,704. Electric Fixture. Edwin T. Greenfield, New York, N. Y.

This invention is directed particularly to improvements in switch [illegible] which are used in the art for connecting electric lights and kindred translating devices to branch mains running into buildings and similar places.

459,705. Electric Light Fixtures. Edwin T. Greenfield, New York, N. Y.

This invention is directed particularly to switch devices for use in connection with electric light and analogous electric circuits, and is designed to take the place of the ordinary well-known form of key switch, such as is found in general use in connection with incandescent electric lamps.

459,706. Electric Snap-Switch. Gerald W. Hart, Kansas City, Mo.

459,711. Fastener for Spring Jacks of Switch-Boards. Charles E. Scribner, Chicago, Ill.

459,721. Safety Cut-out for Overhead Wires. Nicholas Froloff and Wm. Subbotin, Boston, Mass.

This invention relates to trolley wires and the means for supplying the same with an electric current, the object being to so connect the trolley-wire with the supply-wire that in the occurrence of a break in the trolley-wire there will be no leakage of electricity, nor will there be any interruption in the flow of the current to the trolley-wire due to such break at any point other than the point of fracture [illegible] each side of such point, nor will there be any danger of [illegible] due to the falling of a live wire.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used. Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the Boston Fire Underwriter's Union, under date of March 29, 1886, he says: "A Thoroughly Reliable and Desirable Wire in Every Respect."

The rubber used in insulating our wires and cables is specially chemically prepared, and is Guaranteed to be waterproof and will not deteriorate, oxidize or crack and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid, an 1 to a very great extent, fire proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS.

4 LaSalle Avenue, Chicago.

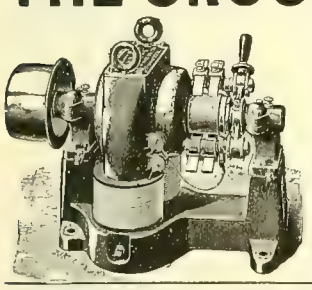
☞Write us for Prices.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

G. A. HARTER, Manager. Telephone, 1718.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

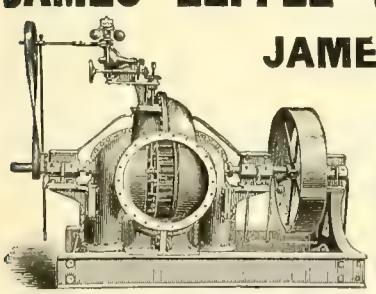
Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.



UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

RECEIVER'S SALE. — Thomson-Houston Electric Light company et al. vs. the Hughes & Gawthrop company et al. No. 866, June term, 1891.

In pursuance of a decree of the court of common pleas No. 1 of Allegheny county, made in the 29th day of August, 1891, in the above entitled case, the undersigned, receiver of the Hughes & Gawthrop company, will expose to public sale at the office of said company, corner of Fifth Ave. and Market St., in the city of Pittsburgh, Pa., on Thursday, September 24, 1891, at 10 o'clock A. M., all the property of defendant company (except accounts, bills receivable and contracts in course of completion) in manner following: 1st, Office furniture and fixtures separately; 2d, all supplies and materials connected with annunciator and bell work in bulk; 3d, all supplies and material connected with and used in arc and incandescent lighting in bulk. Terms cash. For further particulars inquire of S. M. HAMILL, Receiver, Hughes & Hacke Building, Fifth Ave. and Market St., Pittsburgh, Pa., or GEO. P. HAMILTON, his Attorney, 119 Fourth Av.

SITUATION WANTED.

Wanted: Position as [illegible] in electric station. Six years' experience in the business as electrician and engineer and in the building of machinery and in construction work. The best of references. Address "H. S. E.," Care WESTERN ELECTRICIAN.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician.

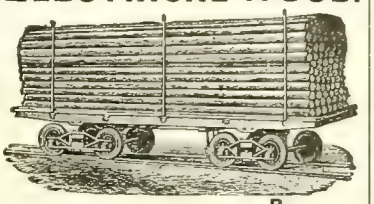
50 N. Clinton St., Chicago.

Experimental Work in Anything Electrical.

FREEMAN, COLEMAN & CO.,

53 and 55 South Jefferson Street, - - CHICAGO, ILL.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS POLES ARMS

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. 136 Liberty St., NEW YORK.

The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N.Y.**

REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

"MAGNETIC VANE"

AMMETERS AND VOLTMETERS

ARE THE BEST INSTRUMENTS FOR

Central Stations, Isolated Plants,

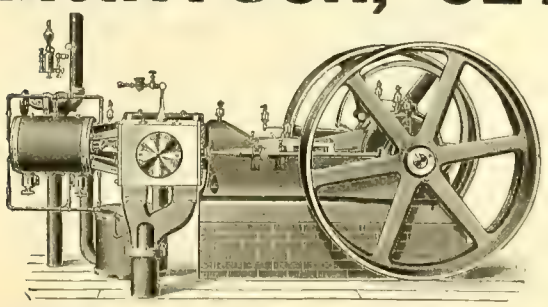
Marine Installations, Electric Railways

Correspondence Solicited.

Send for Illustrated Circular 235.

QUEEN & CO., PHILADELPHIA.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

SIZE.	H. P. OF EACH ENGINE.	DESTINATION.
One 12½x12	80	Edison General Electric Co., Groton, N. Y.
Two 18½x17	300	Gloucester Street Railway Co., Gloucester, Mass.
One 13 and 23x17	240	T.-H. International Electric Co., Rio Janeiro, Brazil
One 11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One 13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One 11 and 19x15	150	Lawrence, Mass.
Two 13 and 23x17	240	Lawrence, Mass.
One 13 and 23x17	240	Fall River, Mass.
One 8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One 13 and 19x15	150	G. A. Rollins & Co., Chicago, Ill.
One 15 and 23x17	325	Somerville Electric Light Co., Somerville, Mass.
One 13x15	100	A. G. Weeks, Boston, Mass.
One 14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One 18½x18	200	T.-H. Int. Elec. Co., Leeds, England.
One 8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two 9½x10½	45	Presbyterian Hospital, New York City.
One 23x19	500	Chicago Edison Co., Chicago, Ill.
One 11 and 19x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One 11 and 19x15	150	Fritz Wilen, Helsingfors, Finland.
One 16x15	150	T.-H. Electric Co., Boston, Mass.
Two 14½x15	125	Cortland Forging Co., Cortland, N. Y.
One 13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One 15 and 26x17	400	Baltimore Electric Reduing Co., Baltimore, Md.
One 14½ and 23x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, 339 Rookery Bldg., CHICAGO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.
No. 180 MAIN St.
FITCHBURG, MASS, U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

LINK BELTS FOR DYNAMOS.

CHICAGO, May 7, 1891.

PAGE BELTING COMPANY.

GENTLEMEN:—We desire to express to you our unbounded appreciation of the good qualities of your Acme Link Leather Belting, furnished us in August, 1890.

We have been using the two 13 inch as drive belts constantly since you placed them on the pulleys and they have fulfilled our greatest expectations. The two 8 inch and two 6 inch belts same style), which you furnished us to drive our Dynamos, have also performed their duties in a highly satisfactory manner, and we are satisfied that they are giving us one third more power than the ordinary flat belting would develop under same conditions. We hand you this letter thinking it might be of some use to you in further introducing the Acme Link Belting. We shall take pleasure in showing your belts in actual operation to any one interested, and can only say in conclusion, that we consider this belting superior to any other now in the market.

HANNAH & HOGG

Made only by PAGE BELTING CO., Concord, N. H.

BRANCHES:

New York, Boston, Chicago, San Francisco.

If you wish to use electricity for any purpose whatever, write us for full information.

ROOM 422

Electrical Exchange Building,

NEW YORK CITY.

Manufacturers of

OCTAGONAL AND CEDAR

TELEPHONE & ELECTRICAL

RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

BINDERS

—FOR THE—

WESTERN ELECTRICIAN,

ONE DOLLAR.

73-75 W. Jackson St.

RELIABLE

WE ARE FITTED WITH

RELIABLE Machinery and Tools,

And Employ **RELIABLE** Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.

ELECTRICAL BOOKS

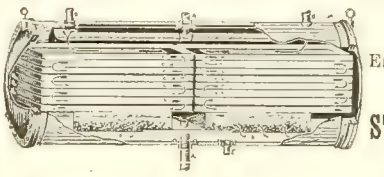
OF ALL KINDS.

Send for Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO, ILL.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

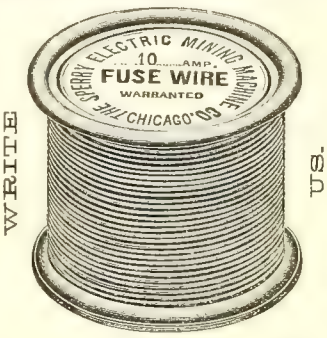
Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EVERYTHING IN

WIRE—FUSE— STRIPS.



MANUFACTURED BY

The Sperry Electric Mining Machine Co.,

39th St. and Stewart Ave., CHICAGO.

ALUMINUM

50 Cents per Pound.

THE COWLES

Electric Smelting & Aluminum Co.,

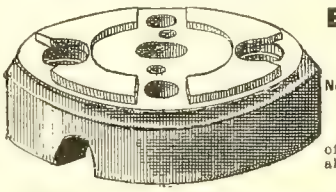
LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum at 50 cents per pound for ton lots in ingots.

Aluminum sheet, wire and castings at lowest market price.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence solicited.



EMPIRE CHINA WORKS,

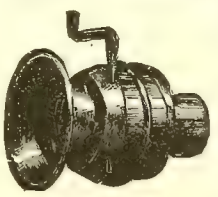
144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

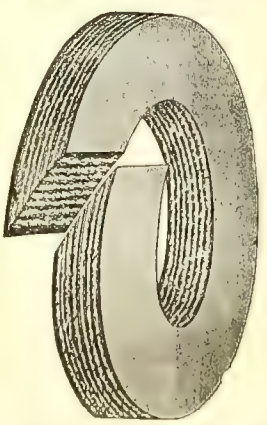
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.



Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

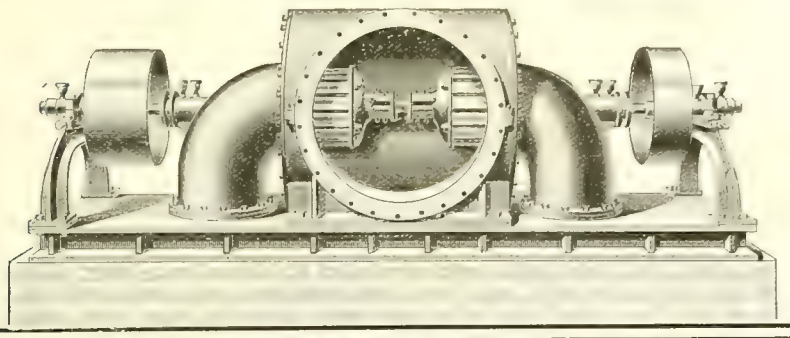
SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

VICTOR TURBINE WATER WHEEL.



The attention of [illegible] CELEBRATED WATER WHEEL [illegible] on account of its remarkably steady motion, high Speed and great Efficiency, [illegible] large Capacity [illegible] diameter, being double the Power [illegible] by number of [illegible] economical [illegible] of useful effect guaranteed.

SEND FOR CATALOGUE AND PARTICULARS

Our Horizontal [illegible] and it can be [illegible] direct [illegible]

The accompanying engraving [illegible] VICTOR TURBINES [illegible] Tubes and Bearing for Shaft [illegible] a substantial cast-in [illegible] strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),

DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

FOR HANDLING

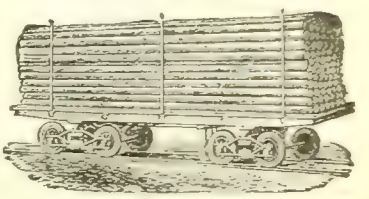
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing. Will carry two different kinds of material in opposite directions at the same time.

Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

VULCANIZED FIBRE CO.

ESTABLISHED 1878.

SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

HIGH EFFICIENCY VS. LONG LIFE.

A GENERAL STATEMENT.

SUNBEAM INC. LAMP CO. SUNBEAM INCANDESCENT LAMP CHICAGO ILLINOIS U. S. A.

Several years ago when the manufacture of incandescent lamps was practically new, it was not an easy matter to make lamps that were at all satisfactory, and all efforts were directed toward making lamps that would give a reasonable good light for as great a number of hours as possible. When by the employment of improved means of manufacture it became possible to make a large number of lamps all giving a reasonably good light, the sole efforts of most manufacturers were given to producing a lamp that would burn the greatest possible number of hours. While some manufacturers may then have understood in a general way that lamps burning an unusually great number of hours could not be the most economical on account of the extra amount of current that would be consumed, it was not considered necessary in order to make sales to produce a lamp of high efficiency. The users of incandescent lamps did not carefully investigate the economies of incandescent lighting and had not a keen appreciation of the greater cost of producing light with a lamp made to last a great number of hours rather than one intended to burn a reasonably long life at a high efficiency. The times have been gradually changing, however, and those advanced in incandescent lighting no longer ask in reference to the life of the lamps, but their whole attention is given to the efficiency, knowing that a lamp that will burn for 5,000 hours cannot possibly be an economical one for their use.

It is our purpose next week to say more in reference to this subject.

IT IS NOT DIFFICULT FOR ANY EXPERIENCED MANUFACTURER OF INCANDESCENT LAMPS TO PRODUCE A "GOOD" LAMP THAT WILL HAVE A LONG LIFE. IT IS MUCH MORE DIFFICULT TO MAKE A "GOOD" LAMP OF HIGH AVERAGE EFFICIENCY. TRUE ECONOMY LIES ENTIRELY IN THE DIRECITON OF THE LATTER.

THE SUNBEAM INCANDESCENT LAMP CO., Chicago, Ill.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

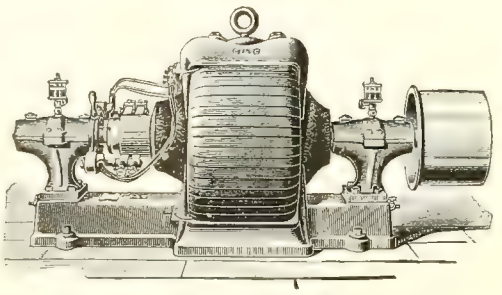
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

"THE PURE SARSAPARILLA."

PERRET DYNAMOS AND MOTORS.

OFFICE OF JERSEY CITY MILLING CO.
MANUFACTURERS OF FLOUR.
542 & 544 Henderson Street.

JERSEY CITY, N. J., August 3d, 1891.

THE ELEKTRON MANUFACTURING CO.

GENTLEMEN:—The dynamo bought of you last February has run up to the present time without any attention whatever beyond oiling it. It is simply perfect. We would not accept a high speed dynamo as a gift after using yours. It is truly "the pure Sarsaparilla." None other can be found like it.

Very truly,
W. R. WATSON, Manager.

THE ELEKTRON MANUFACTURING CO.,

New York Office, 89 Liberty Street. SPRINGFIELD, MASS.

SELLING AGENTS

Washington, D. C., J. U. BURKETT & CO., 1409 N. Y. Avenue.
New Orleans, La., GEORGE BAQUIE, 140 Gravier Street.
Chicago, Ill., THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.
St. Paul, Minn., F. J. RENZ, 95 East 4th Street.
Philadelphia, Pa., PENNSYLVANIA MACHINE CO., 29 North 7th Street.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

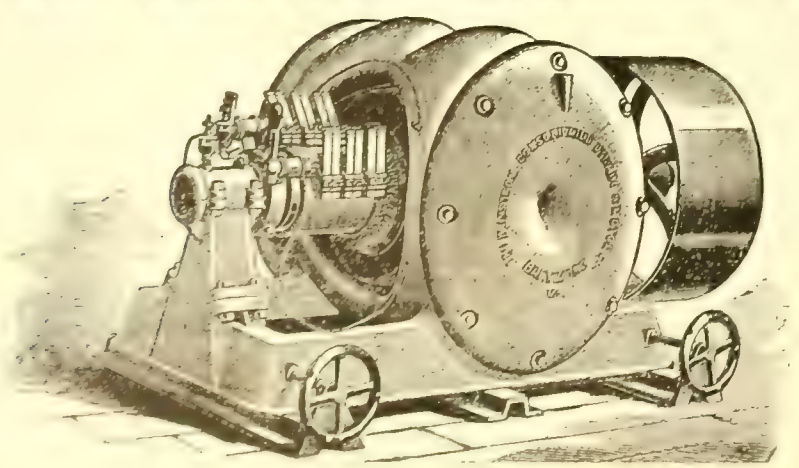
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS

For All Work.

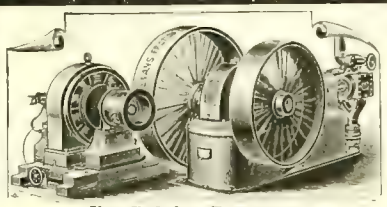
DYNAMOS

For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

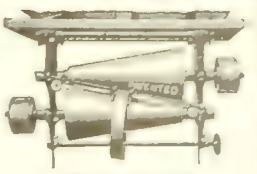


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones, For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | **CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.**

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO, Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make. | **THOS. L. SCOVILL,** New York Agent, 25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus, Electric Motors and Generators,
Alternating Current Apparatus, Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

—GENERAL AGENTS FOR—

ALL PRODUCTS

—OF THE—

THOMSON-HOUSTON ELECTRIC CO.,

—FOR—

Northern Wisconsin,
Minnesota,
North Dakota,
South Dakota,
Montana,
Wyoming,
Idaho,
Washington,
Oregon.

PRINCIPAL OFFICE:

403-405 Sibley Street, St. Paul, Minn.

H. M. BYLLESBY, President. HOWARD C. LEVIS, V.-P. and Treas. B. F. MEEK, Jr., Secy. and Asst. Treas.

GEO. C. DUFFIE, Asst. Secy.

BRANCH OFFICES:

Cor. A and Front Streets, PORTLAND, ORE.
H. W. GOODE, Manager.

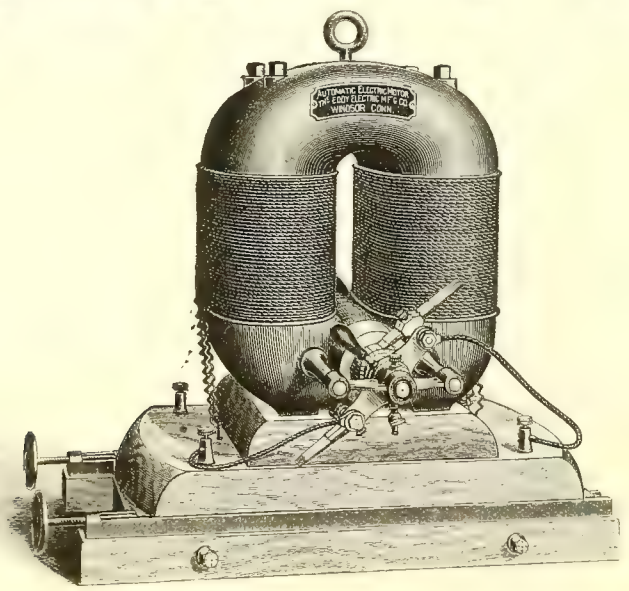
Thompson Block, HELENA, MONT.
H. W. TURNER, Manager.

THE

EDDY ELECTRIC MFG. COMPANY

MAKES A SPECIALTY OF THE COMPLETE EQUIPMENT
OF FACTORIES WITH

ELECTRIC POWER.



EDDY POWER GENERATORS,

ANY SIZE UP TO 300 H. P. AND ANY VOLTAGE.

THE EDDY ELECTRIC MOTOR

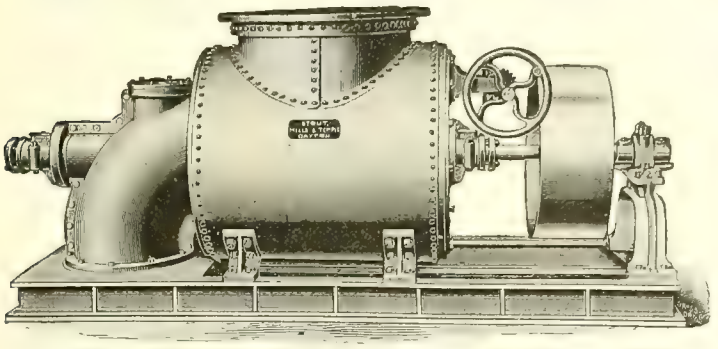
Is Simple, Efficient, Durable, Economical and Always Reliable.

THE EDDY ELECTRIC MFG. CO.,

WINDSOR, CONN.

136 Liberty Street, - NEW YORK.
92 Franklin Street, - - BOSTON.
506 Commerce St., PHILADELPHIA.
341 The Rookery, - - CHICAGO.
Rialto Building, - KANSAS CITY.
413 Jackson Street, - ST. PAUL.
409 West Michigan Street, DULUTH.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

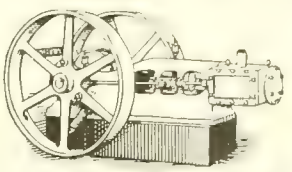
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS' No. 447 North Street, BALTIMORE, MD.

COMPLETED TO DEADWOOD.

The Burlington Route, C. B. & Q. R. R., from Chicago, Peoria and St. Louis, is now completed as far as [illegible] are running through Lincoln, Neb., and Custer, S. D., to Deadwood. Also to Newcastle, Wyoming. Sleeping cars to Deadwood.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES

A FEW PROMINENT MISCELLANEOUS USERS

(Excepting Governments and Railroads).

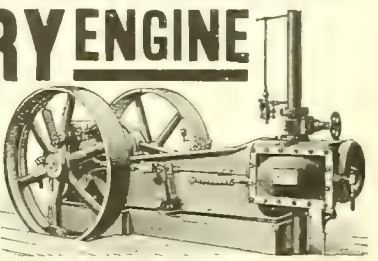
Adams Express Company; Allegheny City Light Plant; Allegheny County Light Company; Anheuser-Busch Brewing Company; Arbuckle Brothers; Ashcroft Manufacturing Company; E. Balbach & Son; Baldwin Locomotive Works; Bowers Dredging Company; Brooks Locomotive Works; Brown & Sharpe Manufacturing Company; Brush Electric Company of Baltimore; Brush Electric Light Company of Buffalo; Burlington Electric Street Railway Company; Calumet & Hecla Mining Company; Cambria Iron Company; Carnegie, Phipps & Company; Cincinnati Gas Light & Coke Company; Coxe Brothers & Company; Crescent Steel Works of Miller, Metcalf & Parkin; Cumberland & Presumpscot Mills, Denver Consolidated Electric Company; Detroit Dry Dock Company, Detroit Electric Light & Power Company; Dunnell Manufacturing Company; East End Electric Light Company of Pittsburgh; Elgin National Watch Company; Federal Street & Pleasant Valley Electric Street Railway Company of Pittsburgh and Allegheny; Forest Paper Company; Gate City Oil Mills; Glen Echo Electric Street Railway Company of Washington; Herkimer Paper Company; Howe, Brown & Company; Illinois Steel Company; Lehigh Avenue Passenger Electric Street Railway Company of Philadelphia; Lombard, Ayres & Company; McConway & Torley Company; McKeesport Electric Light Company; Metropolitan Electric Light Company of London; Missouri Electric Light & Power Company of St. Louis; Muncie Pulp & Paper Company; New England Dredging Company; Newton Paper Company; G. H. Nichols & Company; Ohio Paper Company; Oliver Oil Company; Omaha & Council Bluffs Electric Railway Company; Omaha Electric Street Railway Company; Otis Iron & Steel Company; Pacific Rolling Mill Company; Pencoyd Iron Works; Pennsylvania Steel Company; Philadelphia & Reading Coal and Iron Company; Pittsburgh Locomotive & Car Work; Robert Poole & Son Company; Quaker City Dye Works; St. Charles Car Works; Sawyer-Man Electric Company; Schenectady Locomotive Works; Williams Sellers & Company; Sherman Oil & Cotton Company; Shoenberger & Company; Southern Cotton Oil Company; Claus Spreckels' Sugar Refinery; Tacoma Light & Water Company; Terre Haute Electric Street Railway Company; Union Switch & Signal Company; United Electric Light & Power Company; Vancouver Electric Street Railway & Light Company; Wellman Iron & Steel Company; Westinghouse Air Brake Company; Westinghouse Electric & Manufacturing Company; Wilmington City Electric Street Railway Company.

Over 3000 other users.

THE WESTINGHOUSE MACHINE COMPANY.
BUILDERS & AGENTS PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application. —
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO.
HALF TONE PLATE A SPECIALTY.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

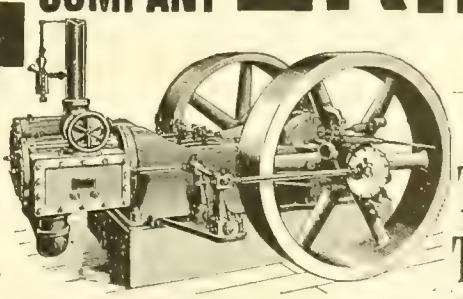
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

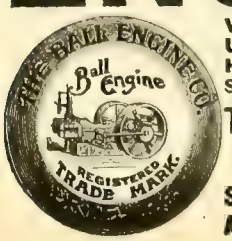
POND ENGINEERING COMPANY,
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound



With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER & CO., 38 South Fourth Street Philadelphia, Pa.; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY Co., Tacoma, Wash.; CROOK, HORNER & CO., Baltimore, Md.; E. G. GILBERT, Atchison, Kan

BRANCH OFFICE, Room 506 Rookery Building, CHICAGO, ILL. ALBERT FISHER, Manager.

A MARVELOUS INNOVATION

THE THOMSON-HOUSTON ELECTRIC COMPANY

HAS REVOLUTIONIZED THE ELECTRICAL EQUIPMENT OF STREET RAILWAYS.

The Intermediate Shaft, Pinion and Gear have been discarded.

The Armature Pinion and Axle Gear are now inclosed in a dust-proof case filled with oil.

Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

The construction of the Armature avoids the possibility of a burn-out, except by malicious carelessness, and when damaged, can be readily repaired by a novice.

Don't make a mistake by contracting for Railway Equipment before seeing or understanding this marvelous machine.

Prices for Repairs, Parts and Supplies materially reduced.

Information, Prices and Literature furnished on application.

THOMSON-HOUSTON ELECTRIC CO.

CHICAGO OFFICE:
148 MICHIGAN AVENUE.

BOSTON OFFICE:
620 ATLANTIC AVENUE.

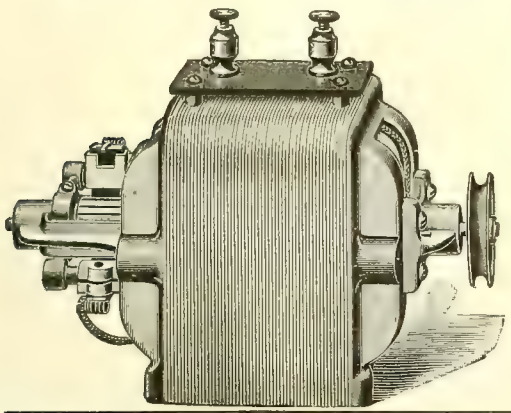
Western Electric Co.,

CHICAGO, NEW YORK, BERLIN, PARIS, ANTWERP, LONDON.

ELECTRIC LIGHTING APPARATUS,
Arc and Incandescent Systems,
Automatic Regulation.

S-U-P-P-L-I-E-S.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer.

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

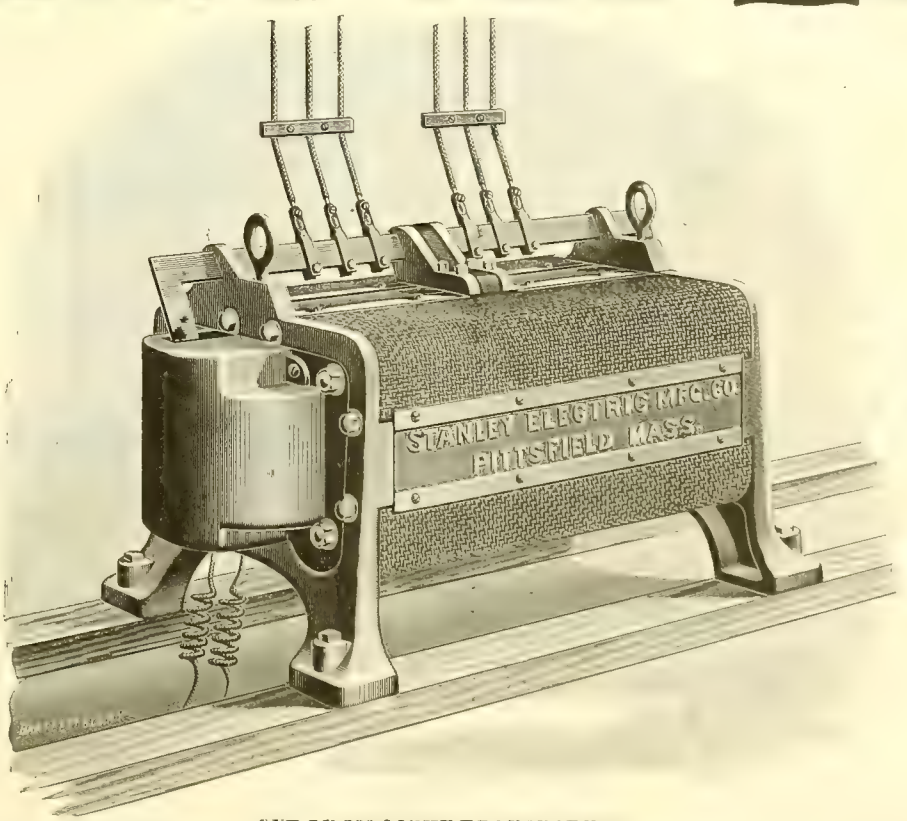
Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

TAKING THE LEAD.

THOUGH ONLY
ON THE
MARKET
—FOR—
SIX MONTHS,
THE
STANLEY
—IS—
NOW KNOWN
—AS—



THE
BEST
Transformer.

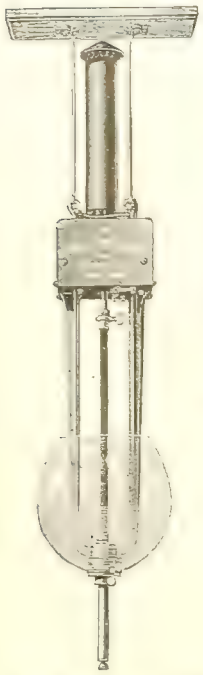
CORRESPONDENCE
SOLICITED.

CUT OF 300 LIGHT TRANSFORMER.

STANLEY ELECTRIC MFG. COMPANY, - - - PITTSFIELD, MASS.

WESTERN AGENTS: The Electrical Supply Co., Corner Randolph St. and Michigan Ave, Chicago, Ill.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

We append a letter from a customer:

CHICAGO EDISON CO.,
139 & 141 Adams St., Chicago, Ill.

Chicago, Ill., Sept. 7, 1891.

ELECTRIC CONSTRUCTION & SUPPLY CO.,
18 Cortlandt Street, New York City.

Gentlemen:—We are using 220 of your arc lamps on our incandescent system. We take pleasure in stating that they are giving us perfect satisfaction, and that the light is equal in power and steadiness to any of the series arc lamps in the city.

CHICAGO EDISON CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building, **CHICAGO, ILL.** Established 1881. Telephone Building, **NEW YORK CITY.**

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.,

— MANUFACTURERS OF —

VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES.

CONCENTRIC CABLES. any millage. FLEXIBLE CORDS. SILK. HEMP. COTTON. DYNAMO WIRES and CABLES. very pliable. Every variety of INCANDESCENT CORES.

HABIRSHAW

RUBBER COVERED.

CABLES AND CORES.

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High Insulation and Long Life, all milage

If you are not acquainted with the merits of Habirshaw Insulation we shall be pleased to send you samples upon application.

W. M. HABIRSHAW, Gen'l Mgr. **OFFICE: 315 Madison Ave., Cor. 42d St., New York.**

FACTORY: Glenwood, Yonkers, N. Y.

WESTERN AGENTS, The Electrical Supply Co., 171 Randolph Street, Chicago, Illinois.

WHAT THE PRESIDENT SAYS:

The Safety Insulated Wire and Cable Co.,

234 WEST 29th ST., NEW YORK.

GENTLEMEN:--

We have made a thorough investigation of the various cables [together with the records of the same] that have been submitted to us for use in our subway here, and we beg to state that we will accept your proposition for cables, laid and connected at the price named in your proposal.

Yours very truly,

The Brush Electric Light Co.,

(Signed) C. R. HUNTLEY, Gen'l Mgr.

President of the Electric Light Association.

PERKINS LAMPS

ARE STILL BEING USED BY

THE MILLIONS.

We are Western Agents for both of the above.

THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS OF

ELECTRICAL SUPPLIES OF ALL KINDS,

54 and 56 Franklin Street, CHICAGO, ILL.

TWO Insulated WIRES which enjoy a well earned prominence in their respective fields are **Habirshaw Rubber Covered** and Shield Brand Moisture-proof. The one is distinguished for its purity of Rubber insulation, and above any other, is preferred for **interior* systems of wiring**—for use in underground conduits, on ship board, and in cables, under water.

OF A Somewhat different character is the other. We have made **SHIELD BRAND MOISTURE-PROOF** wire to withstand the upsetting influences of wind and weather, the abrasions of Time and Trees, and withal to preserve by its **Moisture-proof** Qualities, the Current, which it is its office to distribute. The line of Service for which you intend the Wire will determine its

KIND.

THE ELECTRICAL SUPPLY CO.,

CHICAGO.

ENCLOSE BUSINESS CARD FOR OUR ILLUSTRATED CATALOGUES.

FACTORIES: ANSONIA, CONN.

*In breweries, paper and pulp mills, or other buildings especially liable to moisture.

TESTIMONIALS.

SUN ARC LAMP.

For Arc Circuits.

For Direct Incandescent Circuits.

ONLY Arc Lamp in the market that burns on an INCANDESCENT CIRCUIT **SUCCESSFULLY.**

SINGLY OR TWO IN SERIES.

READ THESE:

THE CHICAGO TRIBUNE,
EDITORIAL ROOMS.

CHICAGO, Sept. 2, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO.

GENTLEMEN:—We have been using your Sun Arc Lamps for photo engraving, and find them first-class in every respect. Have used several Arc Lamps, but find yours superior to all, and consider them second to none. Yours truly,

(Signed) LOUIS RASICOT,
Engraver.

THE DAILY INTER OCEAN.

CHICAGO, ILL., August 25, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO.,
195 to 207 S. Canal St., City.

GENTLEMEN:—We are using your Sun Arc Lamp, and find it the best Arc Lamp for Incandescent circuits that we know of. It is giving the most eminent satisfaction, and we take much pleasure in certifying to its merits. Yours very truly,

(Signed) THE DAILY INTER OCEAN,
Per D. LAPOINTE, Photo-engraver.

KNAPP ELECTRICAL WORKS,
54 Franklin St., Chicago.

August 27, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO., Chicago, Ill.

GENTLEMEN:—The Sun Arc Lamps which we are using on our Incandescent circuit are giving us the best results and we regard them as the best lamp of its kind in the market.

Wishing you continued success, we remain,

Yours truly,

(Signed) KNAPP ELECTRICAL WORKS,
Per M. A. KNAPP, Manager.

ROCKFORD ELECTRIC MANUFACTURING CO.,
Manufacturers of
ELECTRIC MOTORS, RAILWAY AND STATIONARY.

ROCKFORD, ILL., Sept. 2, 1891.

GREAT WESTERN ELECTRIC SUPPLY CO., Chicago, Ill.

GENTLEMEN:—..... I started up the lamp and saw it in operation for several nights and it worked very nicely, certainly better than any lamp I have ever seen in use on Incandescent Circuits. I hope to be able to send you other orders soon.

Wishing you much success,

Yours very truly,

(Signed) GEO. A. MAYO.

(**MORE NEXT WEEK.**)

Convince Yourself by Sending an Order for One or Two to us.

Great Western Electric Supply Co.,

201, 203, 205, 207 SO. CANAL STREET,

Selling Agents. **CHICAGO, ILL.**

Special Inducements to Supply-Houses.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

Long Distance Series Incandescent Lighting

—BY THE—

HEISLER SYSTEM.

HAS NO EQUAL

In the Economical Subdivision of the

ELECTRIC LIGHT.

No Transformers or Other Translating Devices.

We distribute the capacity of our largest dynamo on a No. 8 wire, and thus avoid the excessive cost of conductors as used for other methods of distribution.

Awarded gold medal at Paris Exposition, 1889.

Estimates furnished on application for the complete installation of plants in any section.

Write for price list of series lamps for use on arc light circuits. State for what current and system.

Correspondence solicited.

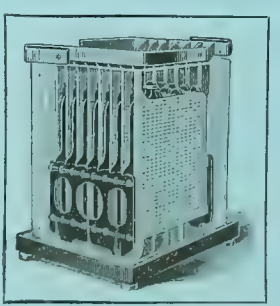
HEISLER ELECTRIC LIGHT CO.,

DREXEL BUILDING, PHILADELPHIA, PA.

Send for Circular.

ELECTRICAL ACCUMULATORS

Useful and economical for all purposes to which electricity is applicable, such as



- Propulsion and Lighting of Street Cars, Vehicles, Yachts, Etc.
- Central Station and Isolated Lighting.
- Portable Lighting or Power.
- Portable Electric Lanterns.
- Electric Power for Motors.
- Portable Electric Fans for Office, Family and Sick Room.

Only Clean and Convenient Battery for Surgeons, Dentists, and Professional Men Generally.

MANUFACTURED EXCLUSIVELY UNDER THE PATENTS OF

FAURE, SWAN, SELLON, GRISCOM, and others.

COMPLETE ELECTRIC LIGHT AND POWER PLANTS.

THE ACCUMULATOR COMPANY,

224 and 226 Chestnut Street, Philadelphia, Pa.

PHILADELPHIA AGENCY:—ELECTRO DYNAMIC CO., 224 and 226 Chestnut St.
NEW YORK:—TRUEX & VAIL, 44 Broadway. CHICAGO:—WM. HOOD, 239 La Salle St.
SAN FRANCISCO:—THE PACIFIC ELECTRICAL STORAGE CO., 118 and 120 Pine St.
BOSTON:—THE HOLTZER-CABOT ELECTRIC CO., 111 Arch St.
PROVIDENCE:—SWARTS & GANNETT, Swarts Building.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, OCTOBER 3, 1891. No. 14

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building, - - CHICAGO.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE
Standard Underground Cable Co.,
New York. Pittsburgh. Chicago.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES Lead Encased Wires.
Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.
Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

AGENTS
J. W. Peale, No 1 Broadway, New York.
Electric Eng. & Supply Co., - - Syracuse, N. Y.
Central Electric Co., - - - - - Chicago.
The Electrical Eng. & Supply Co., St Paul, Minn.
St. Louis Electrical Supply Co., - St Louis.

CLOWER, HARRIS & CO.,
CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.
The Largest Electrical Supply House West of the Mississippi River.
Everything Electrical
289 ELM STREET. - - DALLAS, TEXAS.

FOR SALE.
One 3 Horse Power Electric Motor.
One 5 Horse Power Electric Motor.
Both in excellent condition, having been used but little.
ERIE ELECTRICAL SUPPLY CO.,
ERIE, PA.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers. F. CAZENOVE JONES, Manager of Factories.

The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.

INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

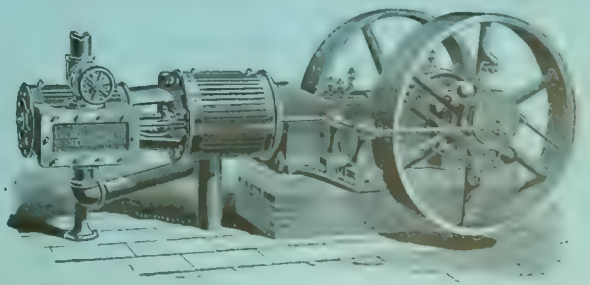
WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

WM. ROTCH, Prest. CHAS. G. WINTER, Treas.
CHAS. E. BIBBER, Gen'l Manager.

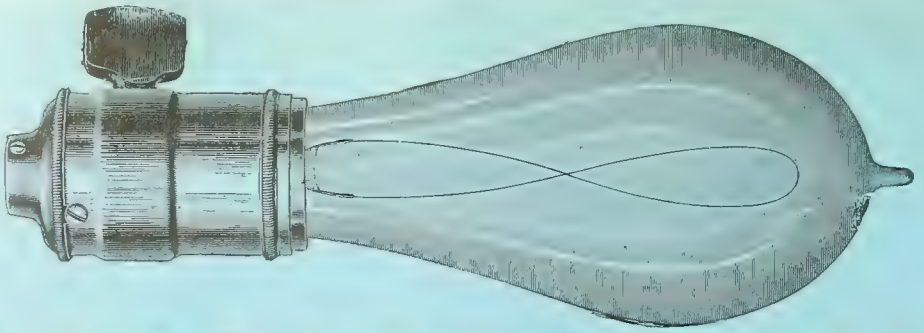
DO NOT
Equip your Switch-board with cheap Switches.
BUY THE
C. E. M. Jack-Knife Switch.
It is a Record Breaker and a reliable Circuit Breaker
Manufactured Solely By
THE CONSOLIDATED ELECTRIC MFG. CO.,
154 Franklin St. and 355 Congress St., BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS.

IMPROVED BALL ENGINES,

BUILT BY THE BALL & WOOD CO., NEW YORK.



W. B. PEARSON, Selling Agent. Home Ins. Bldg., Chicago, Ill.



LONG LIFE

INCANDESCENT LAMPS.

SEE WHAT PURCHASERS SAY:

BURLEY HOUSE,
Belle Plaine, Iowa,

State of Iowa }
Benton County } ss.

I, B. B. Burley being duly sworn upon oath depose and say, that I am a resident of Belle plaine Benton County Iowa, and proprietor of the "Burley House" in said City — That Sept. 20th 1889, the Union A. Hunter Electric Company, placed a 32 Candle power — 52 volt incandescent lamp, of the Thomson-Houston System, on the Porch at my said Hotel — That said lamp burned Continuously for 4620 Hours, burning out July 15th 1891. —

B. B. Burley

Subscribed in my Presence and Sworn to before me August 10th 1891.

John H. Miller
Notary Public in
& for Benton Co., Iowa.

B. B. BURLEY,
Prop. BURLEY HOUSE,
Belle Plaine, Iowa.

Extract of letter from Manitou Electric Co., Manitou Springs, Colo.

DATED AUGUST 23, 1891:

"We have got T. & H. Lamps burning and giving good light that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston Lamps still burning that have burned 5,000 hours. The lamps were all I could ask. Have tried 'Sunbeam,' 'Edison' and other lamps made in Chicago, and the 'Perkins,' all of which are no good on earth."

MANITOU ELECTRIC CO.,
By C. F. TINGLEY, Manager.

THE IRON MOUNTAIN ELECTRIC CO., IRON MOUNTAIN, MICHIGAN, state that they have lost but 2 lamps in three months, with one thousand installed.

In the face of these Facts, why do you buy lamps that are of Short Life, Low Candle Power, and that quickly Blacken?

We make our own lamps and can furnish them at once

From 45 to 116 Volts,
From 6 to 150 Candle Power.

Write for Price Lists.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Avenue, BOSTON, MASS.

148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co... xiii
Alexander, Barney & Chapin.....i
American Electrical Works.... xiii
Andrews & Co., A. H..... xxi
Baggot, E xiv
Bain Electric Mfg. Co..... vii
Ball Engine Co.....xxi
Ball & Wood Co., The i
Bernstein Electric Co.....viii
Blatz, L.....xiii
Borden & Selleck Co..... xv
Braun Illustrating Co xxi
Brownlee & Co..... xii
Brookfield, Wm..... ... xii
Brush Electric Co..... ...xvii
Butler Hard Rubber Co.....iv
Buxton, Geo. B xiv
C. B. & Q. R. R..... —
C. & C. Electric Motor Co.....xvi
Card E. Motor & Dynamo Co... iv
Central Electric Co..... v
Chicago Electric Mfg. Co..... xiii
Chicago Electric Motor Co..... —
Clower, Harris & Co.....i
Chicago Insulated Wire Co... xvii
Colburn Electric Mfg. Co..... xiv
Coolidge, Fuel & Supply Co ... viii
Consol. Elec. Mfg. Co., The..... i
Cowles Electric Smelting and Aluminum Co.....xiv
Crocker-Wheeler Electric Motor Co..... xiii
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co..xxi
Densmore Typewriter Co..... —
Eastern Electric Cable Co..... xiii
Edison General Electric Co..... vi
Edison General Electric Co., Cable and Wire Department..... vi
Eddy Electric Mfg. Co..... xx
Electric Construction & Sup. Co..viii
Electric Merchandise Co..... xii
Electric Secret Service Co..... xvi
Electrician Pub. Co.. xiv, xv, xviii
Elec. Construction Co., The.... xiii
Electrical Engineering Co..... xiii
Elec. Eng. & Supply Co., The..xiii
Electrical Supply Co., The... xxiv
Elektron Mfg. Co..... xvi
Empire China Works..... . xii
Erie Electrical Supply Co..... i
Evans Friction Cone Co..... xvii
For Sale.....i, iv
Foster, O. A..... —
Fort Wayne Electric Co..... xxvi
Freeman, Coleman & Co.....—
Gleason & Bailey Mfg. Co. Ltd..iv
Globe Carbon Co.... xv
Great Western Elec. S. Co..... viii
Greeley & Co., The E. S.....i
Hale Elevator Co..... x
Heisler Electric Light Co.....iv
Hill Clutch Works ..... —
Hine Eliminator Co..... xii
Holmes, C. H..... xiii
Holmes, Booth & Haydens... .xvii
Hood, Wm..... x
India Rubber & Gutta Percha Insulating Co.....—
Interior Conduit & Insulation Co. x
International Okonite Co..... i
Kartavert Mfg. Co..... xii
Keller & Degenhardt..... xii
Knapp Electrical Works..... xxiii
La Roche Electric Works..... xxvi
Law Telephone Co..... xiii
Leonard & Co., H. Ward..... xiv
Leffel & Co., Jas..... xiii
Loud, H. M. & Sons Lumber Co..xiv
McLaughlin, James iv
Mason, James H..... ... xiii
Milliken Bros.....iv
Minneapolis Street Railway Co. xxv
Monitor Electric Co..... x
Munsell & Co., Eugene..... xiii
Murphy, T. J..... xiii
N. W. T. H. Electric Co..... xix
National Carbon Co.....iv
National Electric Mfg. Co..... ix
N. Y. Belting & Packing Co..... xii
New York Insulated Wire Co.... x
New York & Ohio Co..... i
N. W. Elec. Specialty Co.. xxi
Nuttall Company, R. D..... i
Ostrander & Co., W. R..... xii
Paiste, H. T..... xii
Page Belting Co..... —
Partrick & Carter Co..... x
Payne & Co., Geo. W..... —
Pearson & Co., W. B.....xxi
Phoenix Glass Co..... —
Pond Engineering Co xxi
Powell Co., The Wm..... xiv
Queen & Co..... xiii
Ries Elec. Specialty Co., The...vii
Rockford Electric Mfg. Co.... —
Royal Electric Co..... xii
Sargent & Lundy..... i
Sawyer-Man Electric Co..... xi
Schieren & Co. Chas. A.....xii
Schoonmaker, A. O xii
Schuyler Electric Co..... ..xxvi
Short Electric Railway Co.....xii
Schultz Belting Co.....viii
Sperry Electric Mining Machine Co..... xiv
Standard Underground Cable Co....i
Stanley Electric Mfg. Co..... —
Star Iron Tower Co..... vii
Stearns Mfg. Co.....xxi
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co xv
Taussig, S..... ..iv
Temple, J. C..... xv
Thomson-Houston Elec. Co..ii, xxii
Turner Brass Works..... xiii
Union Electric Mfg. Co., The...vii
Union Electric Works..... —
Union Hardware Co..... ..xii
U. S. Electric Lighting Co.. —
Van Nuis C. S..... —
Vulcanized Fibre Co..... xv
Wanted ..... —
Wenstrom Consolidated Dynamo & Motor Co., The xvi
Western Electric Co vii
Westinghouse Elec and Mfg Co..xi
Westinghouse Machine Co..... xxi
Weston Electrical Instrum't Co..—
Williams Engine Works..... ..xxi
Woodbridge & Turner Engineering Co xv
Woodhouse & Rawson, Ltd....—
Worthington, Henry R.....—

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelting & Aluminum Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
N. W. T. H. Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Schultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co. The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Cars Railway.
Minneapolis St. Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Edison General Electric Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Keller & Degenhardt
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
N. W. T. H. Electric Co.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
La Roche Electric Works.
National Electric Manufacturing Co.
N. W. T. H. Electric Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Wenstrom Consolidated Dynamo & Motor Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co. The.
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrollers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Electric Specialty Co.
N. W. T. H. Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co. The.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Mining Apparatus, Electric
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors
[illegible]
Motor Co.
[illegible]

Name Plates.
[illegible]
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
[illegible]

Patent Solicitors.
[illegible]

Packing
Buxton, Geo. B.
[illegible]

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The
Holmes, C. H.
[illegible]
Western Electric Co.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.
Rochester Railway Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Western Electric Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
[illegible]
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James
Stilwell & Bierce Mfg. Co.

Type Writers.
[illegible]

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

FOR SALE.
New 10 and 25 Light
Arc Dynamos and Lamps.
HIGH TENSION. CHEAP.
JAS. McLAUGHLIN, Mfg. Electrician,
50 N. Clinton St., Chicago.

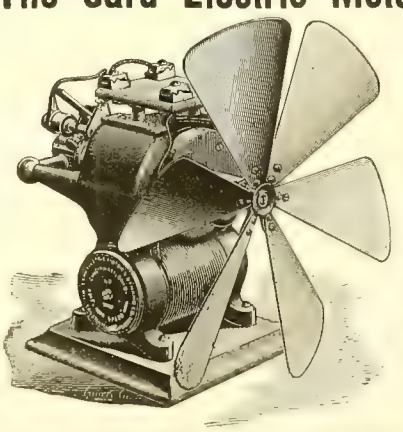
YOU WILL OBLIGE
Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

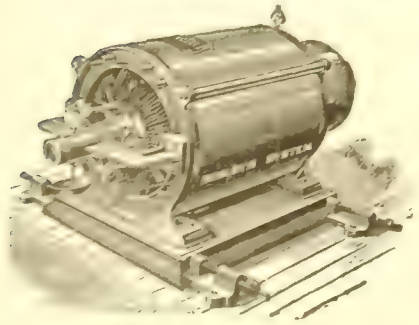
THE MILLIKEN PATENT POLE
For Electric Street Railways and Electric Light Work.
55 LIBERTY STREET, NEW YORK.
MANUFACTURED BY MILLIKEN BROS.
59 DEARBORN STREET, CHICAGO.
Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.
WRITE FOR CIRCULAR AND CATALOGUE.

SYNOVIAL DYNAMO OIL.
Second to None. Free from Gum or Acids.
By refiltering can be used continually. Adopted by the largest Electric Plants of the West.
Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO.

THE BUTLER HARD RUBBER CO.,
33 Mercer Street, New York,
POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF
HARD RUBBER GOODS
Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.
ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF
SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.
KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES
Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.
HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.
Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.
For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

Gleason & Bailey Mfg. Co.,
(LIMITED.)
GENERAL WESTERN AGENTS FOR THE
STEUBEN INCANDESCENT LAMPS,
The best in the Market,
And Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.
Rubber Covered, Weather-Proof Wires and Lamp Cords.
233 Lake Street, CHICAGO, ILL.
It will pay you to get our prices and catalogues.

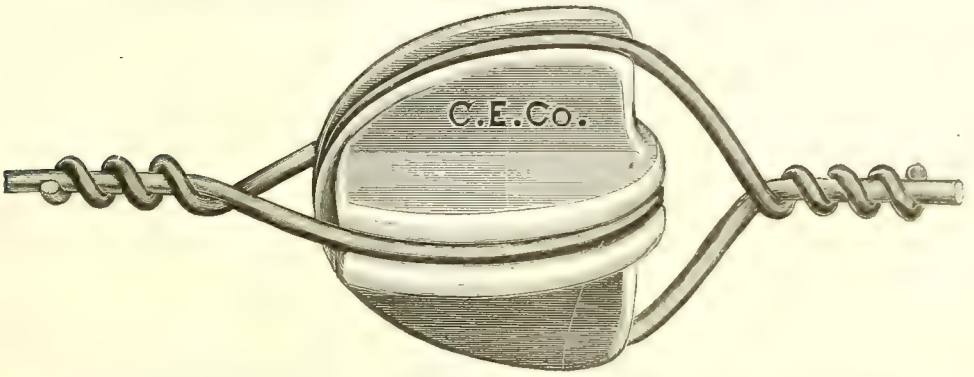
FAN MOTOR,
MANUFACTURED BY
The Card Electric Motor and Dynamo Co.,
Cincinnati, Ohio,
MANUFACTURERS OF
Electric Motors for Arc and Incandescent Circuits, from 1-6 to 50 H. P.
Correspondence Solicited.

AGENTS:
BOSTON—The Eastern Electrical Supply & Construction Co., 65 Oliver St.
CHICAGO—The Thos. L. Johnson Co., 312 Dearborn St.
MILWAUKEE—Henry Ramien, 641 Third St.
WASHINGTON, D. C.—J. Geo. Gardner, 1005 H St.
ST. LOUIS—Stagl Electrical Engineering Co., 1106 Pine St.
MONTGOMERY, ALA.—W. F. Murphy.
DETROIT, MICH.—The Michigan Electric Co., 212 and 214 Griswold St.
MINNEAPOLIS, MINN.—J. M. Lennon, No. 22 Loan and Trust Building.

The Heisler System Long Distance Incandescent Lighting.
A practical subdivision of the electric light. Cheap to install and perfectly automatic regulation.
Specially adapted for the lighting of Public Halls, Railroad Depots, Pleasure Resorts, Streets, Stores and General Illumination.

Noted for the Brilliancy of the Light and Greatest Production of Candle Power per H. P.
NO TRANSFORMERS USED UPON THE CIRCUITS.
We manufacture and carry in stock, dynamos of the following capacity, in 32 C. P. lights: 160,-200,-250,-300,-350,-400,-450, which will operate their rated capacity in 16, 20,-32,-45,-60,-100 and 150 C. P. Lamps. The output of any of the above sized dynamos can be distributed from a circuit composed of No. 8 B. & S. wire; and there will be no drop in candle power of the lights at any point upon the circuit.
Full guarantee given with our apparatus, and special fixtures for indoor and outdoor lighting.
Series Lamps and Sockets for any current or candle power. Send for descriptive matter and price lists.
HEISLER ELECTRIC LIGHT CO., DREXEL BUILDING, PHILADELPHIA.
AGENCIES:—Inter-State Complete Electric Construction Co., St. Louis, Mo.; Belton Electric Co., Belton, Texas.; Howe Construction Co., Norwalk, O.

CONSTRUCTION MATERIAL.

INSULATORS.

THE BAIN BREAK INSULATOR (PORCELAIN). Cut Full Size.



For Insulating Span Wires, Guy Wires, Arc Lamps, Etc. As a circuit break insulator it has no equal.

OUR ST. LOUIS BRANCH.

OKONITE

TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

OUR KANSAS CITY BRANCH.

OKONITE

TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OUR OMAHA BRANCH.

OKONITE

TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

OUR DENVER BRANCH.

OKONITE

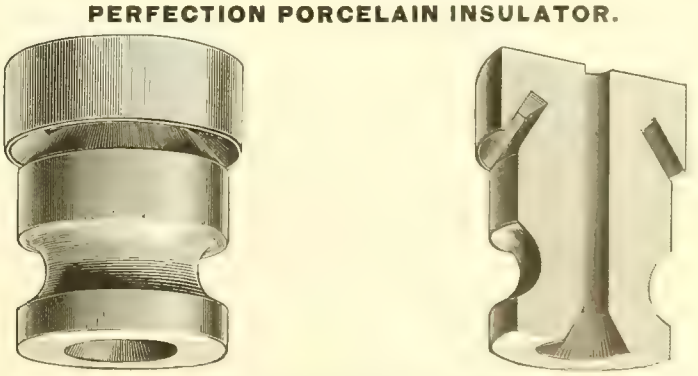
TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., Denver, Colo.

THE BAIN HIGH-RESISTANCE INSULATOR.

Increases distance from wire to support 100 per cent.

PERFECTION PORCELAIN INSULATOR.



For inside wiring in damp places.

CENTRAL ELECTRIC COMPANY,

116 and 118 FRANKLIN ST.,

CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

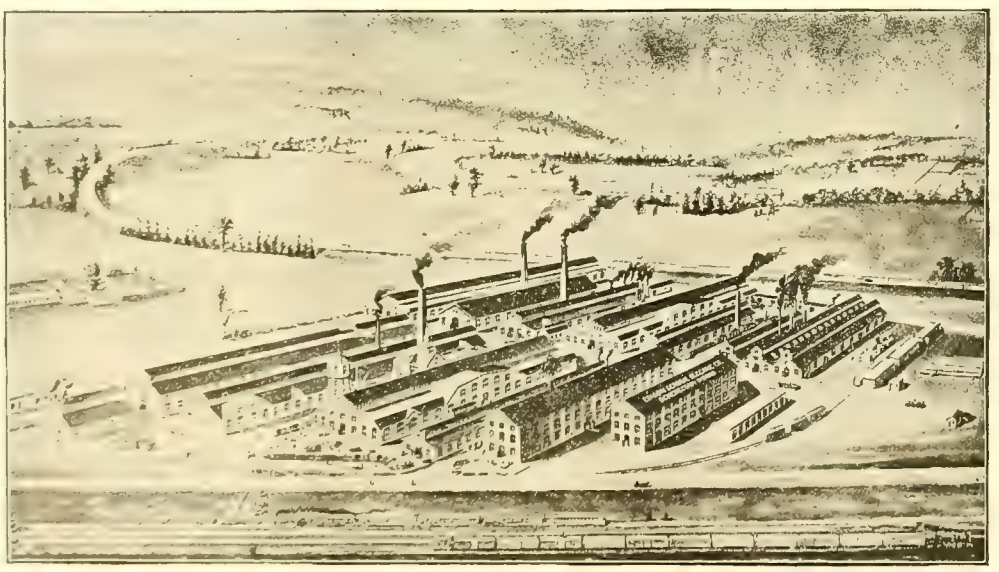
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga.

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

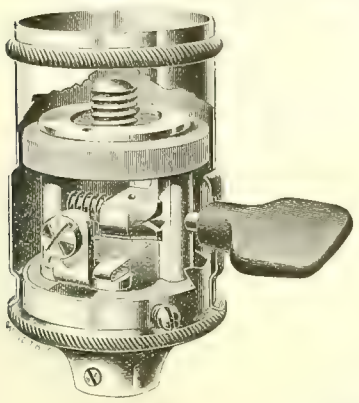
Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

SOMETHING ENTIRELY NEW. SIMPLE, EFFICIENT, ECONOMICAL.

Indorsed by the Electrical Press and Prominent Electrical Engineers and Electricians. For Particulars and Prices address

THE RIES ELECTRIC SPECIALTY COMPANY, PATENTEES AND SOLE MANUFACTURERS

Baltimore and Eutaw Sts., BALTIMORE, MD. REGULATING SOCKETS.



"OF SOME THINGS ONLY THE BEST ARE WORTH HAVING."

WE GUARANTEE ALL GOODS

And will ship to central stations on approval—FREIGHT PREPAID.

The UNION ELECTRIC MFG. CO., Bridgeport, Conn.

NEW YORK: Alexander, Barney & Chapin.

BOSTON: The Eastern Electrical Supply Co.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.

BEST MAST ARM IN USE.

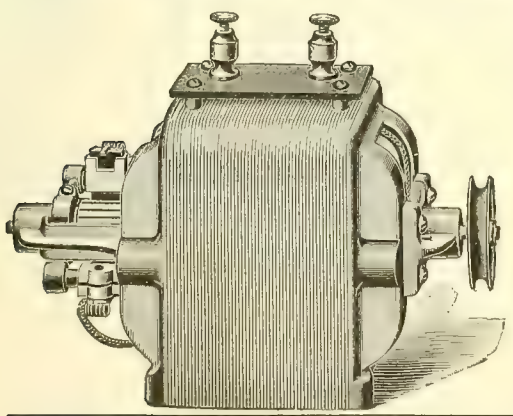
More Lamps Trimmed. No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRON TOWER CO., FORT WAYNE, IND.

SEND FOR New American Electrical Directory, just published; very complete lists. Invaluable for its information of Lighting and Railway Plants.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

SEND FOR CATALOGUE.

Western Electric Co.,

CHICAGO, NEW YORK, BERLIN, PARIS, ANTWERP, LONDON.

ELECTRIC LIGHTING APPARATUS,
Arc and Incandescent Systems,
Automatic Regulation.

S-U-P-P-L-I-E-S.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

BERNSTEIN ELECTRIC CO.

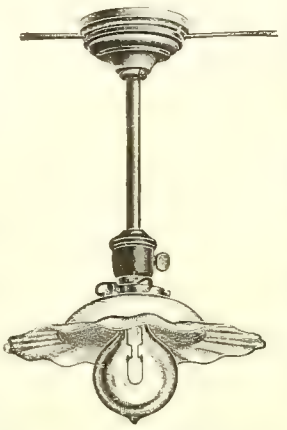
INCANDESCENT LAMPS

—FOR—

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

BRANCHES: 164 Summer St., Boston, Mass ; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa ; 60 W. Monroe St. Chicago. | St. Louis, Mo.

COOLIDGE FUEL & SUPPLY CO.,

RAILROAD CROSS TIES AND PILING.

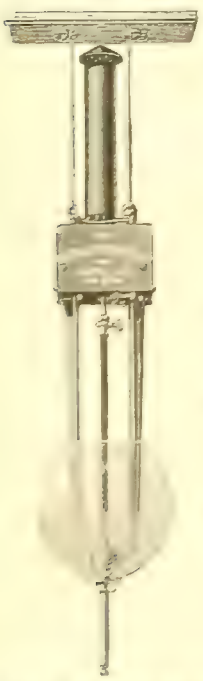
CEDAR AND OCTAGONAL PINE POLES.

CROSS ARMS, PINS AND BRACKETS.

—MANUFACTURED BY—

J. R. CLARK CO., Minneapolis, Minn.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

We append a letter from a customer:

CHICAGO EDISON CO.,
139 & 141 Adams St., Chicago, Ill.

Chicago, Ill., Sept. 7, 1891.

ELECTRIC CONSTRUCTION & SUPPLY CO.,
18 Cortlandt Street, New York City.

Gentlemen:—We are using 220 of your arc lamps on our incandescent system. We take pleasure in stating that they are giving us perfect satisfaction, and that the light is equal in power and steadiness to any of the series arc lamps in the city.

CHICAGO EDISON CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building, CHICAGO, ILL.

Established 1881.

Telephone Building, NEW YORK CITY.

THE NATIONAL TRANSFORMER SYSTEM

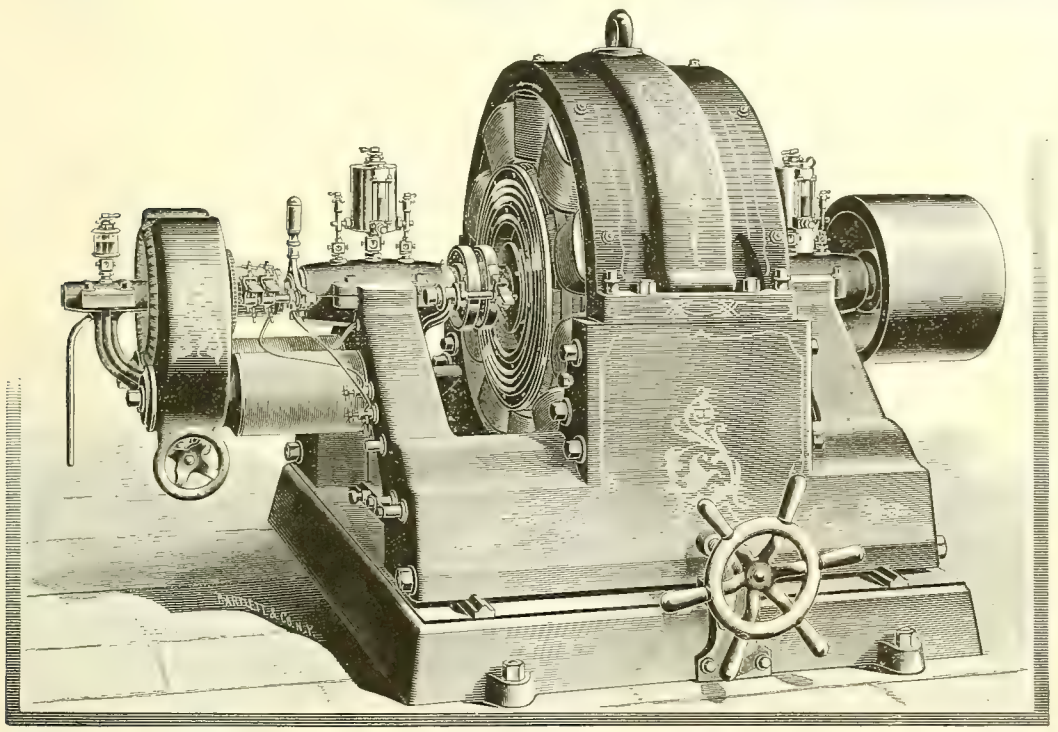
OF INCANDESCENT LIGHTING.

Florence, S. C., August 19, 1891.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.:

GENTLEMEN:—I write this to tell you of the wonderful performance of our Alternating Dynamo, which is a 750 lighter of your manufacture. Last night, while at supper, a cross got on our mains by their sagging on to a telegraph wire, and my engineer, who is a new man, ran the dynamo with the ampere meter needle clear on the end of the scale, which is about 80 amperes, or equivalent to approximately 1,600 lamps. It ran that way until it chocked down a 100 H. P. engine with 110 pounds steam, and then he sent for me. Strange to relate, the machine was not damaged a particle. The excessive current had melted all of the 4 fuses on the board, but the engineer had put in new ones and heavier ones, and had started up again. I consider that we have the only dynamo on earth that would stand such a strain and not be injured. I shall of course see to it, that a thing of this kind does not happen again.

[Signed] A. A. FORMAN, Supt. Florence Impvt. & Mfg. Co.



THIS IS THE MACHINE THAT WE BUILD.

Self-Contained Alternator. Capacity 1,000 16 C. P. Lamps.

SEND FOR CIRCULARS AND PRICES.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

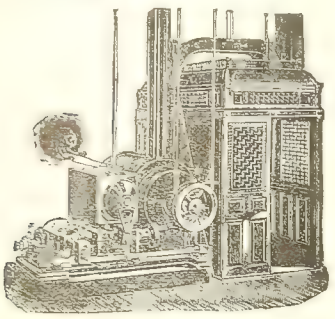
NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	**ST. PAUL, MINN.,**	The Electrical Engineering & Supply Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	**DETROIT, MICH.,**	Commercial Electric Co.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	**DENVER, COLO.,**	The Mountain Electric Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	**WINNIPEG, MAN.,**	Simpson-Davis Electrical Construction Co.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	**SAN FRANCISCO, CAL.,**	National Electric Development Co.
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.	**KANSAS CITY, MO.,**	Thomas Wolfe, 515 Main St.
SEATTLE, WASH.,	Chas. H. Baker & Co.	**DULUTH, MINN.,**	The Electrical Eng. & Supp'y Co.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

PASSENGER AND FREIGHT

Hydraulic and Electric ELEVATORS.

Electrical Supplies

OF ALL KINDS.

House Goods

A SPECIALTY.

ESTABLISHED 1867.

FRANKLIN S. CARTER, CHAS. M. WILKINS, E. WARD WILKINS,

TRADING AS

PARTRICK & CARTER CO.,

Manufacturers and Dealers.

Sole Proprietors Patent Needle Annunciators.

125 SOUTH SECOND ST., PHILADELPHIA, PA.

Send us Your Business Card and get our Catalogue and Trade Discount Sheet.

CORRESPONDENCE SOLICITED.

THE "JEWEL"

WM. HOOD, GEN'L AGENT.

JEWEL INCANDESCENT LAMP

239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES!

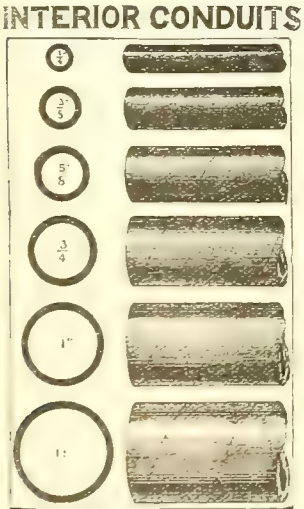
16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

THE INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 626 to 628 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Electrical Engineering Co., 320 Dearborn St., Chicago, Ill.
Southern Electric Co., Baltimore, Md.
Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
B. Frank Johnson, Provident Bldg., Philadelphia, Pa.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

ESTABLISHED 1820.

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

GRIMSHAW

TRADE MARK

WHITE CORE

INSULATED WIRE

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,

ELBOWS, JOINTS, ETC., ETC.

All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street,

CHICAGO.

MAIN OFFICE.
649 and 651 Broadway,
New York

Geo. H. Mecker,
Western Manager.

NEW YORK INSULATED WIRE CO. NEW YORK

MOISTURE-PROOF

VULCA

ELECTRICAL CO.

WIRE-DUCT

NON-INFLAMMABLE

TRADE MARK

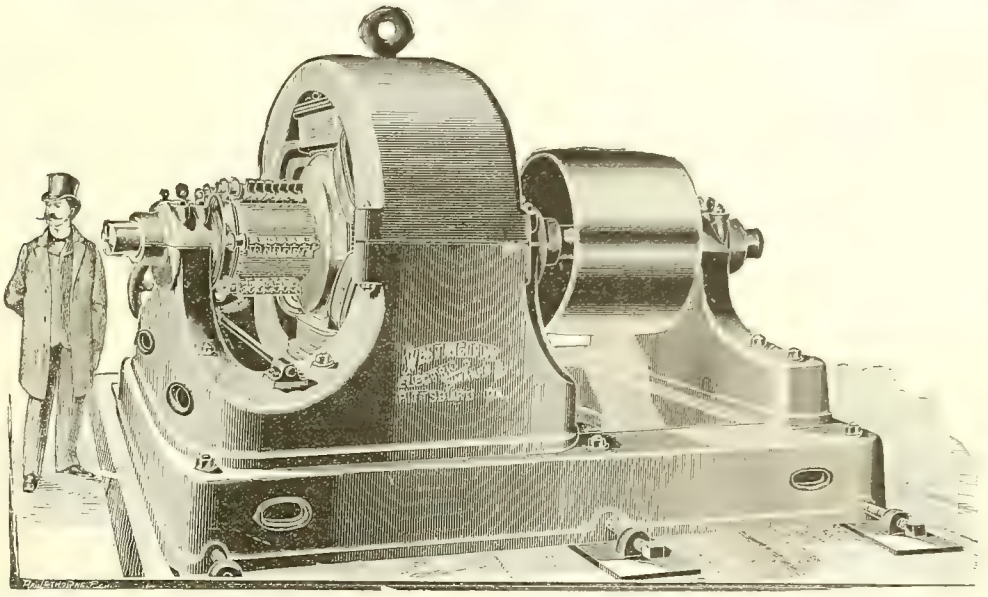
AND CHICAGO.

WESTINGHOUSE
MULTIPOLAR STREET RAILWAY GENERATORS.

COMPOUND-WOUND. SELF-EXCITING.

Perfect Self-Regulation.

High Electrical Efficiency.



Slow Armature Speed.

No External Magnetism.

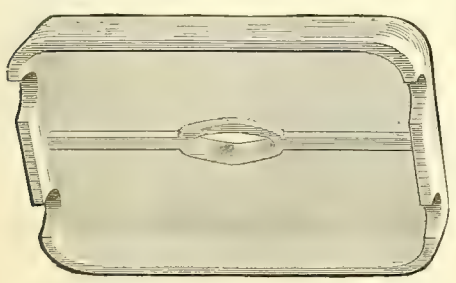
Self-Oiling Bearings.

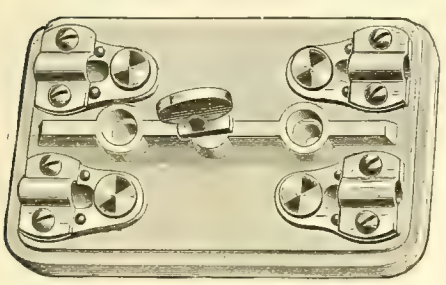
Descriptive Catalogues of Generators, Single-Reduction and Gearless Motors, and Power Station Appliances furnished upon application. Correspondence on all subjects connected with Electric Railways is solicited.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.,

RAILWAY DEPARTMENT,

PULLMAN BUILDING, CHICAGO. PITTSBURGH, PA. 120 BROADWAY, NEW YORK.





CUT-OUTS,

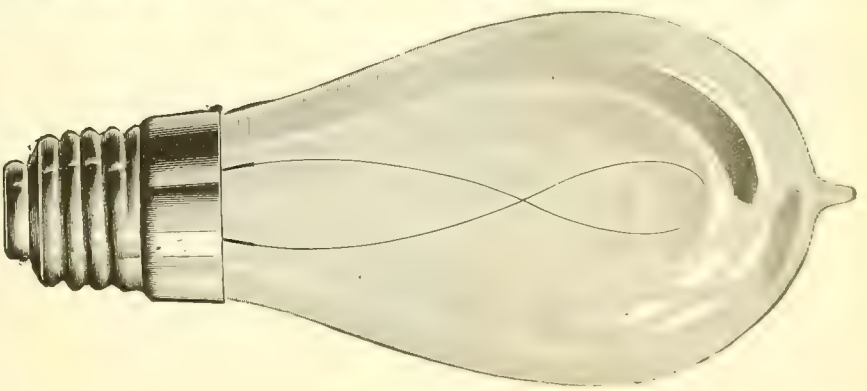
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 1201 Market St., Philadelphia, Pa.

See our full page advertisement in issue Sept 26 for illustrations, prices, etc.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

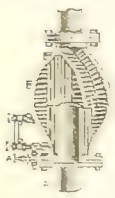
542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

KNOW WHAT YOU'RE GETTING!



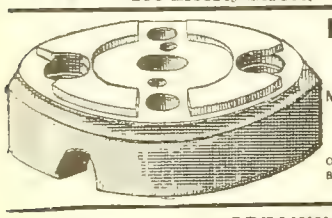
HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

In a test of the best known "Separators" recently made at Cornell University this ELIMINATOR demonstrated percentages of efficiency over ALL competitors ranging from 11 to 59 per cent. The full report of test with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street. NEW YORK.



EMPIRE CHINA WORKS,

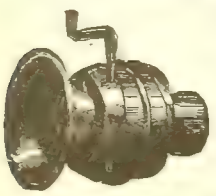
114 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

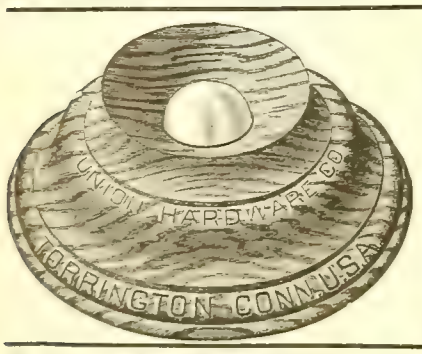
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.



—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

Royal Electric Co.,

911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURER OF

Alternating and Continuous Current Dynamos and Motors,

AND ELECTRIC MACHINERY.

THE MOST COMPLETE ASSORTMENT OF SIZES ON THE MARKET

Agents Wanted for Exclusive Territory.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia.

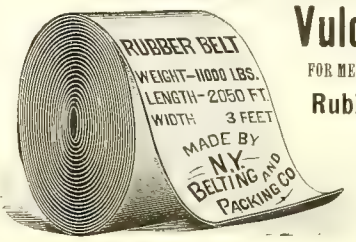
46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

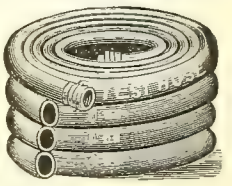
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 160 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 1624 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

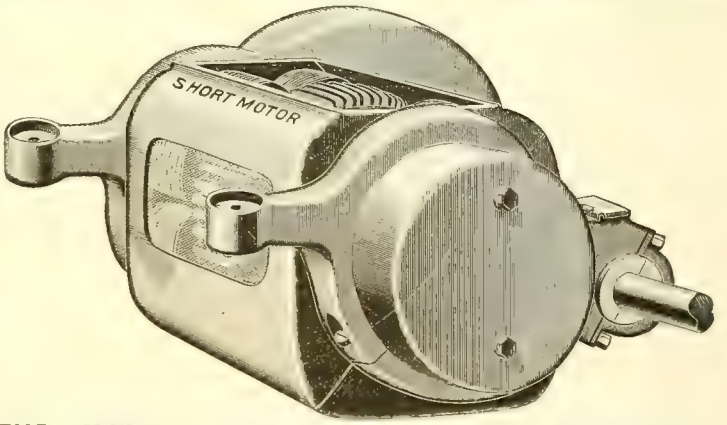
POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

WATER TIGHT SINGLE REDUCTION.



THE SHORT ELECTRIC RAILWAY CO., Cleveland, O.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

Western Electrician.

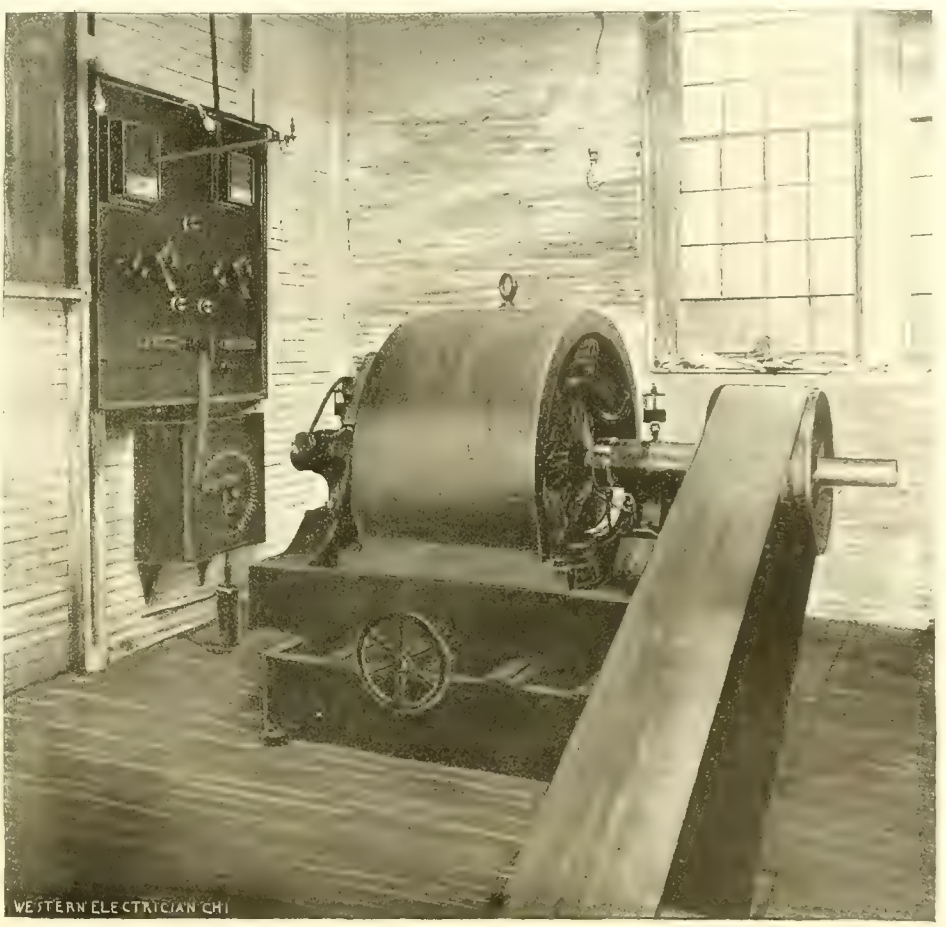
EVERY SATURDAY.

Vol. IX. CHICAGO, OCTOBER 3, 1891. No 14

New One Hundred and Fifty Horse Power Sperry Railway Generator.

The Pullman company recently established an experimental plant at its street car works in which it installed a 150 horse power Sperry generator of an entirely new type. The accompanying cut illustrates the machine in position at the Pullman works. This generator was built specially for street railway work, and is the first of the kind devised by Elmer A. Sperry of Chicago.

A little over a year ago General Manager C. L. Pullman of the Pullman Palace Car company was interviewed by a representative of the WESTERN ELECTRICIAN relative to an electric railway, which, it had been reported, was to be equipped at the works of the company in Pullman. Mr. Pullman stated at the time that his company would undoubtedly equip the road with electricity. He thought the electric motor had come to stay, but he did not consider that electric railway machinery was then in anything more than an experimental stage. He stated further that it was the company's desire to have an equipment which would enable it to illustrate the practical running of cars under different conditions. The road was to be operated the same as any other ordinary street railway, and would be self supporting. It was his intention to give the motor companies a chance to display the merits of their respective machines. He explained further that it was the policy of the Pullman company to build cars not necessarily to suit the Pullman company, but to satisfy those ordering them. In other words, if an electrical company wanted a lot of cars the Pullman company endeavored to construct them in accordance with the requirements of the motors. The electrical equipment was to help the company in this direction.



NEW ONE HUNDRED AND FIFTY HORSE POWER SPERRY RAILWAY GENERATOR.

The Pullman company has now established this experimental plant, and the 150 horse power generator illustrated supplies current to a section of the road equipped on the overhead system. This machine is driven from theshafting which transmits power to the wood working machinery. The power for this department and the generator is obtained from a twin Atlas engine of 300 horse power capacity.

The dynamo employed by the Pullman company is worthy of special mention from the fact that it is the first of the new style electric railway generators built by the Sperry Electric company, Chicago. The machine was designed by Elmer A. Sperry. A glance at the illustration will show the reader that Mr. Sperry has followed the tendency now prevalent in this country and abroad, toward the multipolar machines. This dynamo, which is built to operate at a speed of 700 revolutions per minute, and deliver current at a pressure of 500 volts, is plain shunt wound, and has six poles. Six carbon brushes convey the current to the line.

Several novel features in the design of the machine may be referred to. The armature is of the Siemens pattern, but the winding is such that the wires of the coils do not cross one another where they are usually bunched at the ends. It might be said that the coils are first bound on the cylindrical surface of the armature, and the ends then turned over and into a cavity at each end of the core.

The field coils are wound in sections; that is, each of the six cores is surrounded by five separate and distinct coils. These coils or rings of wire are wound separately, and each one is thoroughly insulated by tape. To provide one of the cores with the proper winding it is only necessary to slip, say, five of these sections on the pole pieces one after the other, and connect them in series. A glance at the illustration will enable the reader to obtain an idea of this construction.

The Oldest Cable Road Dismantled.

Street railroad men, no matter whether connected with electric, cable, or horse car lines, will certainly be interested in learning that the Clay Street Hill Railroad company of San Francisco has run its last car up through Chinatown, over the Clay street hill, and that with it the oldest cable road in the world is now a thing of the past. No unusual ceremonies attended the final trip, beyond the breaking of a bottle of champagne over the grip and a formal declaration that the business of the pioneer cable road was finished, but after the car and dummy had been turned into the round-house many of the officers and men, some of whom had been with the road since its construction was begun, over twenty-five years ago, gathered together and exchanged bits of history concerning the early days of the famous line. Deep regret was expressed by all that it had become necessary to dismantle the road and reconstruct it that it might [illegible] traffic.

Up in the loft of the [illegible] engine [illegible] venworth and Clay streets, are stored parts of the first dummies which astonished the people of San Francisco, together with the original grip-car. This is indeed a primitive affair, consisting of a low platform on small car wheels and supporting the grip. [illegible] while the brakes consisted of steel levers, which were pressed against the four wheels. Five men were necessary to run the dummy, one operating the grip and each of the remaining four standing with a steel lever in his hand ready to lock the wheels should the grip break. The trailer was a common "bob-tail" horse car, and the trial trip of the first cable train, as thus constituted, forms a most interesting chapter of street railway history.

Early in the '70's A. S. Hallidie, now president of the California Wire Works of San Francisco, conceived the idea of propelling street cars by means of an endless, traveling, underground cable. The scheme was at first considered chimerical, but finally three men of means—Joseph Britton, H. L. Davis and James Moffitt—took the matter up. Then came the almost interminable task of working out the mechanical details of the idea, but it was finally completed, and on August 18, 1873, hundreds of San Franciscans climbed up Clay street hill to watch the trial trip. As the gripman who was to take the car over the road looked down the steep decline his courage failed, and Mr. Hallidie took the grip. At a given signal the car started off smoothly amid shouts from thousands of throats. The trip was made without a hitch and the innovation was pronounced a success. Soon the line from Kearney street to Van Ness ave. was equipped with cable cars, and since then, until the closing of the line on the night of September 9th, the road has been in operation, using continuously the same engine and the same roadbed. Arthur S. Chase enjoys the distinction of having collected the first fare, he being the first cable car conductor, and Timothy Phalon was the first gripman. Mr. Chase is now in the furniture business in San Francisco and Mr. Phalon, after a long service, resigned and is now a factory [illegible]

It is probable that the now historic train, with its first conductor and gripman, will form a part of [illegible] exhibit at the World's Fair.

Lighting a Jewish Synagogue.

One of the handsomest Jewish houses of worship in Chicago is Sinai temple, on the corner of [illegible] and Twenty-first street. The edifice is to be lighted by electricity, and the contract for furnishing the [illegible] ment has been let to the Chicago Edison company. The building will be wired for [illegible] lamps [illegible] with especial attention to [illegible] tutes will be furnished by the [illegible]

of the electroliers will be designed especially for the temple. The ceiling lights will be grouped in domes in ten-light bunches. Current will be furnished from the Edison South Side station.

Siemens & Halske's Lighting Plant at Charlottenburg.

In a recent number of the *Elektrotechnische Zeitschrift* an interesting account was given of the lighting plant of the immense factory and shops of Siemens & Halske in Charlottenburg, near Berlin. Thoroughly practical in all details, the installation possesses only the most approved its modern apparatus.

The dynamos used are of the six pole type, and are coupled directly to triple expansion engines, each of 200 or 250 horse power, operated at 145 revolutions a minute. At the front of the dynamo and fastened to the shaft is a

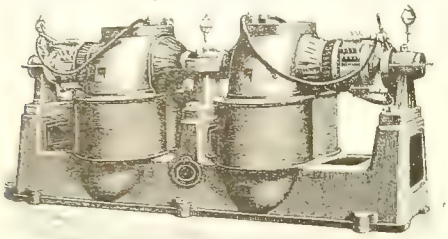


FIG. 2. SIEMENS & HALSKE'S LIGHTING PLANT AT CHARLOTTENBURG.

star shaped casting, having at its ends studs which carry the six sets of brushes, the whole being actuated by a hand wheel and gears so that all the brushes can be set simultaneously. The casting holding the front bearing is so arranged that it can be moved to one side, allowing the field coils to be easily reached. The winding of the ring armature is accessible without disturbing any of the other parts, and is in itself an interesting feature. Instead of having the ordinary winding with a corresponding commutator, these machines have no armature winding in the ordinary sense, but make the commutator serve the dual purpose of commutator and armature by using copper strips instead of wire, and connecting them so as to produce one continuous conductor, and over this all the brushes slide as on an ordinary machine. This arrangement has been used by Siemens & Halske for some time in their central stations in Berlin. The conductors from the dynamos to the switch board are not run, as is usual, in conduits, but in plain sight along the walls and ceiling on porcelain insulators.

In the corner of the power house, shown in Fig. 1 and

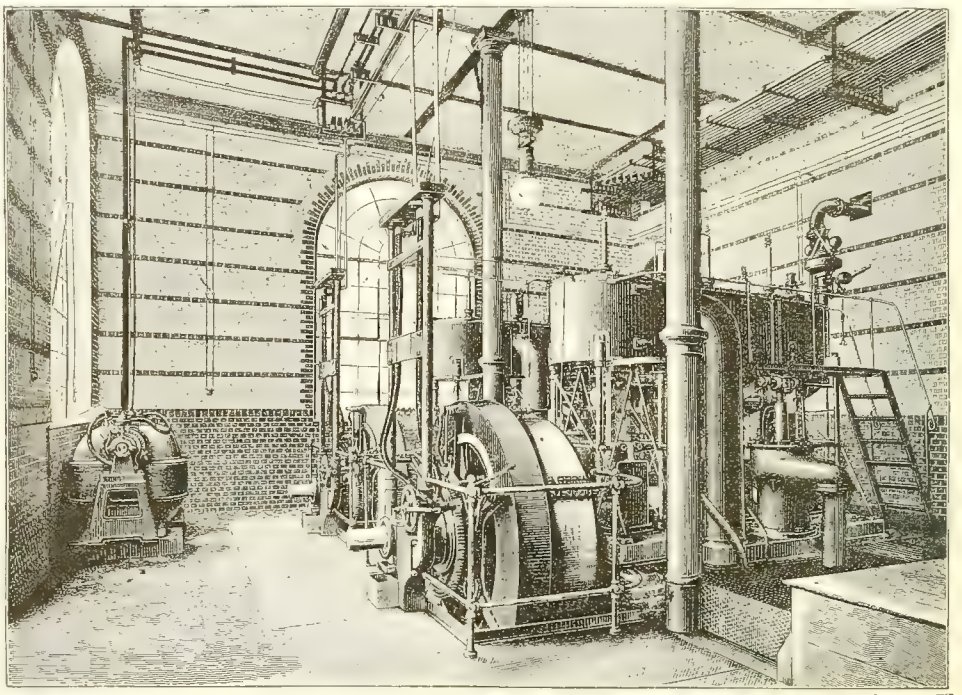


FIG. 1. SIEMENS & HALSKE'S LIGHTING PLANT AT CHARLOTTENBURG.

other gives is used in raising the electromotive force of the charging current. In other words, a current of 110 volts is converted into one of from 0 to 70 volts. By altering the exciting current of this double machine, the potential that is produced can be regulated so that, in the simplest manner, the electromotive force of the charging current can be regulated between the necessary limits, according to the completeness of the charging, from 110 volts to 180 volts. In discharging, this machine can be used in the reverse order; that is, at the beginning of the discharge, while the electromotive force is too high it can be transformed to one of 110 volts, the two parts of the double machine exchanging offices. However, in discharging there is very little necessity for ever employing this arrangement.

In another room near the boiler house are the accumulators, Fig. 3. These are of the Tudor type, the battery consisting of 66 cells, demanding a charging current of 400 amperes and having a capacity of 1,400 ampere hours.

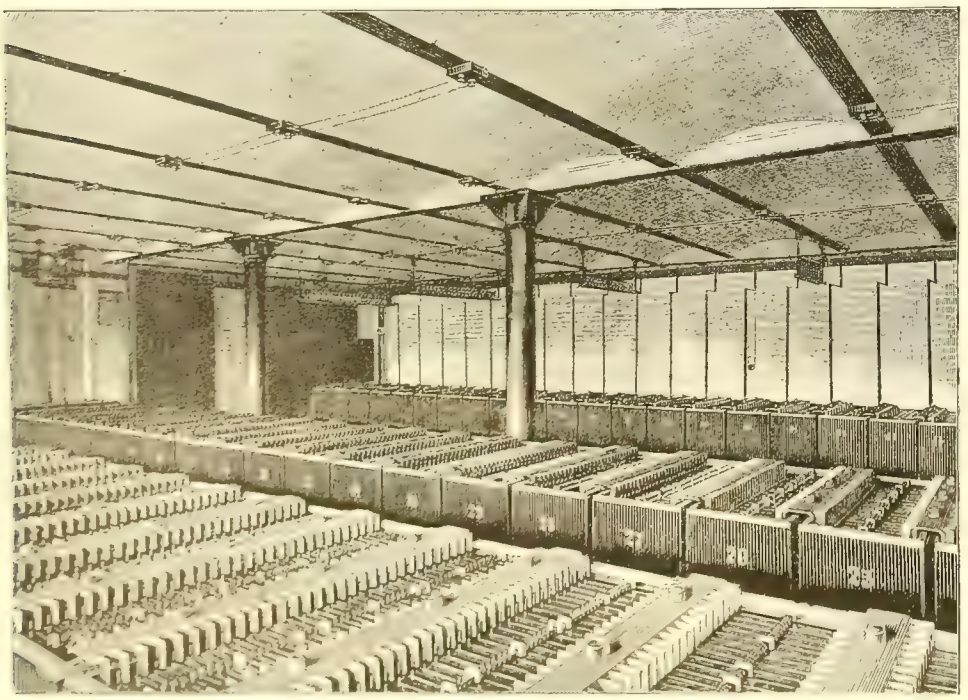


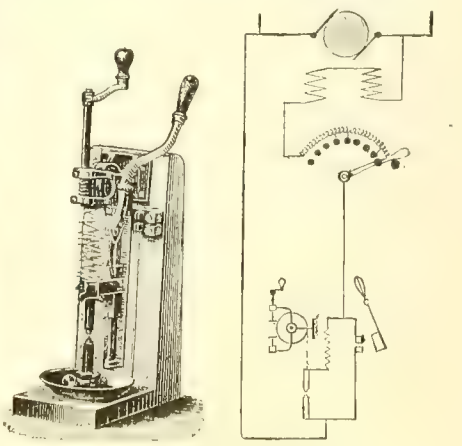
FIG. 3. ACCUMULATORS AT CHARLOTTENBURG.

The cells are arranged in three rows on heavy wooden beams, from which they are very carefully insulated by glass supports.

The whole arrangement of steam and electric plant, while used entirely in lighting the workshops, not only attests the firm's resources, but also emphasizes the ease with which large isolated plants can be run when carefully and intelligently installed.

Carbon Switch for Dynamos.

Among the improvements in appliances and accessories for electric plants which have of late been introduced, that very necessary piece of apparatus—the switch—has not been overlooked. The essentials required are greatest possible surfaces of contact, combined with ease of operation, yet the larger size dynamos demand still another quality. Practice has shown that in suddenly cutting out a dynamo, or in lifting the brushes, an "extra current" in the field is set up, which may be of such a high potential as to pierce the insulation of the winding. It is quite probable that as the result of this sudden cutting out the polarity of the dynamo is frequently reversed, with such unpleasant results, especially when storage batteries are being charged. In the accompanying cut is illustrated a carbon switch used recently by the Allgemeine Elektricitaets Gesellschaft in Berlin. If, as shown in the accompanying figure, the current should be cut off by the lever at the right, it will flow through first the band resistance and then through the carbons. An arc will be set up between these latter, which, by turning the crank and thus separating them, can be made as long as desired. In this way a gradual increase in the resistance and consequently a reduction in the field current can be accomplished, and this without producing a dangerous amount of induction. The accompanying diagram shows the connections between dynamos, shunt regulator and switch. The arrangement is such that in cutting in with the switch lever the carbons are at the same time automatically brought together, thus insuring against any sudden breaking of the current in the machine. The cut is reproduced from the *Elektrotechnischer Anzeiger*.



CARBON SWITCH FOR DYNAMOS.

It is stated that the two largest driving belts ever made in the United States are now being manufactured in St. Louis for an electrical power station. They are of three thicknesses of leather, each 72 inches wide, and 150 feet long. They weigh about 1,800 pounds each, and each belt contains about 200 tanned hides.

Electricity at the World's Fair.

On April 11th the WESTERN ELECTRICIAN published a map of the World's Fair grounds as then laid out, with another drawing showing the plan of the proposed "loop" of railway tracks with the inclosed circular machinery annex. Since that time, however, the design of the grounds has been changed and amplified to such an extent that the accompanying map, which is the latest issued by the construction department, will be found both interesting and valuable. As will be seen by the map, which shows Jackson Park as it will look in '93, the "loop" has been abolished entirely and its place taken by a system of terminal tracks or "stubs." With it went the circular monstrosity designated as the machinery annex. This annex, it is now decided, will be a rectangular building adjoining Machinery Hall on the west, as indicated on the map. A large part of this building will be used as a power station for the many engines and dynamos needed to supply electric light and power for the grounds. This installation will be of mammoth proportions. It is proposed to utilize the dynamos sent for exhibition purposes if satisfactory arrangements as to remuneration can be made with the exhibitors. Many other minor additions are shown on the new map, such as the location of the state and foreign buildings, the livestock exhibit, etc., but the change in the location of the power station will be of principal interest to electricians. Applications for space in the electrical building continue to pour in rapidly and Chief Barrett suggests that prospective exhibitors should file their requests as early as possible in order that all may receive due attention. A plan of the power house will soon be issued.

A complete fire alarm system will soon be in operation on the grounds at Jackson Park. One fire engine is already on the grounds and others will be added as needed. The signaling system is being installed under the supervision of Prof. Barrett and his assistants, and will be ready for operation in a few days. It will be connected with the fire alarm telegraph of Chicago, so that, if necessary, the entire fire department of the city can be hurried to any part of Jackson Park where it may be needed. It is thought, however, that the fire apparatus on the grounds will be ample to cope with all emergencies.

Before Col. Clowry's temporary absence from the city the committee on electricity transacted considerable business. An advisory committee consisting of Lieut. F. B. Badt, Chicago, and Luther Stieringer and Paul Le Maire, New York, was appointed to give the committee on electricity and Engineer Sargent the benefit of its advice in the designing of the lighting installation. Lieut. Badt is one of the leading electrical engineers of the country, while Mr. Stieringer and Mr. Le Maire have had considerable experience in exposition work, and will have charge of the decorative lighting effects. The committee on electricity has decided that all companies furnishing lights must provide conductors and everything complete, from the dynamo to the lamp. There was some opposition to this on the part of those who thought that the cable companies should be given an opportunity to provide the underground equipment at first hand in connection with their displays.

Electricity will be used for lighting the battle-ship exhibit, and electric motors will be used to work the great guns. Lieut. Taussig of the navy, accompanied by Engineer Sargent, recently inspected the work so far accomplished.

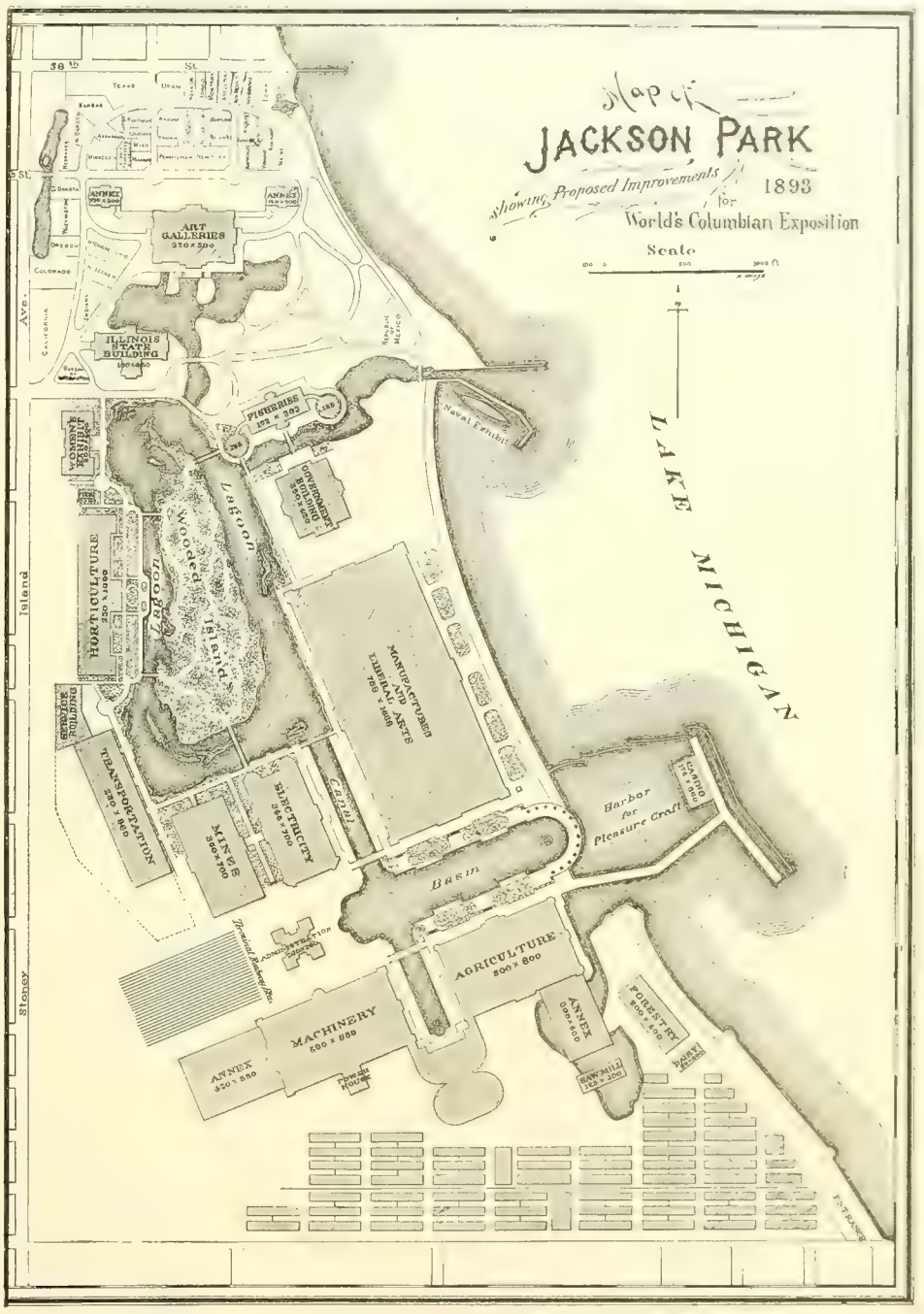
A dispatch from New York to the *Chicago Tribune* conveys the following interesting news:

The Western Union Telegraph company has instituted a search for the first telegram that ever went over the wires. When the Western Union concluded to make an exhibit at the World's Fair John W. Kirk, the veteran telegrapher, opened a correspondence with Maj. John Johnston, Piqua, O., who, he was satisfied, had the first message that was ticked out over Prof. Morse's wire. Maj. Johnston, in a response, said he had the message in the original cipher, but that it was mixed up with his papers and a partial search had failed to secure it.

Mr. Kirk has urged a closer and more complete search, and has offered in behalf of the Western Union company to bear the expense of the search. He will go to Piqua in a month to help on the search. The story of this first message, as told by Mr. Kirk, is interesting. In May, 1844, Prof. S. F. B. Morse, who was considered a crank by all except a few, was experimenting in a room in the Capitol at Washington, provided free of expense by the government under an appropriation by Congress. His line extended from Washington to Annapolis, Md. At that time delegates to the Whig convention were arriving in town, and among them was Maj Johnston of Piqua, O. Mr. Kirk took him into Prof. Morse's private office, where he was cordially greeted by Prof. Morse. The latter, after some conversation, said to him:

[illegible] in his pocket, carefully buttoning the latter. The message, as [illegible] over the wire.

When [illegible] message it will be carefully and handsomely framed by the Western Union company and be given the most prominent position in its exhibit at the World's Fair.



ELECTRICITY AT THE WORLD'S FAIR.—MAP OF GROUNDS SHOWING LATEST CHANGES.

[illegible] 20,000 feet in the electrical [illegible] distinguished foreigners that [illegible] enable them to have the required amount. Mr. [illegible] London, is [illegible] of a complete exhibit of English electrical machinery and appliances.

American Institute of Electrical Engineers.

The fifty-ninth meeting of the American Institute of Electrical Engineers, and the first of the present season, was held at the Institute, 12 West Thirty-first street, New York, on Tuesday evening, September 22d. Considering that it was a warm evening and early in the season, the attendance was quite large. A paper, "On the Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo Electric Machinery," was read by Professor Harris J. Ryan of Cornell University. This paper is presented in another column. The reading of the paper was followed by a general discussion.

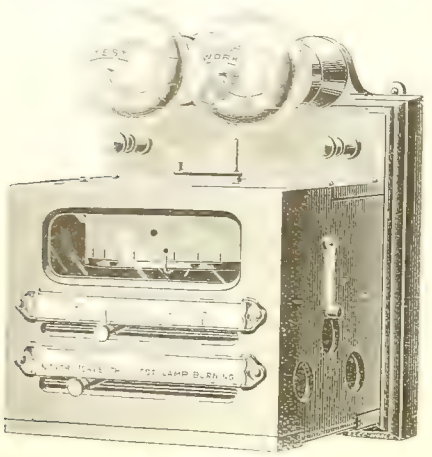
In view of the importance of the subject it was decided that the discussion be continued at a future meeting. Members who may not be able to attend and who are interested in the matter are requested to send to R. W. Pope, secretary, 12 West Thirty-first street, any communications which they may wish to have incorporated in the discussion.

The following named gentlemen have been elected associate members of the institute: Fordyce S. Caldwell, Kansas City, Mo., and 150 West Eighty-second street, New York city; Frederick G. Cartwright, San Francisco, Cal.; W. C. Cheney, Portland, Ore.; Charles W. Foote, Cleveland, O.; John L. Hall, Wilmington, Del.; William H. Hamilton, Albany, N. Y.; Henry H. Hosford, Cleveland, O.; Frank Land, Syracuse, N. Y.; Robert Heath MacMullan, Lafayette, Ind.; Lucius E. Marple, Nashville, Tenn.; Wm. Morris Mordey, London, England; Everett Morse, Boston, Mass.; Frank A. Pattison, New York city; Edward H. Rogers, New York city; W. M. Rutherford, Boston, Mass.; Fred. G. Schlosser, St. Louis, Mo.; Geo. Montague White, Kingston, Jamaica, W. I.

Marshall Field & Co. have added two 540-light Edison dynamos to the plant at their [illegible] on Adams street, Chicago. The sale was made by the Chicago Edison company.

Edison Pressure Indicator.

The Edison pressure indicator is illustrated in the accompanying cut. It is claimed that this device is the result of several years' experience and experiments with all kinds of indicators. It is an engine room indicator, and serves as a guide to the engineer and his attendant. The proper operation of an incandescent electric light plant demands good regulation; the pressure must be uniform and must be right, or the plant will not give the best results. Uniformity in the pressure is very necessary. Lamps operated



EDISON PRESSURE INDICATOR.

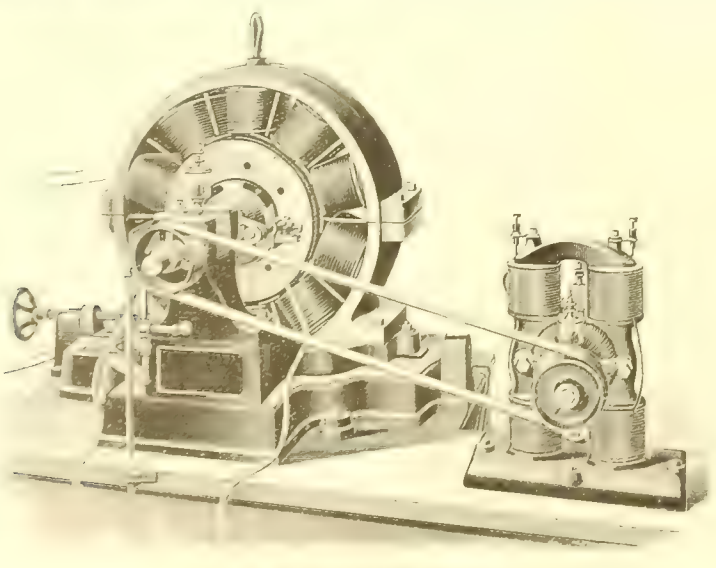
on a circuit, the pressure of which is sometimes above and sometimes below normal, never give satisfaction, while lamps operated on a circuit with uniform pressure are more satisfactory, and give a better light and life, even though the pressure averages several volts higher than the normal. The device illustrated is introduced by the Edison General Electric company.

A New Span Wire Tightener.

A simple span wire tightener is shown in the illustration. It is designed for use on the "field" side of the pole. It has only two parts, made of malleable cast iron, and, it is claimed, is practically indestructible. It is made by the Electrical Supply company, corner of Randolph street and Michigan avenue, Chicago.

La Roche Alternating Dynamo.

In the accompanying cut is shown the latest type of alternating dynamo placed on the market by the La Roche Electrical Works of Philadelphia. It is set on an insulated base, the belt tightener being also insulated to avoid any possibility of accident, and is so constructed that in case it should be necessary to remove the armature, the top or one-half the fields can be easily taken off by one man. The iron in the fields is made expressly for this purpose, and the [illegible] can be removed or put in without any adjustment whatever.

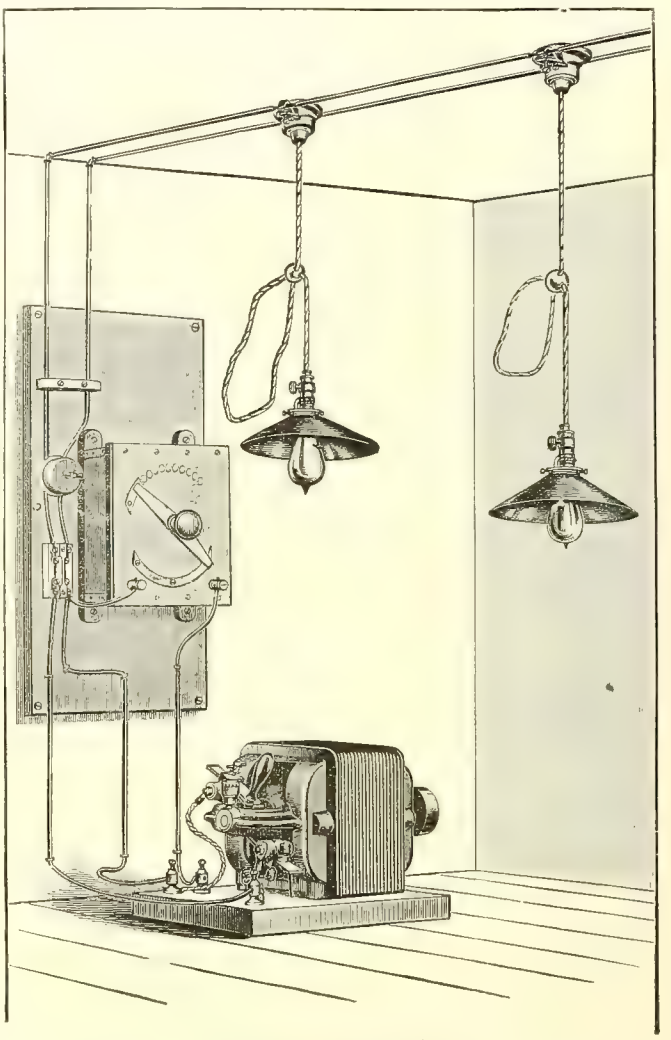


Small Electric Light Plants.

Foree Bain of Chicago, has devised an ingenious method of introducing small electric lighting plants in residences and small stores and shops. The fact that the residence to be illuminated is an isolated country home, or is not in the lighting district in the city, or that only a few lights may be required, does not now preclude the use of electric light, according to Mr. Bain. He also says that electricity "is the cheapest manner of producing light."

In the system which Mr. Bain is now introducing the dynamo is made of the softest Juniata sheet iron. The field magnets are stamped out of a single piece of sheet iron. A number of these pieces are put together and form a laminated field magnet of the best wrought iron without a joint. The end castings, which support the bearings are mitis iron, making them "iron clad," thus producing an ideal field. The field coils are placed inside, on the projections or poles on the field, between the two cast plates, so that every inch of wire on the field contributes to useful effect. The armature is of the drum type with Paccinotti projections, and winding of Froelich modification; the shaft is large and runs in thimble bearings of bronze metal, which are easily renewable; lubrication is accomplished with "Helmet" grease, and is almost entirely automatic; the commutator is made of tempered copper, it is large, and solidly put together with mica insulation. The voltage and speed are plainly stamped on each machine.

In the accompanying cut is illustrated a plant of this character in position ready for operation. The plants are placed on the market by the Bain Electric Manufacturing company of Chicago.

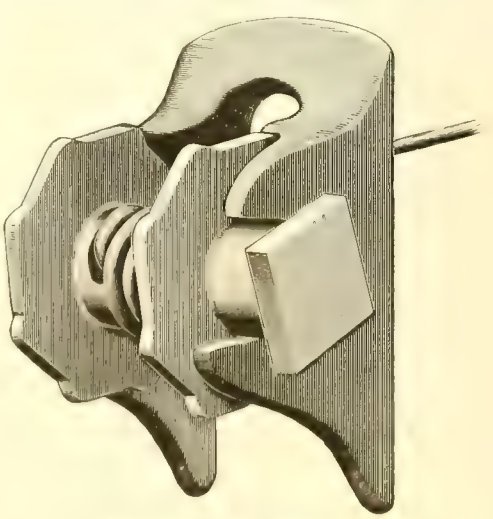


SMALL ELECTRIC LIGHT PLANTS

Lighting Chicago Boulevards.

Mayor Washburne of Chicago is heartily in favor of lighting the boulevards leading to the World's Fair by electricity. And, for that matter, so is every one else who has expressed himself on the subject. His Honor says:

"I have been indirectly informed that the South Park commissioners are willing to place lamps and posts for electric lighting along Grand and Drexel boulevards at the expense of the South Park board, if the city will only furnish the necessary power. Unfortunately the financial circumstances of the city [illegible] that I cannot give a definite answer to your proposition. For the present we may be in a position to treat with the commissioners on their [illegible] I do not see that this should preclude us from gotiations now. It is of the utmost importance to the city that both the boulevards shall be lighted by electricity. They lead directly to the World's Fair grounds. Fifty per cent. of all the people who visit the fair grounds will pass over them. Tens of thousands will drive on them to and from the fair grounds at night. The fair grounds will be brilliantly lighted, and of course by electricity. Coming from the fair grounds into a boulevard lighted by gas would be like going from the sunlight into a dark room. It is imperative that both boulevards be lighted by electricity. They are each 200 feet wide. There are rows of trees running along between the lamps. What good is gas in such a case? I hope that the negotiations between the city and the South Park board will result in the lighting of both boulevards after the most approved modern method—that is by electricity. Indeed, I hope the time is not far distant when all our leading thoroughfares shall be lighted by electricity."

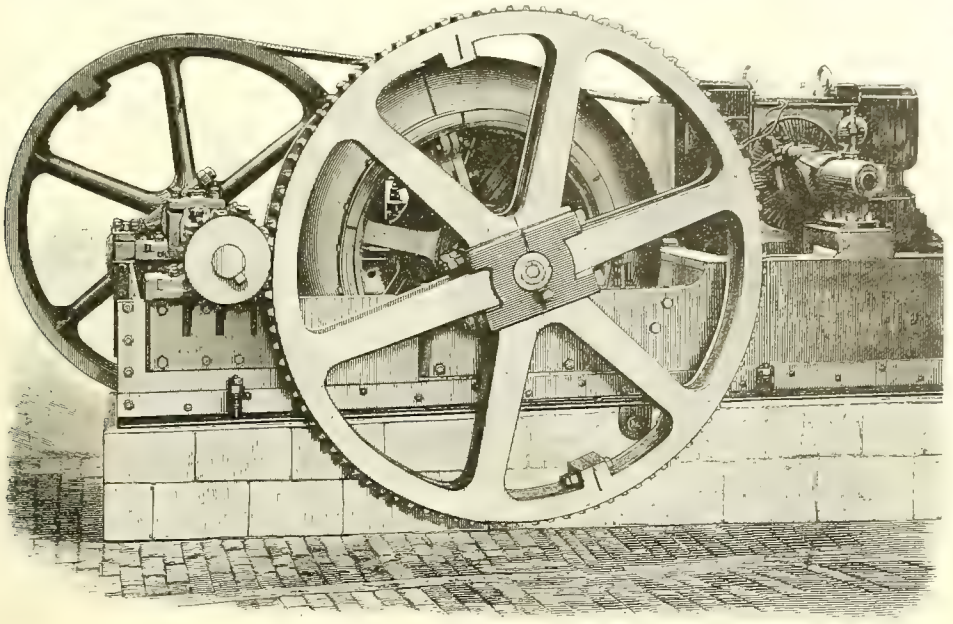


NEW SPAN WIRE TIGHTENER.

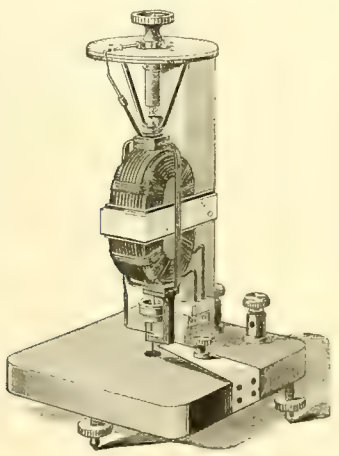
The far famed People's Palace of London is to be lighted by electricity at an expense of $30,000

Electrical Haulage for Mining Work.

Mining engineers in this country will learn with interest that English mining and electrical engineers are giving considerable attention to the development of electrical machinery for mines, and that already some good results have been obtained. Crompton & Co of London have installed an electric haulage plant at the Abercanaid colliery in South Wales. The winding gear is the usual form employed in the main and tail rope system, and this is found to work exceedingly well. The motor is a series-wound machine built to run at 600 revolutions and take 80 amperes at 450 volts at starting. When a heavier current is required it will take 160 amperes without harm. The motor is placed horizontally at one end of a wrought iron frame which forms the bed for the drum and spur wheel. The drum shaft, which is of steel, is driven from a countershaft by means of spur gearing, and the motors drive the countershaft by means of six one inch ropes. The haulage engine is fitted with two drums 3½ feet in diameter and one foot wide, which are controlled, by clutch and foot brake. This plant will haul coal from three different parts of the pit, and although these are not far from the motor at the present time, it is expected that coal will eventually have to be hauled nearly a mile. The generating plant comprises a Crompton dynamo, horizontal pattern, built on a wrought iron bed-plate. It is compound wound, running at 550 revolutions, and deliver ing 160 amperes at 500 volts. The cable connecting the dynamo with the haulage plant is 3,200 yards long, and is carried down the level by the side of the shaft, and between the hauling engines it is fixed on each side of the roadway. The plant will replace 27 horses, many haulers and numerous helpers, at the same time increasing the output 100 tons a day. The cut is reproduced from the London *Electrical Review*.



ELECTRIC HAULAGE FOR MINING WORK

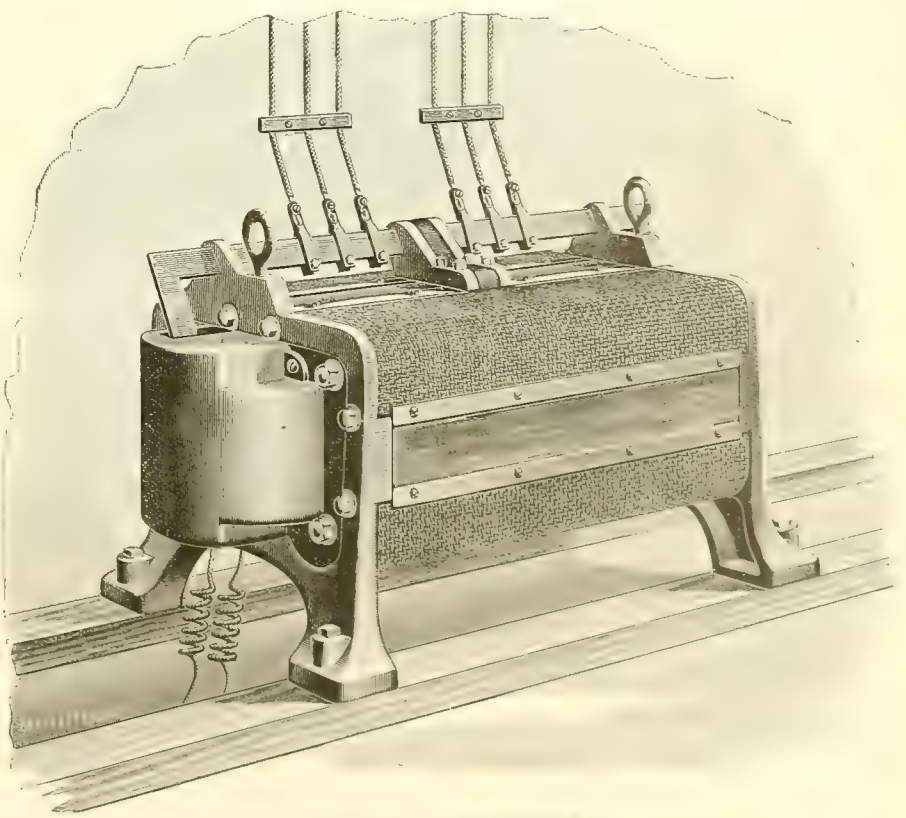


QUEEN'S NEW TYPE OF SIEMENS' ELECTRO DYNAMOMETERS.

The French man of war Magenta has been supplied with seven electric ventilators.

Stanley's Large Transformer.

In the accompanying cut is shown a new transformer recently placed on the market by the Stanley Electric Manufacturing company of Pittsfield, Mass. In general electrical design this transformer is similar to those already introduced by the company, but as will be seen from the cut is made for indoors, and is not intended to be placed on poles or outside of buildings. They are made in sizes of 200 and 300 lights each, and are too heavy to be put up in the air like the smaller sizes. A great advantage can be gained, it is claimed, by putting one of these large transformers in the center of a block instead of using a lot of small ones. The transformer is designed in such a way that the heat generated in it is rapidly dissipated, and as it is fitted with bus-bars for making connections with the circuits, is extremely convenient to use. It is further claimed that these transformets have an efficiency of 96 per cent., and that they regulate within 1½ per cent.



STANLEY'S LARGE TRANSFORMER.

At the dinner given during the recent visit of the French fleet to Portsmouth some striking effects were obtained at the dinner table by lighting up the table (which was of glass) underneath, so as to glow in the "red, white, and blue" of the familiar tricolor.

Queen's New Type of Siemens' Electro-Dynamometer.

[illegible] it is claimed embodies the excellent features of the Siemens' [illegible] by releasing the spring shown on the base the coil is lifted from its agate and held tightly so that despite the roughest handling in transportation the jewel cannot be broken, while the steel center will accurately reseat itself in the agate owing [illegible] depressed by means of its screw. Instead of two uprights as in the Siemens' made type Queen's design employs but one, reducing the weight of the instrument, and making the working parts more accessible. The binding posts are placed at the rear of the instrument instead of in front, thus getting the connecting wires out of the way.

The instrument is finely finished in polished mahogany, and lacquered brass and copper. The dial is of opal glass and graduated in 400 equal divisions. These instruments are also being made inclosed in glass cylinders, and with a brass instead of wood support, and a silvered instead of opal dial.

Big Power Transmission Scheme.

The great dam across the Colorado river at Austin, Tex., is now making substantial progress. This dam will be, when completed, 1,150 feet long, 60 feet high and 18 feet wide at the top. There will be about 9,000 cubic yards of granite, 6,800 cubic yards of limestone and 55,000 cubic yards of rubble in the dam. The estimated cost of the dam itself is $465,000; to this is to be added the cost of the gate house, the canal which is to convey the water to the manufacturers and other auxiliary works, which is estimated at about $800,000 more. The dam is intended to utilize the power of the Colorado river. The water power will run the electric light plant, furnish power for electric railroads and for pumping, the water supply of the city and leave a surplus of some 15,000 horse power for the use of factories. It is about two miles [illegible] and the natural conditions are very favorable, as the river there runs between high banks [illegible] so that very little excavation is required [illegible] tion. It will be the largest power dam [illegible] this country.

Western Electrician

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, Editor and Publisher.
J. B. O'HARA, } Associate Editors.
F. L. PERRY, }
W. E. KELLY, }
J. J. BAKER, Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers, in clubs of four or more, $2.50, with free extra copy for eight subscriptions, foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.
N[illegible] One Hundred and Fifty Horse Power Sperry Railway Generator. Illustrated 199
The Oldest Cable Road Dismantled 199
Lighting a Jewish Synagogue 199, 200
Siemens & Halske's Lighting Plant at Charlottenburg. Illustrated 200
Carbon Switches for Dynamos. Illustrated .... [illegible]
Electricity at the World's Fair. Illustrated 201
American Institute of Electrical Engineers 201
The E[illegible] Pressure Indicator. Illustrated .... [illegible]
Ne[illegible] Wire Tightener. Illustrated 202
[illegible] Alternating Dynamos. Illustrated 202
Small Electric Light Plants. Illustrated 202
Lighting [illegible] 202
F[illegible] Ha[illegible] Mining Work. Illustrated .... [illegible]
[illegible] Large Transformer. Illustrated .... 20[illegible]
[illegible] Siemens' Electro-Dynamometer. Illustrated 203
[illegible] Power Transmission Scheme 203
Editorial 204
Street Railway Magnates, with Portraits .... [illegible]
[illegible] Association .... [illegible]
[illegible] of the Air Gap and the Shape of the Poles to the Performance of Dynamo Electric Machinery, by Harris J. [illegible] Illustrated. American Institute of Electrical Engineers .... 206, 207, 20[illegible]
[illegible] and the Census .... [illegible]
[illegible] C[illegible] .... 20[illegible], 20[illegible]
[illegible] H[illegible] .... 20[illegible]
[illegible] by [illegible] .... [illegible]
[illegible] .... [illegible]

DEPARTMENTS.

[illegible] .... 21[illegible]
[illegible] .... [illegible], 211
[illegible] 211
[illegible] .... [illegible]
[illegible] .... [illegible]
[illegible] .... [illegible]
[illegible] 211
[illegible] .... [illegible]
[illegible] .... [illegible]
[illegible] .... [illegible]
[illegible] .... [illegible]
[illegible] .... [illegible]

[illegible]

[illegible] bring the electric light within the reach of all, and when it is brought into competition with other forms of lighting, as an economical measure, there is no question of its adoption. Its superiority in other respects is too well established to leave room for question.

THE change by which the circular "machinery annex" at the World's Fair grounds is abolished is a good one. The present arrangement is shown in a fine map of Jackson Park, with the proposed improvements, which is presented in this issue of the WESTERN ELECTRICIAN. The square building will be much better adapted for use as an electric power station, for which it is largely intended.

PROF. RYAN's paper "On the Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo-electric Machinery," read at the recent meeting of the American Institute of Electrical Engineers and presented in this number, is a scholarly production and worthy the careful attention of electrical engineers. The author gives evidence of his painstaking researches, and the data he presents should be of much value to manufacturers of dynamos and superintendents of electrical plants.

AMERICAN electrical engineers are not braggarts and are always ready to give hearty recognition to the achievements of other countries in the science and application of electricity. It is gratifying to observe that this fact is recognized in England by leading technical journals, which feel called upon to remark it in view of Prof. Silvanus P. Thompson's silly attack on the electricians of the United States at the recent meeting of the British Association. Prof. Thompson is a man of considerable scientific attainments, with presumably a fair amount of common sense, and we are at a loss to know why he should make statements that are certainly false and apparently malicious.

ELECTRIC and mining engineers in this country will learn with satisfaction that electric machinery has been applied to mining in Wales, and that it is pronounced highly successful. Americans have long realized the practicability of electric mining and have not been slow to take advantage of the possibilities presented by the introduction of electrical apparatus in mines. Yet English miners have held aloof and criticised the work of their more progressive cousins. They have at last, however, been obliged to concede not only the availability of electrically operated mining machinery but also its superiority over other forms. The latest illustration of the success of English miners in applying electricity to their work is given in the case described elsewhere in this issue, which will no doubt be read with interest. That electric mining is bound to assume considerable importance has long since been realized in this country and it behooves our friends across the water to fall into line and take advantage of the new order of affairs.

IN another column is presented a brief synopsis of Allen R. Foote's paper before the New York Electric Club on "Making a Model New York City." Mr. Foote would have the whole system of transportation changed and as a matter of course he advocates the adoption of the electric motor in place of the steam engine for all service within the city limits. It is scarcely possible that Mr. Foote's system will be seriously considered, as New York is hardly prepared to undertake such a huge project.

There are, in the first place, too many conflicting interests to allow the establishment of the proposed system. These forces wield a vast power in the metropolis and their influence is by no means decreasing. Take, for instance, the present "L" road system. With the adoption of Mr. Foote's plan this enterprise would be doomed, and there is no probability that it would permit such a project to take possession of the field without a desperate struggle. Its position was plainly indicated when the report of the Rapid Transit commissioners was presented. Mr. Foote, it will be noticed, does not believe that the proposed underground system will prove a permanent solution of the problem. He maintains that the great mass of people will not be benefited by this scheme. Real estate values, he points out, will advance wherever the proposed system is extended, to such a degree that only the wealthier portion of the population will find it possible to take advantage of the improvement. His scheme for utilizing the second [illegible] and turning the upper [illegible] prove a gigantic undertaking and its success could only be secured by substituting electric plants for steam engines in all manufacturing es[illegible] If such a system were [illegible] no means certain that such a revolution could be effected—the question would arise: How is the capital to be secured for the enterprise? Certainly public funds would be required, and they could only be obtained through special legislation. And right here another difficulty would be met. It is hardly possible that the legislature of the state of New York would pass an enabling act providing for the issuing of bonds to secure the indebtedness. It is but necessary to consider for a moment the jealousy with which the municipal authorities of New York city are watched by the politicians of the rest of the state to realize the spirit with which this proposition would be received. It is to be regretted that the fate of great public improvements in this country depends largely on their political significance, and this is nowhere so apparent as in the Empire state. In this case it would mean increasing the political patronage of the party in power in New York city and such a result would be bitterly opposed in the rest of the state, where there is a strong tendency to cripple the political machine that controls the metropolis.

In view of these facts, therefore, it is hardly possible—in fact it is highly improbable—that Mr. Foote's scheme will be seriously considered and at the present time there seems no possible chance for its adoption. There are many commendable features in the project and some of them may be adopted, but the plan, as a whole, cannot but fail in spite of its many advantages.

IN this issue is presented a resume of the work instituted under the direction of the census department for the collection of statistics relating to electrical industries. The value of these statistics is fully appreciated by electrical companies, and as there is at the present time nothing of the kind at the disposal of managers of the companies the work was looked upon with much favor. The recent announcement at the Montreal convention that the work would be temporarily discontinued was received with marked disapproval, and the convention adopted resolutions protesting against this order and appealing to the department to resume the work in hand. It is to be hoped that other organizations—the American Street Railway association, for instance—will take similar action, and that a concerted movement be made to secure recognition of the claims of the electrical interests.

An idea of the scope of the work undertaken by the special agent of the census department in connection with the electrical industries is shown in the schedules prepared under his direction. They are complete in detail and cover the entire field of electrical development. It has been the aim of this branch of the census department to make as complete a record of the advancement of electrical industries as money and labor could secure. For a time this work must be permitted to rest, and it only remains for the electrical concerns to say how long this period shall be. United action on their part will bring the Department of the Interior to a realizing sense of the importance of the work in hand and the necessity of a prompt completion.

A STEAM railway journal, in an announcement quoted on another page, tells of a St. Louis suburban road on which steam locomotives have been supplanted by electric motor cars. Part of the line was operated by cable, but all of the old equipment has been discarded, and the cars and engines are offered for sale. This is a notable victory for electric traction over two rival systems. The superiority of electric over horse cars, in all respects, is very generally conceded. But the advocates of the cable system for large cities and of steam for suburban traffic have contended that these systems could be operated much more advantageously than electric cars where the traffic was very heavy. In the case in point, however, both systems were superseded by electricity under circumstances that their adherents claim to be best adapted to them. St. Louis is a large city, and it is fair to presume that the travel on a line of sufficient importance to be cabled is heavy. For over three miles in the city itself the line was operated by cable, while the steam cars plied on the suburban portion. Here is every condition that is supposed to be most favorable to steam and cable roads. And yet we are informed, on the authority of a leading steam railway journal, that the whole cumbersome combination is to be done away with, and electricity is to be substituted. The logical inference is very obvious, and the lesson to be drawn from the change is striking enough to attract the attention of street railway managers and owners all over the country. It is evident that electricity is destined to operate the street railways of the larger as well as the smaller cities, and the quicker this fact is realized and acted upon the better it will be for the pockets of the stockholders of companies now operated by other systems.

Street Railway Magnates.

The portraits presented in the accompanying group include prominent street railway magnates who will take a conspicuous part in the affairs of the American Street Railway association during the convention at Pittsburg. The group includes: Henry M. Watson, president of the American Street Railway association and president of the Buffalo, N. Y. Consolidated Railway company; William J. Richardson, secretary of the association and secretary of the Atlantic Avenue Railway company, Brooklyn, and the following Pittsburg magnates: J. E. Rugg, general superintendent of the Citizens' Traction company; James D. Callery, president Second Avenue Electric company; John H. Dalzell, president Pittsburg & Alleghany & Manchester Traction company; Murry A. Verner, president Pittsburg & Birmingham Traction company; D. F. Henry, president Federal Street & Pleasant Valley Railway company; George B. Hill, president Alleghany Traction company George I. Whitney, president Central Traction company; C. L. Magee, president Duquesne Traction company. These gentlemen are all prominently identified with street railway work, and are known to the members of the association.

Col. Watson of Buffalo has been interested in street railway matters many years, his first official connection with the Buffalo system being in 1868, when he took the position of secretary of the Buffalo Street Railway company. In June, 1881, he was elected president of the company, and has since been the controlling spirit in its affairs. In 1889 he was also made president of the East Buffalo Street Railway company, and when the several systems of the Breezy City were consolidated Col. Watson was placed at the head. His administration of the affairs of the Buffalo railways has earned him a naitonal reputation. His connection with the association has dated from the organization of that body, and he has proved himself one of its most aggressive and popular members.

William J. Richardson of Brooklyn has been secretary and treasurer of the American Street Railway association since its formation, and he has conducted the affairs of these offices on the same business principles that have earned him success and renown in street railway affairs. He has been identified with the Atlantic Avenue Railway, Brooklyn, as secretary since 1872.

Probably the best known street railway superintendent in Pittsburg is J. E. Rugg, general superintendent of the Citizens' Traction company. He is a progressive and intelligent business man, and is alive to the necessities of the patrons of his company. Improved methods of rapid transit are constantly being introduced, and at the present time there are seven miles of the company's road equipped with electrical apparatus.

The Second Avenue Electric company's line when established ten years ago was, of course, a slow going horse-car line, but shortly after the present management assumed control, with James D. Callery president, it was converted into an electric system, and is now operating 20 motor cars. Mr. Callery's progressive spirit is manifested throughout the management of the affairs of the company. Several extensions have been made, and the system is one of the best equipped in the city.

John H. Dalzell, president of the Pittsburg, Alleghany & Manchester Railway company, has always pursued a conservative policy in the management of this system. This company was the last to introduce rapid transit methods, and it will welcome the delegates to the convention with a complete equipment of electric cars fresh from the shops. The company is one of the most substantial in the city, and has equipped its lines with a costly system, representing the most approved methods of electric railway construction.

Murry A. Verner, president of the Pittsburg & Birmingham Traction company, has pinned his faith to electric railways, and is now reaping the rewards. His system is considered the finest short system in the country. Mr. Verner is a man of marked executive ability, and his success and that of his company have been due largely to his own activity.

D. F. Henry, president of the Federal Street & Pleasant Valley Railway company, has the distinction of being at the head of the corporation which introduced electric traction to the people of Pittsburg, and afforded rapid transit to residents about Allegheny. At present 55 electric cars are operated on this company's lines. Mr. Henry's efforts in behalf of the residents of Pittsburg and Allegheny were not fully appreciated at first, and he was opposed at every step by influential citizens, supported by the public press. The innovation seemed to startle the people, and but for Mr. Henry's perseverance the scheme would no doubt have been defeated. The success of the project may be realized, when it is noted that over 6,000,000 passengers were carried last year by this company.

George B. Hill is president of the Allegheny Traction company. He is also interested in several other street

STREET RAILWAY MAGNATES.

1.—Henry M. Watson. 2.—William J. Richardson. 3.—J. E. Rugg. 4. James D. Callery. 5. John H. Dalzell. 6.—Murry A. Verner. 7.—D. F. Henry. 8.—George B. Hill. 9.—George I. Whitney. 10. C. L. Magee.

road.

Among the recently constructed street railways the [illegible] position owing to the excellent construction and engineering [illegible] road. C. L. Magee, [illegible] known throughout the East, and especially in Pennsylvania, as a shrewd politician, and in the management of the Duquesne company he has shown himself a successful business manager. He [illegible]

American Street Railway Association

The tenth annual meeting of the American Street Railway association will be held at the Monongahela House, Pittsburg, Pa., beginning Wednesday, Oct. 21st, at 10 A. M., and continuing three days. The arrangements for the business meetings have been completed, and an attractive programme is offered. The secretary announces that special committees will report on the following subjects: "A Perfect Electric Motor;" "A Year's Progress of Cable Motive Power;" "Public and State Treatment of Corporations, No. 3;" "The Dependent—Overhead or Underground—System of Electric Motive Power, and The Independent—Storage or Primary Battery—System of Electric Motive Power." Notice has been received by the secretary from the president of one of the member companies that a special paper will be read on Standards in Machinery and Appliances for Electric Railways. Representatives of the leading companies manufacturing electric railway apparatus will be present to explain the operation of their systems. This will probably be the most interesting part of the proceedings to the delegates, as the majority of the 172 companies comprising the association are operating electric plants or contemplating the introduction of an electrical equipment. Comparisons of the several systems, therefore, cannot fail to prove both interesting and instructive to these delegates.

The local committee on arrangements, of which John G. Holmes, president of the Citizens' Traction company, is chairman, has chartered a double-decked excursion boat, which will be moored to the wharf alongside the Monongahela House to be used for the exposition. Heavy supplies will be placed on the lower deck and lighter ones on the upper. The boat will be suitably decorated, and lighted in the evening, and will be made a pleasant and interesting place for the exhibition of supplies.

The Pittsburg street railway companies have not yet fully completed the arrangements for the special entertainment of those in attendance. Preparations for two excursions are under way, and they will assuredly be of a very enjoyable character. A handsome souvenir of the meeting is being prepared. In addition to the representatives of the companies included in the association, there will be the usual number of supply and construction companies represented, and many of them will have interesting displays. The electrical features of street railway work will no doubt occupy the greater part of the attention of the delegates and visitors.

An interesting event will be the banquet at Monongahela House Thursday evening. This, it is promised, will be the most pretentious affair thus far undertaken by the association.

On the Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo-electric Machinery.[1]

By Harris J. Ryan.

The object of this paper is not to deal with the subject in a new light, but to add to its literature a limited amount of data, the deductions from which go to establish the correctness of the ideas, and the utility of the suggestions put forth in the papers read by Messrs. Swinburne and Esson, at the meetings of the Institution of Electrical Engineers on Feb. 13 and 20, 1890. Up to the time of the publication of these papers the air gap was usually treated by contributors to electrical literature as an evil in a dynamo, having a necessary existence, and the smaller that it could conveniently be made the better. The shape of the poles had often been spoken of as having a somewhat decided effect on the performance of the dynamo, while but little had been said regarding the cause of such an effect.

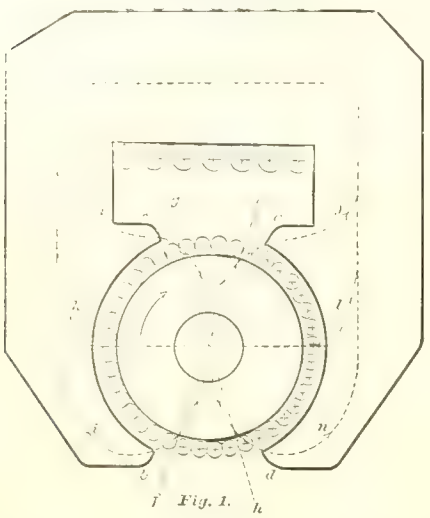


Fig. 1.

There exists some difference of opinion as to what should be known as the number of ampere turns on an armature.

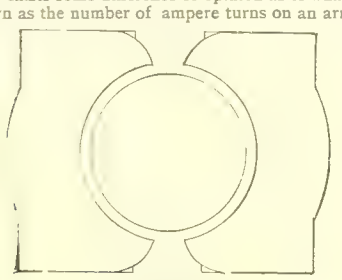


Fig. 4.

For our present purpose we will assume that the

Total number of conductors on the surface of the armature.	Strength of current in the armature conductors.

Ampere turns on armature = ——— Number of poles.

Referring to Fig. 1, it is evident that when we consider the magnetic forces acting in a working dynamo by the route *O, I, J, O*, that the entire number of ampere turns on the armature are directly opposed in action to the ampere turns on the field. By the route *O, M, N, O*, all the ampere turns on the armature except those that lie between

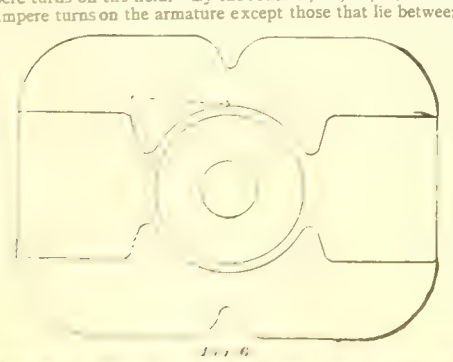


Fig. 6.

pere turns that lie between the double angle of lead are opposed to the action of the field ampere turns at all points. It is evident that the portion of the armature ampere turns not included between the double angle of lead will increase the magnetization through the air gap by the route *O, M, N, O*, just as much as they diminish it along the route *O, I, J, O*, as long as magnetic saturation does not take place in the strengthened pole corners *C, D*. If the pole corners are thin, as in the types shown in Figs. 2, 3 and 5, saturation is apt to occur. It is then that the magnetic resistance increases by the route *O, M, N, O*, and the magnetic density by this route is no longer increased by the same amount that it is diminished along the route *O, I, J,*

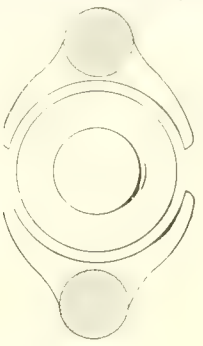


Fig. 2.

O. On the other hand, when the pole corners are fashioned as seen in Figs. 4 and 6, so that saturation in the strengthened pole corners cannot occur in practice, the current in the armature can produce no modification of the total amount of magnetization through it, other than that which is produced by the action of the ampere turns that lie between the double angle of lead. This action can always be compensated for by putting an equivalent number of series ampere turns on the field acting with the field ampere turns. The double angle of lead can be determined

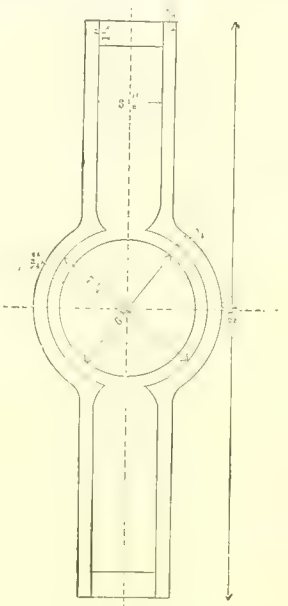


Fig. 5.

with sufficient accuracy, for with pole corners slightly extended at the center, see Fig. 11, the diameter of commutation at all loads is very near the weakened pole corners. The pole corners are slightly extended at the center, so that the coils always enter the field of the weakened pole corners gradually. The electromotive force developed in the coils as they pass under the poles can never be far different from that actually needed to reverse the current in the coil when passing under the brush. In this way the point of commutation in a dynamo can be kept the same when carbon brushes are used without undue sparking, as long as the armature does not reverse the magnetization under the weakened pole corners.

From the discussion of the magnetic relations of an armature to its field in a dynamo in connection with Fig. 1, it is seen that the magnetization in the air gap under the weakened pole corners becomes zero, when the armature ampere turns are equal to the ampere turns on the field, whose magnetizing force is impressed between its pole faces through the armature. This impressed magnetizing force is that due to the difference between the total number of ampere turns on the field and the number of ampere turns required to set up the magnetization through the field cores, from pole face to pole face. In order to commutate the current without spark at the commutator, the magnetization in the air gap under the weakened pole corners dare never be allowed to become zero. It follows then that the field ampere turns impressing a magnetizing force between the pole faces must always be somewhat in [illegible] number of ampere turns on the armature. The amount of this excess need only be sufficient to [illegible] a [illegible] field at *I* and *J*, Fig. 1, strong enough to [illegible] the current in the coils as they are commutated. When a certain amount of magnetization is to [illegible] armature with the application of the magnetizing force of a given number of ampere turns impressed between the pole faces, we must provide the requisite amount of magnetic resistance between these pole faces. The value of this resistance will have to be such that the impressed field magnetizing force will establish the desired amount of magnetization. This resistance in most cases is best provided for in a proper length of air gap. In general it is found best to avoid heating in the armature core as far as consistent, by the use of comparatively low magnetic densities for wrought-iron. The magnetic resistance of the armature core under these circumstances is very small and may be neglected.

The magnetic resistance between the pole faces is occasionally provided for largely, either through a saturated

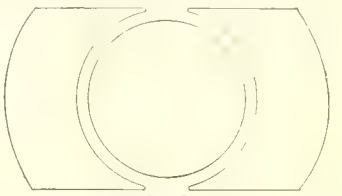


Fig. 3.

core of a ring armature, saturated lugs on armatures where the wires are placed in grooves, or both. This in addition to what air gap may be necessary from a mechanical point of view, go to make up the total amount of magnetic resistance that is provided between the pole faces. Machines of this order have been developed largely through the old and rather expensive method of experimentation. This method has given us some types in which ordinary results are arrived at, through rather extraordinary means. Take the case of a machine with a ring armature, wires wound in grooves, a very small air gap, and poles shaped somewhat as shown in Fig. 2. Such a machine operated as a dynamo, may require only a quarter of the number of ampere turns that it will have on the armature at full load, for field excitation in order to produce a certain electro-motive force at a given speed. Yet this machine produces a fairly constant potential at the brushes under all variation of load, and without undue sparking at the commutator in the following manner: For the production of a constant electro-motive force at constant speed, the total magnetization through the armature must remain constant. At no load one-fourth of the ampere turns needed on the field at full load, are provided by a shunt winding. This shunt winding is sufficient to set up the total amount of magnetization for the production of the normal electro motive force of the machine when there is no current in the armature. Now in order to take the normal current from the armature without reversing the magnetization under the weakened pole corners, three times as many series ampere turns as there are shunt ampere turns must be added to the field. The addition of these series ampere turns must not increase the total amount of magnetization through the armature, which is accomplished by the thin pole corners. The strong pole corners become saturated when the armature is furnishing even a small amount or the normal current for which it is designed. For most values of the current then, the armature ampere turns tend to diminish the magnetization under the weakened pole corners but cannot increase it correspondingly under the saturated pole corners. The action of the series ampere turns on the field prevents the reduction of the magnetization under the weakened pole corners to zero, while the saturated portion of the pole pieces prevents the increase of the total magnetization through the armature, and thus a constant potential is maintained.

The "armature characteristic" IV., plotted in Fig. 7, was taken from the machine of the above sort, built with cast-iron fields. The cross-section of the field cores proved on trial to be too small, and became strongly saturated at full load, while they were quite a little under the point of

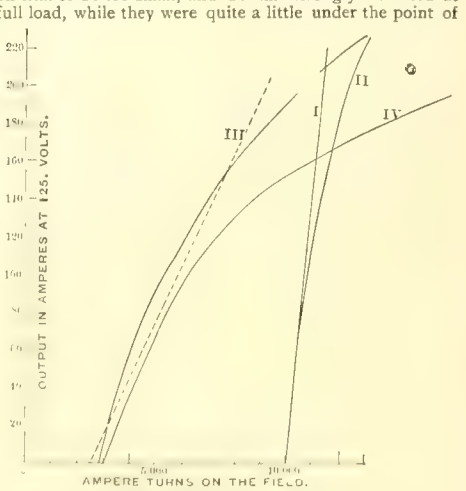


Fig. 7.

saturation at no load. This curious result for a constant potential generator was due to the increased magnetic leakage, produced as the series ampere turns on the field came up with the load. Saturation took place as the curve indicates, when the armature furnished a current of about 140 amperes, and no possible compounding could ever make this generator produce even approximately a constant potential, with variation of load. Steel cores of the same dimensions were substituted for the cast-iron cores. Saturation did not occur in them due to magnetic leakage. The pole corners were very thin, as in Fig. 2, and the "armature characteristic" III. was obtained. The machine was then furnished with a shunt winding that pro-

duced a slightly smaller number of initial ampere turns than curve III. indicates as required to produce 125 volts, and with series turns at such a number that the total number of ampere turns on the field for any current developed by the armature is shown by the broken line drawn through curve III. It was under these conditions that the machine performed in the manner described above, and not vary more than 5 per cent. from the normal electro mo ive force on either side, or total variation of 10 per cent. It was then almost entirely rebuilt. The armature was provided with a core that was considerably larger in cross-section, and the maximum magnetic density used in it was 11,000 lines per sq. cm. as against 20,000 used before. The lugs on the core were dispensed with, and the wires wound on the surface of the core. The poles were made of cast

Fig. 8.

iron, and fashioned to accord more nearly with those in Fig. 3. The air gap required ten thousand ampere turns to set up the magnetization through it at no load, while the armature ampere turns were 8,000 at normal output, so that series ampere turns had only to be added to counteract the action of the ampere turns on the armature that lie between the double angle of lead, to increase slightly the electro-motive force by the amount equal to the fall of potential through the armature caused by its resistance, and to compensate for the slight effect of the pole corners that still became saturated to a limited extent for the higher outputs. It should be remembered that the magnetic leakage that takes place between the adjacent north and south pole corners, one of which is strongly and the other weakly magnetized, plays an important part in saturating thin pole corners. It is evident that unless the "armature characteristic" is a straight line as in curve I., Fig. 7, that the machine cannot be made to regulate for constant potential with a high degree of refinement. The poles were again changed and shaped as in Fig. 4, when an "armature characteristic" given in curve I was obtained, and the proper number of shunt and series ampere turns for a refined degree of regulation were readily decided upon. These experiments confirm what has been said above, and show how useless have been the attempts to diminish the air gap beyond certain limits.

It was shown on the outstart how we can calculate the actual magnetic densities in the air gap for any total magnetization through the armature, for any armature current. The results of the following experiments confirm the correctness of these methods. The diagrams in Fig. 8 give the values of the magnetic density at all points of the air gap of a generator producing 125 volts at the brushes and 80 amperes. The following are its dimensions and data:

Diameter of armature core	6.25 in.
Length of armature core	12. in.
Diameter of bore of poles	7 10 in.
Double depth of air gap	.94 in.
Armature sections	50.
Turns per section	2.
Resistance of armature	.06 ohm.
Poles shaped as in Fig. 3.	
Shunt turns on field	6400
Field current, no load, 125 volts	1.48
Field current full load, 125 volts	2 10
Speed	1600.
Carbon brushes used without lead.	

The "armature characteristic" curved considerably, indicating that the pole corners become saturated It is evident too that the normal magnetization in the pole

Fig. 11.

corners in addition to the magnetic leakage which is greater there than anywhere else, produced saturation in all pole corners, even with no current in the armature. For at full load there were 4,000 ampere turns on the armature, while 4 000 series ampere turns had to be added to the field that produced 125 volts at no load to keep the electromotive force the same. Therefore, at full load we have the same number of ampere turns acting through the weakened pole corners as at no load, and the total amount of magnetization has only been increased 5 per cent., to compensate for the resistance of the armature conductors. The conditions, however, are not the same, for there are just 4 000 more ampere turns to cause magnetic leakage at the pole corners, so that on the whole the magnetization in them is increased. This increase of magnetic density in them greatly increases their magnetic resistance, for they are saturated to begin with. It is on this account that we find the magnetization under the weakened pole corners diminished, when apparently the forces acting have not been changed. The magnetization under the strengthened pole corners through the air gap is increased more than it is diminished by the effect of the added magnetic leakage, through the 8,000 additional ampere turns that act to produce magnetization by this route through the armature.

In Fig. 9 the diagrams show the magnetic action of the armature of a 10-horse power 110 volt motor, with poles fashioned as in Fig. 6. Measurements of the magnetic leakage were made on this motor, and the results indicate that the shape given to the pole corners avoided saturation in them even at full load. The double angle of lead was almost 60 degrees. The ampere turns embraced by it on the armature were partially compensated for by 9 series turns on each of the consequent fields. The remainder of the armature empere turns that lie between the double angle of lead served to weaken the field by just the amount required to produce a constant speed. The following figures give additional data on this motor:

Diameter of armature core	8 33 in
Diameter over all	9 in
Bore of poles	9.35 in.
Double air gap	1 05 in
Shunt turns on field	2200.
Shunt current at 110 volts	3.55.
Ampere turns on field at 110 volts	7800
Ampere turns on armature at full load	5750.
Armature sections	40.
Turns per section	3
Speed	1200.

The ampere turns required to set up 2,600 lines per sq cm. through a distance of 1.05 in. or 2.64 cms. in open air are

$$\frac{2600 \times 2.64}{1\ 26} = 5600.$$

This is the number of field ampere turns that exerted

Fig. 9.

their magnetizing force between the pole faces through the armature. The ampere turns acting through the weakened pole corners are, therefore, very near zero, which is entirely corroborated by the fact that the magnetization was observed to be zero at this point—see full load curve in Fig 9. Through the strong pole corners the ampere turns acting were the 5600 of the shunt ampere turns, + the 720 of the volt series turns + the armature ampere turns, 5150,—twice the ampere turns between the double angle of lead, 2, [3×5750], or 3400=8670 which will produce a magnetic density through an air gap of 2.64 cms. depth of

$$\frac{8670 \times 1.26}{2.64} = 4100,$$

while the actual magnetic density measured at this point was 3950, an agreement within the possible limit of error.

In Fig. 10 are given curves showing the magnetic performance of an armature, with its conductors laid in deep narrow grooves, as shown in Fig. 12. The clearance on each side was one-sixteenth of an inch, making the double air gap one eighth of an inch. Additional dimensions are as follows:

Diameter of the armatue core	6 in;
Length of armature core	6. in.
Resistance of armature	.34
Number of sections	64.
Turns per section	3.
Output, amperes	20.
" volts	100.
Speed	1800.

Curve I, Fig. 10, shows the distribution of magnetization at 112 volts, no current, a speed of 1800, and a field excitation of 2600 ampere turns. Curve II shows the magnetic distribution for an output of 97 volts and 24 amperes, at a speed 1800, and a field excitation of 2600 ampere turns. Curve III shows the magnetic distribution at an output of 40 volts and 20 amperes, at a speed of 1800, with a field excitation of 750 ampere turns. This same excitation when the armature furnished no current, produced an electromotive force of 48 volts, at a speed of 1800 revolutions. The poles were shaped as in Figs. 11 and 12, but modified as explained below. In making these experiments carbon brushes were used, and their position maintained at the normal diameter of commutation. An average magnetic density in the air gap of 3400 lines per sq. cm. was required to produce an electromotive force of 112 volts. The grooves on the armature in which the conductors were placed, occupied one-half of the armature surface, so that the actual magnetic density in the air gap was 1.8 times this average magnetic density. The ampere turns required to set up this magnetic density in the air gap were

$$\frac{.125 \times 2.54 \times [3400 \times 1\ 8]}{1.26} = 1520,$$

which is the number of field ampere turns whose magnetizing force is impressed between the pole surfaces through the arm[illegible] current. The ampere turns [illegible] of 24 amperes [illegible]

[illegible]

again [illegible] in. p[illegible] the magnet[illegible] reversed as is [illegible] 10, or the curves [illegible] Fig [illegible] also shows that the magnetic density under the strong pole corners was 5,100 lines per sq. cm. Now in building this machine six longitudinal slots, 1¼ inches deep were cut in each pole immediately back of [illegible]

Fig. 10.

us to be sure of the exact densities in the pole corners for a given distance. For a depth of 1¼ inches immediately back of the pole faces, these slots took up one-half of the cross-section of the poles. Then a density, therefore, of 5.100 really means a density of 10,200 or a strong saturation for a distance of 2½ inches in the cast iron of the poles. The magnetizing force required to produce 10,200 lines per sq. cm. through cast iron is 200 per centimetre length Therefore the ampere turns required to establish this density through 2½ inches are

$$\frac{2.5 \times 2.54 \times 200}{1.26} = 1,000$$

The total number of ampere turns acting to produce magnetization through these strong pole corners was the sum of the field ampere turns that impressed magnetizing force from pole face to pole face through the armature, and the ampere turns on the armature covered by the poles. The poles covered approximately 85 per cent. of the armature surface, making this value: 1,500 ×[2,300×.85] =3,400. Of this number, as was just shown, 1,000 were utilized in producing the magnetic density of 5.100, through the saturated portion of the poles. The remaining 2,400 ampere turns exerted their magnetizing force in producing the average magnetic density of 5,100 through the air gap, and affords another opportunity of checking these ideas of the action of the armature of the field. For the ampere turns required to set up an average magnetic density of 5 100 through the air gap under consideration were

$$\frac{[1.8 \times 5,100] \times .125 \times 2.54}{1.26} = 2,300.$$

which checks with the above value as well as could be expected. When the armature furnished 24 amperes, the electromotive force at the brushes was 97 volts while with no current it was 112 volts. Of this drop of 15 volts, 8 are accounted for by the resistance of the armature, and the extra seven were caused by the saturated pole corners. By operating this same machine at an electromotive force at which the pole corners could not saturate with normal output of current, we have demonstrated for us in a very striking manner that the armature ampere turns cannot change the total magnetization established through the armature by the field when the pole corners do not saturate. The electromotive force with the armature current at zero, was brought to 48 volts with a

Fig. 12.

separate field excitation of 750 ampere turns. Then when the armature was allowed to furnish 20 amperes the electromotive force at the brushes dropped to 40 volts. Of this drop of 8 volts, 7 were produced by the resistance of the armature. Yet the field is powerfully distorted by the armature current, as may be seen by reference to curve III, Fig. 10, or the curves [illegible] Even with this very great rearrangement of the magnetization produced by the armature current, the total magnetization set up by the field is practically unchanged. The difference

of potential on the commutator between the points A, B. Fig. 12, was observed to be 72 volts. This excess of electromotive force over that which was produced at the brushes, the figure shows clearly to be due to the magnetization produced by the armature through itself and the strengthened pole corners. The points where the field is zero are at A, B. They mark the diameter through which the ampere turns encountered on the armature are just equal and opposite in action to the ampere turns of the field that impress a magnetizing force between the pole faces through the armature. A simple computation will show that this is true. The field ampere turns that impress magnetizing force between the poles when the armature produced an external electromotive force of 48 volts are

$$\frac{1\ 520 \cdot 48}{112} = 650.$$

The ampere turns on the armature opposed to the magnetization set up by the route A, B. are $\frac{12}{40}$ of the total number of ampere turns on the armature, Fig. 12, or

$$\frac{12 \times 64 \cdot 3 \cdot 20}{40 \cdot 2} = 570.$$

This is a fair agreement when we consider the accuracy with which the original data may be determined.

Mr. Esson in his valuable paper, above referred to, discussed the requisite features for a generator for constant current, with closed coil armatures, in which regulation is effected by shifting the brushes. He stated that the field should be uniform at all points, under the poles, and that the armature core should be saturated. These statements are a little misleading. The magnetizing force impressed by the field ampere turns must be uniform at all points between the pole faces. This is accomplished by proportioning the poles so that the strongly magnetized pole corners will not become saturated when the brushes have their extreme position for the development of the highest electromotive force that the machine is to produce. The air gap is made of such a depth that the ampere turns required to set up the magnetization through the armature, without current, and for the production of the highest electromotive force that the machine will be called on to give, shall be a little more than the armature ampere turns when it furnishes its normal current. Then as long as the brushes are kept under the pole faces, the non-sparking point will be wherever the brushes are placed. This will be the case whether the armature is or is not saturated. A practical demonstration is found in the following experiment: A Siemens & Halske dynamo with magnet and armature cores, whose shape and dimensions are shown in Fig. 5, was used.

Length of armature core [illegible]	[illegible] 25 in
Number of armature sections [illegible]	[illegible]
Turns per section [illegible]	[illegible]
Revolutions [illegible]	[illegible]
[illegible]	[illegible]
[illegible] amperes [illegible]	[illegible]

The field was separately excited with 4,000 ampere turns on each of the sets of consequent poles Regulation could then be effected for a constant current in the armature of 22 amperes by shifting the brushes from no electromotive force to 35 volts without the slightest sparking, even when metallic brushes were used. Within this limit the pole corners did not saturate. The field cores were wrought and the yokes cast iron. When the armature circuit was broken, it was found that the field excitation of 4,000 ampere turns produced an electromotive force of 50 volts. The magnetic density in the field cores, including leakage, was only 11 000 lines per sq. cm. Therefore, of the 4,000 ampere turns on the field, not more than 200 were applied in setting up the magnetization from pole face to pole face through the field cores. It is safe to assume then, that of these 4,000 ampere turns, 3,800 were active in producing a magnetizing force impressed uniformly over the pole faces through the armature. This same value is obtained by the method adopted in the previous cases. That is by calculating the magnetic density in the air gap when 50 volts were developed, and then deducting the number of ampere turns required to establish such a magnetic density through a 1½ inch air gap. [illegible] when it produced 22 amperes its ampere turns numbered

$$\frac{[illegible]}{2} = [illegible]$$

[illegible] impressed by the field [illegible] armature. As long as this [illegible] maintained on the field it was not possible to regulate for a constant current of a lower or a higher strength without sparking. The impressed field ampere turns are in excess of the armature [illegible] in the coil when its terminal bars at the commutator pass under the brush. When regulation is effected by this [illegible] magnet [illegible] and [illegible] highest electromotive force, the magnetization under the [illegible]

Electrical Industries and the Census.

opposite direction when field and armature currents remain the same as in a dynamo. The electromotive force of self-induction caused by the reversal of the current in a current has not changed, while the electromotive force developed in the coil by the field has changed sign with the change of the direction of rotation. The result is that the reversal of the current in an armature section must take place in a weak field of an opposite sign in a motor from what it does in a dynamo, when sparking is to be avoided entirely.

The action of the current in the armatures of multipolar dynamos and motors will be the same as that found for two pole machines.

Electrical Industries and the Census.

Interest in statistics concerning the electrical industries of this country is not confined to those actively engaged in the manufacture or operation of apparatus. It is quite probable that there is no other department in which the general public has evinced so much interest. In view of this fact the recent circular issued from the electrical department of the census office, if such it may be termed, will be eagerly scanned. According to Allen R. Foote, the special agent appointed for this work, there have been prepared, for the collection of statistics for the electrical industries for the eleventh census, nineteen schedules and as many supplements, covering the following subjects:

1. Schedules for Preliminary Information.
2. Schedule for Educational Institutions, giving a course in Electrical Engineering.
3. Electric Light and Power Stations.
4. Manufactures of Electrical Apparatus and Supplies.
5. Isolated Electric Light and Power Plants.
6. Commercial Telegraph Companies.
7. Commercial Telephone Companies.
8. Steamboat Electric Light and Power Plants.
9. Municipal Electric Light and Power Stations.
10. Uses of Electricity in Medicine and Surgery—Manufactures of Apparatus.
11. Uses of Electricity in Medicine and Surgery—Medical Colleges.
12. Uses of Electricity in Medicine and Surgery—Hospitals.
13. Uses of Electricity in Medicine and Surgery—Physicians.
14. Municipal Fire Alarm Telegraphs.
15. Municipal Police Patrol Telegraphs.
16. District Messenger Companies.
17. Uses of Electricity in Mining.
18. Telegraph Lines used by Steam Railroad Companies.
19. Electric Street Railroads.

There have also been issued about fifty forms of printed letters of inquiry and transmittal, besides numerous typewritten and form letters.

In addition to the statistics provided for by these schedules, statistics will be collected by letter or personal application on the following subjects:

1. Scientific Electrical Instruments.
2. Ocean Telegraphs.
3. Electrical Distribution of Time.
4. Uses of Electricity by the United States Government.
5. Electrical Tabulating Machines and Registers.
6. Electroplating.
7. Electro-Metallurgy.
8. Electric Welding.
9. Special Uses of Electricity by Steam Railroads, such as—
   (a) Telegraphing from Moving Trains.
   (b) Special Uses of the Telephone.
   (c) Block and Road-Crossing Signals.
   (d) Electric Headlights.
   (e) Electric Train Brakes.
   (f) Electric Train Lighting.
   (g) Uses of Electric Motors for Operating Drawbridges, Turntables, Traveling Cranes, Hoists and Telpherage.
10. Electrical Patents issued by the United States.

At first it was proposed to limit the special inquiry to manufactures of electrical apparatus and supplies and electric light and power stations. It soon became apparent, however, that public interest in the multiform applications of electrical energy to commercial uses was very great.

The proper relations to be established between municipalities and electric light and power companies and electric street railroad companies, covering necessary rules for the safe wiring of streets and buildings for these services and the proper regulation of charges for service rendered, are questions of vital importance to the entire urban population of the country.

The series of schedules here presented is a first attempt, as none have before been formulated for the collection of such statistics. The report, giving the results of the work, will be the first statistical record of the electrical industries. The statistics will be largely used to settle questions of supreme importance to the public and those whose labor and capital are employed in rendering various quasi-public services. These conditions and a due regard for the credit of the census office have united to fix a great responsibility upon the work of formulating these schedules. The work done to this date has been in the direction of preparing for the collection of statistics. Schedule making being now finished, the work of collecting statistics provided for will be pushed to a conclusion as rapidly as circumstances will permit.

These subjects have presented many difficulties, being entirely new and highly technical, and without a guide of any kind in the history of the census office. The cordial co-operation and assistance uniformly given by all persons called upon having a general or special knowledge of a particular electrical subject have rendered a reasonably satisfactory result certain. Every assistance that could be given has been rendered by those in interest, and the schedules formulated, with a single exception, have been approved by them before publication.

It is certainly to be regretted that at this stage of the proceedings the census department should decide to postpone the work, and it is to be hoped that the action taken at the recent convention of the National Electric Light association at Montreal will serve to show the authorities at Washington the necessity of pushing the work vigorously.

Commissioner Gilroy, of the Department of Public Works, New York city, [illegible] in a report to the effect [illegible] of removing wires and poles has been so great that the fund is about exhausted.

New York Electric Club.

At the last meeting of the New York Electric club, Sept. 24th, Allen R. Foote read a paper on "The Making of a Model New York City." Mr. Foote believes that the city should be rebuilt practically, with double-decked streets and stores on the second floors of buildings, etc; and instead of looking for relief from over crowded residence districts by resorting to the suburbs he would have "wage workers" live in the upper floors of the business blocks. In a word Mr. Foote does not believe the present lines and proposed system of rapid transit for New York will afford permanent relief. The following extracts from the paper may prove interesting to electrical engineers:

The problem to be solved is how to secure for New York the quickest and cheapest facilities for handling passengers and freight for its internal and external traffic; to provide the best and cheapest homes for wage workers; also warehouse and manufacturing privileges.

Supplementary the problem includes the services of water supply; gas for illumination, heating and cooking; electricity for telegraphing, telephoning, signaling, illumination and power.

The problem is not only to create the best conditions for the services named for New York as it is to-day, including its internal and external environments and relations, but to make the provision in such a way that it will be capable of gradual and systematic development, so that it will be ample for the requirements of New York as it will be one hundred years hence.

The problem is all this and more: It is so to fix conditions that increase of population and increase of business shall cheapen, instead of increase, the cost of comfortable homes for wage-workers, and the tax on commerce and industry for its accommodations and services.

The people are incited to favor this or that plan for rapid transit by glowing accounts of the time to be saved, the distance to be traveled and the comfortable homes to be enjoyed when the proposed better transit facilities are ready for use.

In all the descriptions given the following facts are omitted: That long before the proposed construction can be ready for use every foot of land within the zone of its influence will be advanced in price to a point that will prevent home-hungry humanity, with small incomes, from securing a home so located that any time whatever can be saved for the trip between the place of employment and the home.

That the supplementary conditions for supplying the necessities of modern urban life will cost infinitely more in the suburban districts—and for some time many of them cannot be obtained—than in the closely-built districts of the city. When the suburban home acquires all facilities that render time and expense saving service, the rent to be paid, if rented, or the cost of investment, if owned, will be equal to that of a city home.

That if advantages are to be enjoyed for intellectual associations in church, industrial, political or social meetings, a second trip must be made to such centers. The two round trips in a day will involve more loss of time than can be saved by any possible speed.

It is impossible for wage-workers, in order to get the advantage of present land values, to buy lots now, and let them lie idle during the time the improvements are being made that make such lots available for homes. They cannot have a home at all unless they can move into it at once and utilize their rent payments in the purchase. Their income will not admit of a duplication of payments.

Quick and cheap means of communication and transportation are fundamental industrial conditions. They include telegraphing, telephoning, the transportation of mails, persons and property. Those localities possess an economic advantage that have the quickest and cheapest facilities for such services. These services are each essential to the other. They can have no separate existence.

A system of rapid transit that does not provide for all of them is incomplete and partial totally inadequate to furnish facilities needed now, and absolutely incompetent to deal with the requirements of the future.

It seems strange that rapid transit for passengers should be the only thing talked about, when all the improvements of the century have been devoted to that object, while freight traffic is handled in wagons on wagon roads, as was done one hundred years ago. Is it not time this slow moving, endless procession of freight wagons should be notified that the quicker, cheaper and tireless forces of steam and electricity have been tamed to the service of transportation?

It is undeniably to the best interests of New York city that it be made the quickest and cheapest center in the world for manufacturing and for the handling of freight and its storage. This can only be done by improving terminal facilities for all waterways and all railways. This requirement determines the location and form of construction.

The route must be along the water front around the island, with cross-town connections at convenient intervals.

The construction must include the docks on one side and the area between the first and second streets from the water front on the other side, with a surface and an elevated roadway occupying the whole space of the water front street.

The surface roadway and the first stories of the docks and squares should be utilized entirely for freight or manufacturing, so constructed that a car from any railroad can be switched into any dock, warehouse or factory on the route, on either side of the city. The tracks should be so planned as to bring the floor of the car on a level with the floor of the docks, warehouses or factories.

The elevated roadway and the second stories of the

docks and square should be utilized for passengers, warerooms, manufacturing and stores.

The roadway structure should be substantial enough to be used for trains from any of the steam railroads and to admit of their being run at high speed.

There should be four or more tracks below and above, to provide for express and way traffic. The power used should be electric locomotives, which will eliminate the smoke, dirt and fire that are inseparable from the use of steam locomotives. This construction will enable passengers to travel in open air and daylight, and will make possible sanitary conditions that will change what is now the most filthy part of the city into a state of cleanliness and freshness of air that will make it, in these respects, a continuation of Battery Park.

All squares should be supplied with ample elevator capacity for freight and passengers, also with water, gas, steam heating, electric lighting and power, telegraph, telephone and signal services, so that each will have within itself all the mechanical appliances that modern science and invention have made contributory to industry and comfort. The buildings being of uniform height will afford the best supports in the world for the wires needed to supply electric light and power, also the telegraph and telephone lines, not only for internal communication, but for all external service. Stoppage of service or accidents to persons or property, with such construction, will be almost wholly unknown. Being over the tops of buildings and on a line with them, the wires will be almost entirely hidden from view, yet accessible, and offer no interference with other services, the natural place for which is underground as assuredly as the natural place for electrical service is in the air.

Steam power and electrical plants should be located at proper intervals to generate the power required for the roadways, and for all power-driven machinery used along the route, for docks, in warehouses, or manufacturing establishments, and for electric lighting of the whole area. These plants can also generate the steam and gas required for heating, cooking and other similar purposes

The upper floors should be designed for homes and should be supplied with every convenience for that purpose, such as baths, hot and cold water, steam heat, gas for cooking, electric lights and call bells. It will be seen at once that more comfortable homes do not exist. For many persons they will be on the same square or within one square of the work to be done. They will be surrounded by fresh air and good light; will be out of the reach of street filth, dust and annoyances; can be easily policed, inspected for sanitary and health purposes; will have passenger and freight elevator service, and will be accessible to all lines of travel and methods of communication.

In every room on every square electric power can operate any power-driven machinery and furnish a light that will not vitiate the atmosphere. At a cost of not more than fifty cents a month the family sewing machine can be made to work without causing the wife and mother to tread out her life at the wheel. The sewing woman can double her earning capacity and decrease her use of physical strength by using electrical energy to do the work. The skilled mechanic can easily acquire a room, the tools and machinery he needs and the command of power. This will enable him to enter the list of self-employed.

Manufacturing, from the smallest and lightest to the largest and heaviest undertakings, can be carried on with advantages never before known. The command of power without investment in a power plant and with absolute relief from its cares—a power that is always ready but need never run to waste; a power that brings with it no heat, smoke or dirt; steady as the power that holds the stars in place, strong as the power that moves the worlds through space, tireless as the power that lights the universe, is the ideal power for turning the wheels of industry.

Rebuked at Home.

On the discussion which took place on Mr. Preece's and Mr. Bennett's papers at the recent British Association meeting, *Engineering* commented as follows: "Prof. Silvanus Thompson made some remarks, which we notice, in order to protest against them as being uncalled for. No doubt there are certain citizens of the United States guilty of bad taste in decrying everything done abroad, and claiming for their own country the merit of originating all important advances. But these people are a minority, and even if it were not so, their existence would not warrant Prof. Thompson in saying, in regard to electrical matters, that Americans think they lead the world. When he adds that we, 'our noble selves,' lead the world, he identifies himself with that happily small number of Englishmen who are given to what we call 'bragging,' and Americans call 'spread-eagleism;' but which is objectionable to the majority of electrical engineers on both sides of the Atlantic. Americans are, as a body, ever ready to acknowledge the debt they owe to European, more especially English, physicists and engineers, while we trust that Englishmen are equally willing to admit that Americans show energy and resource in turning the discoveries of science to actual use, and this is the reason they often outstrip us in practicla showing."

The London *Electrical Review* adds: "No one can read Prof. Thompson's remarks without coming to the same conclusion as *Engineering*, for they were conspicuous for their want of good taste."

Steam Locomotives Supplanted by Electricity.

The lines of the St. Louis & Suburban railroad at St. Louis, Mo., including the narrow gauge steam road, says the *Railroad Gazette*, are to be operated wholly by electricity, and the company advertises its narrow gauge engines and cars for sale. This road comprises the old "West End Narrow Gauge," and what was formerly the St. Louis Cable and Western. The original terminus of the West End was west of Grand avenue, from which it was formerly worked in connection with the Olive street horse car line. Later the St. Louis Cable & Western was organized, and the two were worked together. The cable road from Grand avenue to the center of the city was opened in 1886, but it was unfortunate in location, and costly in operation, and finally succumbed, the whole being reorganized as the St. Louis & Suburban. The steam line, single track, narrow gauge, from Grand avenue to Florissant (northwest, in St. Louis county) is 16 miles in length. The cable, in the city, was 3.2 miles long, from Sixth and Locust streets to Grand avenue and Morgan street. This has all been prepared for operation by the Thomson-Houston electric system, the wires being nearly all up. The line will be made all of one gauge, and the company expects to have 120 new cars, laying aside entirely the old equipment. The opening of this line as an entirety is practically bringing an important passenger railroad right into the heart of the city. The terminus is two blocks south of the Lindell Hotel, on Sixth street. The line passes the postoffice two blocks farther west, and the company will carry mails and express freight, as the steam division has been doing all along. The date of beginning operations has not been fixed, but the preparations are going forward rapidly. Florissant is an old French villiage in a pretty valley near the Missouri river.

A War-time Reminiscence.

"It isn't often that a telegraph operator stops to think of the message he receives or sends," said an old operator in the *Lewiston Journal*. "They are all of a size to him. But I remember one night during the late war I felt my eyes moisten as I read the following to Senator Fessenden: 'My son is sentenced to be shot to morrow morning at 6 for sleeping at his post. Will you kindly see President Lincoln at once and intercede until I can reach Washington to present evidence which will clearly prove my son's innocence?' I knew that if the message were compelled to wait its turn it would not reach Senator Fessenden till too late for any hope of reaching the president, to say nothing of getting a reprieve sent to the line of battle, where the son was. I said to myself, here is a human life hanging by a thread. Shall I cut the thread by letting the message take its turn? No, I couldn't. I violated the rules and telegraphed the solemn message to all the hotels in Washington till the Senator was found and the message safe in his hands. Word came back that Senator Fessenden had obtained the reprieve, and I telegraphed the glad news to the poor old man up in Maine."

CORRESPONDENCE.

New York Notes.

NEW YORK, Sept. 26.—Within the last week there have been two reminders that the summer is past. On Tuesday night the American Institute of Electrical Engineers held its first fall meeting, and on Thursday evening the New York Electric club opened with a paper on "The Making of a Model New York City" by Allen R. Foote. Erastus Wiman, who presided, indorsed the views set forth in a half-hour speech.

Last week an account was given of the Western Union's schemes to secure the news of the Brooklyn Jockey club races. As was then stated, the telegraph company made desperate but unsuccessful attempts to outwit the Jockey club, and it seemed then as though the racing people would remain masters of the situation. Yesterday, however, there was a new development in the case. The Jockey club during the last week has been suspicious that there has been a leak somewhere, for the pool rooms have been receiving information which, is was plain, did not come exclusively from the Western Union man in the crow's nest. The crow's nest, it may be explained, is another name for a pole with a man on top. To be brief, the telegraph company's last dodge was to have the news telegraphed to those outside the track by means of flashes of light through holes in a coachman's hat. A handsome barouche stationed on the lawn near the betting ring, a well-dressed but statue like coachman, a family party of ladies, gentlemen and children in the carriage, a small battery, a key and an incandescent lamp concealed within a perforated hat—such was the outfit. The Pinkerton men were suspicious, however, and were rude to the coachman. They hauled him down from his box, pulled off his hat, and—well, then there was a great time that ended at a police station.

The newspapers indicted for publishing accounts of the electrical executions were called upon last Thursday to plead in the Court of General Sessions. In most of the cases the plea of not guilty was put in, but the right was reserved to interpose within two weeks demurrers to the indictments.

"I purpose to push the prosecution as rapidly as possible," said District Attorney Nicoll after court had adjourned, "and with all the vigor the office can command. It is not at all a farcical proceeding. My business is to enforce the laws as I find them. As long as the

[illegible] General Term at the October session, but some of the [illegible] November session."

[illegible] company endeavored to obtain the consents of property [illegible] accordingly appealed to the General Term of the Supreme Court, and [illegible] testimony and make a report as to the advisability of the proposed scheme. They will act in a judicial capacity, and public hearings will be held.

A meeting of the [illegible] yesterday, and the reports of the four consulting engineers on the plan of construction of the proposed Broadway-Boulevard line came up for final consideration. All that could be learned was that considerable progress had been made in the matter, and without doubt a conclusion will be reached by Monday, and the report will then be in shape for the presentation to the alderman at their meeting on Tuesday.

A decision in an important lawsuit has just been handed down by Judge Green of Trenton, N. J. The complainant, William A. Jewett of Orange, and the defendant, Robert Garrett of the Baltimore & Ohio Railroad company. The judge refused to set aside the summons, and the action, which involves $3,000,000, will be tried. The plaintiff was backed by an English syndicate, which proposed to lay a cable to England, and Garrett had agreed to assist the scheme by making connection with the Baltimore & Ohio road. It is claimed that Mr. Garrett refused to fulfill his agreement at a time when the plans were nearly consummated.

A report comes from Philadelphia of the first annual convention of the American Electro-Therapeutic association, which was held Sept. 24th, 25th and 26th. It was a representative gathering of physicians who have been pioneers in the advancement of a cause which is destined to be an important department in the general practice of medicine. The prime object of the association is to cause the recognition of electricity as a curative agent by the entire profession, and to surround its use by physicians with every safeguard. Many scientific papers were read. F. L. P.

San Francisco, Cal.

SAN FRANCISCO, Sept. 23.—The [illegible] electric roads projected for Oakland and Alameda is also to have a line on Harrison avenue, which runs along the tidal canal in Alameda from Park street to Fruitvale avenue. The petitions presented to the Alameda trustees for this line were made on behalf of the Oakland, Alameda and Piedmont railroad.

Several streaks of lightning confined themselves to within a radius of one mile of Salem, Oregon, recently, and even if the capital of the Webfoot state is a demure little city, its citizens evidently had a thundering big time. They opened the carousal with vivid pyrotechnics, then smashed the cap of one of the approaches of a steel bridge crossing the Willamette river. A dozen or more trees were splintered, a cow was Kemmlerized, torrents of rain, ruining considerable hay and some grain, were knocked out of the clouds, then, overflowing with mirthfulness, the forked flashes, doubled themselves up like jackknives, [illegible] 'rolled around in balls.' As a wind up [illegible] lively streak, doubtless in emulation of New York's mayor, outdid itself by rising up in its might, then coming down with both hind feet upon a trolley wire, skipping along to the power house, burning out a generator, and paralyzing the system [illegible]

The inevitable contest which arises [illegible] railway people and the telephone company soon after electric cars begin running, was commenced in Oakland a few days ago when [illegible] in falling, broke a telephone wire that dropped upon the trolley wire of the Oakland [illegible] company. In a [illegible] telephone office, together with fifty subscribers' telephones and the indicator and gongs in a fire engine house, was burned out, entailing a loss of $1,500. And now the telephone company holds that the trolley [illegible]

should have been provided with guard wires, while the [illegible] people is that the fault rests with the former in maintaining line wires that tumble down with little or no provocation, and also in that the central office is not protected with fuses. It is probable that the incident will lead to a legal controversy.

The motor men on the Victoria, B. C., electric tramway are on a strike for a reduction of working time to nine hours a day, and the staid Victorians are compelled to revive their English proclivities and walk.

Some three months ago the city and suburban railway company of Portland, Oregon, was organized, with a capital stock of $1,000,000. A recent press dispatch states that the new company has consummated the purchase of the Willamette Bridge Railway and the Transcontinental Street Railway companies' systems, embracing over forty miles of track on both sides of the river in the recently consolidated cities of Portland, East Portland and Albina. These lines cross the river over two different bridges On the east side the roads are both electric and steam motor lines, but the latter will immediately be converted into electric roads. In Portland proper the two roads just purchased are horse car lines and these will also be converted into electric roads. All cars from the east side of the river, after crossing the bridge, will come into Portland and center at the corner of Third and Morrison streets, whence the road will branch off into different lines to various portions of the city. The new company claims that when this is done it will have one of the most complete electric systems in the country.

The most important recent event in local electrical circles has been the announcement that the North Beach and Mission Railroad company is to change its equipment from horses to electricity, and that it is hoped to have the entire system changed by May 1st next. Ever since the Omnibus Cable company paralleled the Folsom street road of the North Beach and Mission company by running a cable road out Howard street, one block distant, the latter has realized the necessity for a better system of transit than by horseflesh, and at one time it was about concluding arrangements for a cable system, when such favorable reports were received from companies operating by electricity that at last the company concluded to adopt the most modern power.

It is not known as yet to whom the contract for the electrical equipment has been awarded, but the superintendent of the company announces that the overheard system will be used and the road will to a certain extent act as a feeder to the San Francisco and San Mateo electric road. The power house will be erected on the southwest corner of Fourth and Louisa streets, the site of the company's present stables, and a large carhouse will be erected on a block of land owned by the company at Folsom and Twenty-eighth streets. Construction will be begun on Folsom street at California avenue, probably during the present month. The superintendent of the company, Mr. Skelley, is authority for the statement that the entire plant, when equipped ready for passenger service, will cost above [illegible]

The seat of the war which has been going on for some weeks between the Consolidated Electric Railway company of Los Angeles and the Pacific Cable Railway company, also of the City of the Angels, has been transferred to San Francisco, and for the past fortnight or so representatives of the rival roads have been trying to effect a compromise without success. Both these roads were constructed by the Pacific Rolling Mills, which is also building the San Francisco and San Mateo electric road, and the triangular controversy between the three first named corporations has given currency to a report that the Rolling [illegible] with the San Francisco and San Mateo company, and desires to break it. This [illegible] the owners of the [illegible] pushed to a [illegible] and men on to it. [illegible] month. The con- tract with the Pacific Rolling Mills for the laying of track [illegible]

intermediate and 38 inch low pressure cylinders with 38 inch stroke. The low pressure cylinder is fitted with the ordinary slide valve and Myer's cut-off, the others having the Corliss valve gear. Each engine has a 16 foot fly wheel having a 31 inch face and weighing 30,000 pounds. Rope transmission will be used.

The Oakland & Berkeley Electric Railway company contemplates a further extension of its system by building an electric line from Fortieth and Grove streets along Fortieth to Telegraph avenue over to New Broadway, to Booth street to Webster street thence to the south gate of Mountain View Cemetery. A franchise covering this route has been applied for by the Oakland Consolidated Street Railway company.

The board of directors of the San Quinten state prison is inviting proposals for a plant for lighting the prison buildings with gas or electricity.

The Portland, Ore., office of the Edison General Electric company has just finished the installation of an Edison three-wire central station with a capacity of 1000 lights at Chehalis, Wash. The installation was placed under the direction of Fred W. Low of the Edison company, and is one of the most substantially constructed plants in the Northwest. S.

Cincinnati, O.

CINCINNATI, Sept. 26.—Geo. H Stout, agent for the Edison General Electric company at Louisville, Ky., has assumed command of the Edison office in this city, Campbell Scott, the late Cincinnati agent, being transferred to Louisville, Ky., to look after the company's interests there.

The Jones Bros. Electric company has just completed the installation of two 300-horse power Sterling water tube boilers, which gives a total boiler capacity of 800 horse power.

The contract for wiring the new Odd Fellows' temple now under construction was awarded to the S. W. Glover Electric company of this city, the contract price being $4,490. The Glover Electric company represents the Interior Conduit & Insulation company.

The D. J. Hauss Electric company reports sales for the month of September to date as follows: To Steubenville Ice Manufacturing & Cold Storage company, one 180 light incandescent dynamo, one 360 light incandescent dynamo, six Ward arc lamps, one 5 kilowatt motor and one 12 kilo watt motor with attachments, wired up complete; one 150 light incandescent dynamo to Simon Baer & Co. Cincinnati; to the Chattanooga Brewing company, Chattanooga, Tenn., one 250 light incandescent dynamo and 8 Ward arc lamps wired up complete; Paris Ice Manufacturing & Cold Storage company, Paris, Ky. one 90 light incandescent dynamo, and 4 Ward arc lamps complete.

F. E. Perry, president and general manager of the Electric Supply & Contracting company of this city spent the last two weeks in the East in the interests of his concern.

The Cincinnati Electric Elevator company is working day and night getting out the new and improved apparatus which was only recently perfected and put on the market. The breaking down of the pumping machinery at the Cincinnati Waterworks a few days since, thereby shutting off the hydraulic elevator service all over the city, has caused it to be completely flooded with orders.

Warner E. Galway, consulting and contracting electrical engineer and dealer in electric light and railway supplies, has perfected a combination electro-hydraulic elevator system which is pronounced a most economical and practicable system.

The Queen City Electric company secured the contract for furnishing a 500 light incandescent dynamo to the St. Clair Hotel company. The dynamo has been installed and the wiring of the building is about completed.

J. H. Mead, superintendent of the Edison General Electric Lighting company has tendered his resignation, to take effect October 1st.

The committee on light from the board of legislation made a trip to Detroit to inspect the electric lighting of that city.

Th[illegible] Electric company has just perfected an arc lamp for use on either constant current or constant potential [illegible]. The company is being reorganized. It is preparing to manufacture this lamp in a large scale [illegible] market at an early date.

[illegible] engine in the generating station of the [illegible] gave out completely last [illegible] overload it was carrying, [illegible] on the entire line [illegible] temporarily, and everything [illegible]

[illegible] light and power [illegible]

will be built on Walnut Hills. Abundant capital has been secured for the project and the promoters of the enterprise are trying to secure a franchise. G.

Concord, N. H.

CONCORD, Sept. 26.—The Shawhan Electrical Works have commenced operations in this city. They employ about 25 hands manufacturing dynamos motors, storage batteries and other electric appliances.

The Penacook Electric Light company, just organized, is installing a central station plant of direct arc and alternating incandescent machinery.

The Concord Electric Light company will install a 1,200 light alternator in its new station, which is now nearly completed.

A short time since it became necessary to move a large building across the track of the Concord Electric Street railway. Of course objection was made to cutting the wires, but after some consultation with the movers, Superintendent Geo. W. Pierce concluded to try to lower the wire sufficient to pass the building over it. Although this line is constructed in the most substantial manner, it was found that releasing four or five span wires would let the wire down sufficiently. It was then planked over, and the building passed over without interruption of service.

Owing to the fact that the central lighting companies have not run a day circuit, there have not been any electric motors in use. The street railway has arranged to supply current, and a large number of stores and small factories have eagerly embraced the opportunity. A number of Crocker-Wheeler motors have been placed in use.

Work is progressing rapidly on the West End extension of the street railway, and a few weeks will see it completed. Superintendent Pierce has made himself so popular here by his energetic management of the road that the croakers are becoming very scarce. Concord people congratulate themselves that for its size their street railroad is second to none, in point of service, equipment and management. A. B. C.

PERSONAL.

W. L. Adams, of the Electric Merchandise company, was in Chicago last week.

G. G. Carter of the Electrical Supply company, left on Saturday for an eastern trip.

J. H. McGraw, of the *Street Railway Journal* of New York, paid Chicago a visit last week.

F. E. Pettingill of Pettingill-Andrews company, Boston, passed several days in Chicago last week.

Walter A. Crowdus of the Crowdus Chemical Works, Memphis, Tenn., is at the Palmer House, Chicago, in his company's interest.

DeWitt B. Brace of the Nebraska State University at Lincoln, called at this office last week, on his return from his summer vacation in the East.

C. K. Mead, manager of the Des Moines Light and Water Power company, was in Chicago last Saturday, on business connected with an extension of his plant.

A. B Sibley, secretary of the Electrical Engineering and Supply company, Chicago and St. Paul, was at the Chicago headquarters of the company for several days last week.

B. M. Downs, representing the Bushwick Glass Works, New York, has been in Chicago for some days looking after his company's interest. Mr. Downs returned to New York Wednesday night.

Thomas Saunders, general manager of the Patton Motor Manufacturing company, Chicago, has assumed personal direction of the company's affairs. Mr. Saunders has had considerable experience in railroading, and will bring to his new position much valuable information.

NEW INCORPORATIONS.

Pulaski electric company, Pulaski, Va.; capital stock, $25,000; electric light, heat and power.

Pulaski Light & Water company, Pulaski, Va.; capital stock, $250,000; electric light and waterworks.

Southern Electric company, Baltimore, Md.; capital stock, $50,000; to manufacture electrical machinery.

Goshen Light & Power company, Goshen, N. Y.; capital stock, $15,000; to manufacture and use electricity for light, heat and power.

Baltimore Gas Fixture & Art Metal Manufacturing company, Baltimore, Md., capital stock, $6,000; to manufacture gas and electrical fixtures and art metal work.

Citizens' Electric Light & Power company, Pueblo, Col.; capital stock, $100,000; to furnish electricity for light, heat and power; also deal in all kinds of electrical supplies.

Buffalo, Kenmore & Tonawanda Electric Railway company, Buffalo, N. Y.; capital stock, $150,000; to operate a street surface railroad; Geo. H. Frost, White building, Buffalo, N. Y.

Suburban Electric Railway company, Bucyrus, O.; capital stock, $200,000; building a street railway to be oper

ated by electric or other motive power, etc.; W. C. Lemert, Bucyrus, O.

Pacific Coast Fuel & Gas company, Chicago, Ill.; capital stock, $5,000,000; to build, operate, sell and buy plants for furnishing gas and electricity for light, heat and power purposes; C. C. March, 134 Dearborn street, Chicago, Ill.

Pittsburg Underground Electric Construction company (Incorporated in W. Va.,) Pittsburg, Pa.; capital stock, $300,000; manufacturing, constructing and erecting electric traction roads, laying tracks and road beds, etc.; C. E. Doyle, 127 Fourth avenue, Pittsburg, Pa.

Anglo-American Gas Control company, San Francisco, Cal.; capital stock, $200,000; to manufacture, buy, sell, rent and deal in governors and gas burners, lamps, fixtures and appliances for control and consumption of gas; also to manufacture and sell gas and electric light; also real estate; Langhorn & Miller, San Francisco, Cal.

ELECTRIC LIGHT.

At Deposit, N. Y., a subscription list is in circulation for the establishment of an electric light plant.

New Orleans capitalists have, it is said, made a proposition for the erection of an electric light plant at Oxford, Ala.

The seaport of Larne has been lighted by electricity. This is the first town in the north of Ireland which has adopted this light.

The Pulaski, Va., Electric company has contracted with the Thomson-Houston Electric company for a complete electric light plant.

It is reported that F. W. Wagener proposes to organize a stock company for the purposes of erecting an electric light plant in Summerville, S. C.

The Montgomery, Ala., Light company is reported as putting in a Thomson-Houston plant, and as making other improvements in its electric light plant.

The Edison General Electric company has been awarded the contract for duplicating the plant of the Park City Light, Heat Power company, of Park City, Utah.

Louis E. Lamarie and others have had introduced in the city council of New Orleans an ordinance granting them authority to erect an electric light and power plant.

The electric light station at McKeesport, Pa., has been improved, and the capacity of the plant increased, in order to furnish motive power for the White electric traction lines.

A recently designed candelabrum for electric lamps is described as a palm tree, the foliage of which is alternately gilt and silvered, rising above a Cupid seated in a pedestal shell of rococco design. The globes containing the light are of slightly clouded crystal and represent the fruit of the palmtree.

Rittenhouse & Embree have installed an isolated plant with a capacity of 100 lights in their lumber mill on the South branch of the Chicago river at Thirty-fifth street. The plant complete, including a New York Safety engine and a 100-light dynamo, was furnished by the Chicago Edison company.

The plant which is being erected by the Standard Electric company at Ottawa, Ont., will be operated by three 66 inch turbine water wheels, developing 100 horse power. The shafts, from the water wheels are of steel 7⅝ inches in diameter each fitted with a mortise bevel gear wheel, 8 feet in diameter, with teeth 20 inches long. The iron pinions which work in these wheels are nearly 4 feet in diameter. The three main shafts are also of steel, 7 inches in diameter, and have on them the three main driving pulleys, which are 10 feet in diameter, and 52 inches wide. The shafting, gearing and pulleys are carried on nine massive iron bridge trees.

It is said that trouble is brewing between the two electric light companies of Toronto, Ont. For several years past the Toronto Electric Light company has made street lighting its specialty, but has still devoted a good deal of attention to commercial lighting and electric motors. Three years ago the Incandescent Electric Light company went into business exclusively as furnishers of light and power for private use. The latter company wants the Toronto to give up its private business and confine itself to street lighting. This the Toronto company, it is asserted, refuses to do, and there are rumors of trouble in consequence.

Work has been begun on the new station for the Hamilton, Ont., Light & Power company. The building will be 137x72 feet, and will have room for from twenty-five to thirty dynamos, and three pairs of twin engines. The 8,000 square feet of flooring will be of concrete. The work is expected to be finished about December 1st, when the dynamos and other machinery will be transferred to their new quarters. Two pairs of twin engines of 600 horse power each will be placed in the new building, and from the station the company will then be able to supply 7,000 incandescent lights, 500 arc lights and 500 horse power for motor service. The cost of improvements is estimated at from $30,000 to $40,000.

ELECTRIC RAILWAYS.

An electric street railway is proposed for Abilene, Tex.

The Jacksonville, Fla., & Panama Rapid Transit company will build an electric road.

The Fayetteville, N. C., Street Railway company intends o build an electric road at once.

The City Electric Street Railroad company of Little Rock, Ark., contemplates extending its lines.

Mottett, Hodgkin [illegible] have been granted a franchise to build an electric line in New Berne, N. C.

An electric railway is to be constructed in Stockholm, Sweden, and a second between the towns of Karislund and Djurslhom.

At a recent meeting of the Alameda county, Cal., board of supervisors, an ordinance was passed granting the Chappelet electric road a franchise for a line extending from Haywards to the county line. At that point connection will be made with the line leading to San Jose.

The Berlin correspondent of the London *Chronicle* says that Siemens & Halske, the eminent firm of electrical engineers, has submitted a proposal to the minister of the interior and the Berlin municipality for the construction of elevated electrical railways throughout Berlin and the suburbs. They propose to construct eight different lines, covering some 40 miles, at an estimated cost of $20,000,000.

ELECTRIC MOTOR.

Kate Field wants electric fans introduced in railway coaches.

The Rockford Electric Manufacturing company has just sold one of its new pattern iron clad motors to the Inter-Ocean Printing Company, Chicago, to run a type-setting machine which is now being put in position.

ELECTRIC MINING.

An electric mining drill especially devised for digging subterranean passages in time of war has been invented by Captain Grasern of the Austrian army. The machine is intended for use about fortifications, and the trial is said to have shown extremely good results.

In the mines of the District of Vermland, in Sweden, electricity has almost entirely superseded steam in the working of the mining machinery. The motive power is obtained from a fall of water two miles from the mining district, and the current is transmited both for lighting and driving the machinery.

The *Lake City Phonograph* says: "The successful inauguration of the electric plant at the Ulay means much for the possibilities of future mining operations in Hinsdale county. With our magnificent resources in water power there is no reason that one half our mines may not be operated most economically and satisfactorily by electric power. Where power is so easily attainable as in this county, electricity, undoubtedly, is to be the economic force of the future."

A $500,000 electric smelting plant will soon be in operation in Pueblo, Colorado. Negotiations are now said to be pending between American and English capitalists for the formation of a company capitalized at $2,000,000, of which $500,000 will be subscribed immediately; $300,000 of this will be put into the plant at once, and $200,000 reserved for an operating fund. The works will be intended especially for the reduction by electricity of dry and refractory ores, although all kinds can be handled. The capacity will be about 200 tons a day, and at least 200 men will be employed. Ground will be broken, it is said, inside of sixty days.

TELEGRAPH.

The Bay City and Tillamook Telegraph company has been incorporated, with a capital stock of $6,000. The purpose of the corporation is to construct and operate a line of telegraph between Forest Grove, Washington county, and Bay City, Oregon, the latter being the loca tion of the principal office.

The laying of the Spanish cable to Morocco called forth, says a Madrid telegram, a strong resistance from the Moors of the Anghera tribe, 150 of whom attacked the working force at Tangiers, during the final operations of laying the wire, and put it to flight. The Spanish minister addressed a remonstrance to the Sultan on the subject, and it is believed that the work will be resumed.

MISCELLANEOUS.

Herman Hollerith, the inventor of the electrical tabulating machine, which has been used in making up the returns of the eleventh census at Washington, has shipped to Vienna the final instalment of the order for a dozen of his machines to be used in making up the returns of the Austrian census. It is said this order came unsolicited, as did also one from Canada for five machines.

TRADE NEWS.

The *Western Engineer*, issued gratuitously by the Pond Engineering company, forms a pleasing medium for the company's advertising.

The Westinghouse Electric & Manufacturing company has established a northwestern office at rooms 515-517 Manhattan building, St. Paul, Minn., with W. G. De Celle in charge. Customers in the Northwest are requested to address the St. Paul office.

The catalogues issued by the Thomson-Houston Electric company are always valuable compilations, giving evidence of care and thoroughness in preparation. The latest issued is that of the lighting supply department, and it is no exception to the rule. It would be difficult to conceive of any article used in the art of electric lighting not mentioned in this book, which is supplied with a care- [illegible] up and bound in boards, the latter feature increasing its [illegible] "Miscellaneous Supplies," and part three, "Tools for [illegible]

[illegible] the Chicago house. Mr. Bruckman is a practical electrician and [illegible] valuable addition to the working force of this company.

The Ries Electric Specialty company of Baltimore, Md., were that [illegible] regulating socket is highly commended. It has been asserted that the Ries socket, which was shown at the Montreal convention, was one of the most novel and ingenious devices on exhibition.

The Electrical Supply company reports constantly increasing sales throughout its entire line of goods. The marked increase in the demand for Habirshaw wire, Sunbeam lamps and Shield Brand moisture-proof line wire, is claimed to be the best possible indications of the esteem in which these articles are held.

Newton L. Schloss, formerly of the Edison company and well known in the vicinity of Baltimore through his connection with the Baxter Motor Works, has taken charge of the New York office of T. H. Dallett & Co., of Philadelphia. Mr. Schloss' experience, ability and perseverance will make him a valuable acquisition to the firm's representatives.

The offices of the United Press Association in the new *Herald* building in Chicago will be, it is said, the most complete and handsome offices of the kind in the country. The telegraph department will in itself comprise a large telegraph office, the instruments being of the most modern pattern and highly finished. These instruments were purchased from the Central Electric company, and are on exhibition in the salesroom of that company.

The New York offices of the Brush Electric company of Cleveland, Ohio, have been located on Union Square for the last ten years. They were removed on October 1st to the Boreel building, 115 Broadway, rooms 80 and 82, to which address all future communications should be sent. Samuel M. Hamill, the secretary of the company, has recently removed to Cleveland to assume the duties of the general managership.

The Thomson-Van Depoele Electric Mining company of Boston, Mass., has issued a handsome pamphlet on "Electricity Applied to Mining Operations," in which is described the electric mining apparatus manufactured under the Thomson-Houston and Van Depoele patents. The pamphlet is handsomely illustrated and contains much valuable information on electric mining machinery.

The beautiful plates contained in the new catalogue of the Gleason & Bailey Manufacturing company, 233 Lake street, Chicago, show the wonderful possibilities of electric and combination fixtures in the way of delicate and graceful effects. Many of the fixtures shown are handsome enough to adorn a palace, while others are less elaborate and more moderate in price. All, however, are noticeable for beauty of design. The firm is well established, and has an assured reputation for the excellence of its goods.

It is announced that there will be a complete exhibit of the Burton heaters at the street railway convention in Pittsburg, and also that Dr. W. Leigh Burton, the inventor, will be present, which will certainly add largely to the interest of the exhibit. This will be an occasion for street railway men to examine the heaters personally and to determine the comparative value and economy of electric and other heaters. Electrical heating, as electrical lighting, is of universal interest, and having received its first successful employment upon electric cars, must necessarily be of deep interest to all street railway men.

The Electric Merchandise company, Chicago, reports the closing of contracts for the complete equipment of electric roads at Defiance, Ohio, and Negaunee and Ishpeming, Mich. The superiority of the equipment manufactured by this reliable company is recognized by both parent electric companies and construction companies, as well as by practical street railway managers. The company also reports orders for the Burton electric heater from roads in Amsterdam, N. Y., West Superior, Wis., Milwaukee, Wis., Escanaba, Mich., Defiance, O., Dallas, Tex., Newton, Mass., Champaign, Ill., Helena, Mont., and Ann Arbor, Mich.

The Great Western Electric Supply company, agent for the Sun Arc lamp is receiving many orders for this lamp. The Sun Arc lamps are especially adapted for use in theaters, central stations, halls, stores [illegible] place where the ordinary arc lamp is [illegible] gives a steady, clear, bright, white light. The Great Western Electric Supply company is also agent for K. K. wire. The company has [illegible] catalogue which is one of the most complete catalogues of its kind that has been issued. Its new [illegible] is now out, and is complete in every detail. It will be ready for distribution in a few days.

Accounts from Sioux City, Ia., [illegible] that the Bradbury Stone storage battery [illegible] a test in that city, was making a most excellent impression. Joseph V. Bradbury, assistant manager [illegible] the company, was recently in Sioux City superintending the

[illegible] was during his visit that an accident occurred which tested the resources of the car. As the motor man was not familiar with the poorly constructed road, the car jumped the track. The track is of ordinary "T" rail, such as is used on steam railroads, and it rests on the sleepers in a like manner. It is stated that the car replaced itself with but little assistance. Running at the rate of 15 miles to the hour with a full load on a steep down grade, the car was brought to a standstill in a 100 foot stop. It is claimed that not a plate was buckled nor injured in the least. The twenty mile run was completed without an accident beyond the derailment, which was fortunate in the sense that an opportunity was presented to show what the car could do under extraordinary circumstances. In this system the motor is so arranged as to act as a dynamo as the car descends grades, thus charging the batteries. This car is arranged so as to receive the battery beneath the seats. The cells are carried on trays, twelve cells to a tray. Each car has two sets of cells. While one set is in service the other is charging at the power station.

BUSINESS.

To the Central Street Railway company of Peoria, Ill., the Chicago Belting company has just sold two thirty inch heavy double main belts.

T. L. Townsend, representing the Partrick & Carter company of Philadelphia, has started on an extended business trip through the West. He will show many novelties to the trade.

The Charles Munson Belting company of Chicago desires it stated that all rumors to the effect that the company is going out of business on account of the death of Charles Munson are unfounded.

Chas A. Schieren & Co. have taken an order from the Davenport, Ia., Gas company for about 110 feet of 48 inch double belting and the necessary dynamo belts. The same company has sold the South Bend, Ind., Electric company 110 feet of 48 inch double belting and 100 feet of 20 inch double belting, with the necessary dynamo belts.

The Central Electric company has just completed arrangements for the exclusive handling of the "Gladiator" dry battery. This arrangement was arrived at only after the most exhaustive tests of the Gladiator, and the Central people are confident that they now have the best dry battery on the market. A series of curve cards showing the characteristics of this battery will soon be issued.

The Electric Engineering & Supply company, St. Paul, formerly located at 413 Jackson street, has moved into commodious quarters at 134 East Sixth street, opposite the Ryan. The amount of business done by this company has been rapidly on the increase, so that a change became imperative. The new office is centrally located, and in every way suited to the wants of this wide-awake company.

The advantages of the Burton electric heater are set forth in a neat circular just issued by the Electric Merchandise company of Chicago. The question is put in this fashion to street railway managers: "We are having cold mornings and evenings. Your road can be made more popular, and consequently your receipts larger, by warming your cars during these hours. No other method can be found elastic enough for this season of the year."

The Royal Electric company of Peoria, Ill., has been organized about three years, but owing to the usual vicissitudes common to the lot of all electrical companies, it has been but a little over a year since the first permanent plant was installed. Since that time very satisfactory progress has been made, until now an alternating system of novel construction, and, it is claimed, very high efficiency, is offered to the public, a number of plants now in successful operation serving as proof. The following is a partial list of the towns in which the central station plants of this company's manufacture are now in successful use, and the number of lights in each: Bement, Ill., 300; Kansas, Ill, 300; Watseka, Ill., 500; Hoopestown, Ill., (2) 500; Washington, Ill., 500; Farmer City, Ill., 650; Mt. Sterling, Ill., 650; Camp Point, Ill, 500; Macon, Mo., 650; Kahoka, Mo, 500. In addition to the above this company has installed isolated plants with the Sunbeam Lamp company, and Wells, French & Co., of this city, and the Weir Plow company, of Monmouth, Ill, each operating a generator of 50 kilowatts capacity. The Royal company has also designed a special form of generator for power purposes and has several in use, [illegible] worth, Kan an [illegible] power capacity.

[illegible] belting com[illegible]

[illegible] son, Reading, Pa.; one 18-inch belt for Danversport, Mass., [illegible]

Piqua, O.; one 14-inch belt for Boston; one 10-inch belt for Amsterdam Street Railway company, Amsterdam, N. Y. Of regular dynamo double belting the company has furnished the following: One 12-inch belt for the Hyde Park Electric company, Hyde Park, Mass.; three 13 inch and one 10-inch belt for the Birmingham Railway & Electric company, Birmingham, Ala.; eight 20-inch belts for Chicago. It has also shipped its patent Acme Link belts recently as follows: Two 10 inch belts for Indianapolis, Ind.; one 12 inch belt for export, and two 12-inch belts to Knoxville, Tenn.

Sargent & Lundy have been pushing work on their Grant Park railway contract at Atlanta, Ga., and will have the line ready for operation on or about Oct 15th. The four double deck motor cars, one of the novel features of this line, have already been received, and nothing but an unusual amount of hard luck will prevent the opening of the line on the date mentioned. The motor cars are the first of this pattern put in use in this country, and, beside other new features, they have a seating capacity of 90 persons, nearly double that of other motors now in use carrying about the same amount of dead weight.

A visit to the extensive quarters occupied by the Electrical Supply company will demonstrate the steady activity which has been characteristic of this enterprising company since it was organized. The department arrangements, which have now been in force about a year, have proved highly successful and efficient in the general office economy. It is by the employment of strict mercantile methods, combined with a determined aggressiveness and an honest intention to furnish only such articles as practical experience have demonstrated to be the best of their kind, that the Electrical Supply company has reared itself in six years to the enviable position it occupies at present.

ELECTRICAL PATENTS.

Issued Sept. 22, 1891.

459,737. Electric Railway Conductor Support. Edward M. Bentley, New York, N. Y.

Claim three reads:

"In an electric railway, the combination of a supply conductor with hangers therefor, provided with grooved fins for receiving the wire and metal sleeves or [illegible] passing around the wire, and holding it in place."

459,739. Commutator Brush Holder. Harry H. Blades, Detroit, Mich.

459,753. Trolley Line Circuit Breaker. Robert M. Jones, Salt Lake City, Utah.

459,757. Electric Arc Lamp. Maurice S. Logan, Otterville, and James H. Barley, Sedalia, Mo.

The object of this invention is to furnish an electric arc lamp provided with an improved carbon-holding rod having a clutch or other suitable feed mechanism engaging with the [illegible] surface or surfaces of said rod, whereby a steady uniform feed movement is attained.

459,772. Electro-Magnetic Motor. Nikola Tesla, New York, N. Y.

Claims one and two read as follows:

"1. An alternating current non-synchronizing electric motor coupled with a synchronizing alternating current motor, whereby the former starts the latter and throws it into synchronism with its actuating current, and switch mechanism for directing the current through either or both of the motors.

"2. The combination of two motors, the armatures of which are mounted upon the same shaft, one of said motors being an alternating current torque motor, or one in which the magnetic points or poles are progressively shifted by the action of the energizing current, the other motor being an alternating current synchronizing motor, and switch mechanism for directing the current through either or both of said motors."

459,786. Electro-Magnetic Device. George R. Lean, Boston, Mass.

This invention has for its object to construct an electro magnet device for restoring a circuit to its normal condition after it has remained in its abnormal condition a certain length of time, it being especially adapted for opening a circuit after it has been closed a definite length of time to thereby save the batteries.

459,794. Rheostat for Electric Motor Cars. Sidney H. Short, Cleveland, O.

This invention relates more particularly to the adjustable rheostats or rheostatic current regulators used on electrically propelled cars or vehicles.

459,800. Rheostat. Henry E. Waite, New York, N. Y.

459,810. Governor for Dynamos. Mahlon S. Conly, Chicago, Ill.

[illegible] have a governor [illegible] dynamo electric machine [illegible] equivalent device.

459,811. Governor for Dynamos. Mahlon S. Conly, Chicago, Ill.

[illegible] Rudolph M. Hunter, Philadelphia, Pa.

[illegible]

[illegible] for Commutator. Sidney [illegible]

[illegible] Incandescent Electric Lamp. [illegible]

[illegible]

459,839. Automatic Disconnector for Overhead Conductors. Andrew L. Johnston, Richmond, Va.

459,840. Automatic Disconnector for Overhead Conductors. Andrew L. Johnston, Richmond, Va.

The object of this invention is [illegible] applied to the overhead trolley wires used in connection with electric cars, and it is especially arranged for that system of electric propulsion in which the trolley wires have relays of electricity located and supplied at suitable intervals throughout its length, as at hills where additional power is required.

459,843. Insulator. Van A. Thomas, Providence, R. I.

459,845. Carbon Clamp for Arc Lights. Van A. Thomas, Providence, R. I.

459,846. Attachment for Electric Arc Lamps. Van A. Thomas, Providence, R. I.

This invention has relation to electric lights, but more especially to the class of arc lamps, or rather to the power portion of the lamps, adapted to arc lighting; and it consists, essentially, of an insulating hood or shield arranged to be readily attached to and inclose the lower or exposed metallic portion of the lamp.

459,848. Trolley Wheel for Electric Railways. Jean A. Wetmore, Brooklyn, N. Y.

459,852. Electric Therapeutic Bath. Charles P. Hoffmhn, Utica, N. Y., and Willard E. Van Houton, Belleville, N. J.

459,872. Electric Lamp. Donald Tommasi, Paris, France.

459,923. Armature for Dynamo-Electric Machines and Motors. John Beattie, Jr., Fall River, Mass.

The object of this invention is to improve the construction of what is known as the "Pacinotti" type of armature. This armature consists of a ring or cylinder having deep grooves in its periphery parallel to its axis, which form projections or teeth in the core of the armature. The coils or conductors are deposited in the grooves.

459,941. Electric Cable. David Brooks, Jr., Philadelphia, Pa.

Claim one reads:

"A cable having the sections of its covering connected by strips of tin foil and rubber, the same forming a flexible connection."

459,942. Magnetized Hat Band. Fred H. Brown, Chicago, Ill.

What is claimed in this invention as a new article of manufacture is a hat band comprising a thin pliable band of magnetized metal formed with openings or slots to increase its pliability.

459,984. Burglar Alarm. Homer T. Wilson, Harrodsburg, Ky.

460,019. Electric Show Case Alarm. Rudolph C. Kruschke, Duluth, Minn.

The object of this invention is to provide a simple and effective electrical alarm for attachment to show cases, for detecting the absence of an article from the tray of the show case.

460,040. Motor Mechanism for Electric Cars. Sidney H. Short, Cleveland, O.

This invention relates to an electrically propelled car or vehicle in which the armature of a propelling motor is connected directly with a driving wheel or axle, by direct connection being understood one which imparts a revolution to the driving wheel or axle to each revolution of the armature.

460,046. Method of and Apparatus for Converting the Electrical Energy of Alternating Currents into Mechanical Motion. Charles S. Bradley, Avon, N. Y.

This invention relates to the conversion of electrical energy, and consists in the method of and apparatus for converting electrical energy of an alternating current into mechanical motion by raising the amount of effective counter electromotive force developed by rotation relatively to the self-induction.

It also consists in the method of and apparatus for making such conversion by developing a phase of counter-current during the passage through the motor of less than a corresponding phase of the line current.

Furthermore, it consists of an alternating current system provided with a generator for delivering currents of determined frequency of reversal, and a motor so organized that when operated at its working speed under the influence of such current the armature will cut the fields of force developed by the field magnets oftener in a definite interval than the number of reversals of current developed on line by the generator during such interval.

460,048. Electric Coupling. Frank M. Farwell, Minneapolis, Minn.

460,056. Process of Manufacturing a Composition Applicable for Electrical Insulating Purposes, etc. Ernst Fahrig, London, England.

What is claimed under this invention is a process of manufacturing a composition for insulating and other purposes, consisting in taking a pulping stuff, then mixing and beating it up with manila or other like fibers, then adding to this mixture a soap solution and treating the resulting mass with a precipitate until the precipitate shows itself in a mass, then forming the pulp thus prepared into sheets and applying an insulating powder to the same, next subjecting the material thus prepared to pressure and drying heat, and finally treating the said material with insulating solution, and then subjecting the treated material to great pressure.

460,059. Electric Regulator. James F. McElroy, Albany, N. Y.

460,071. Electric Transmission of Power. Rudolph M. Hunter, Philadelphia, Pa.

The object of this invention is to [illegible] a method, by the [illegible] apparatus, whereby the conversion of [illegible] by means of induction apparatus may be accomplished in a more satisfactory manner, particularly when very high potential currents are to be transmitted.

460,076. Controlling Switch for Electric Motors. Schuyler S Wheeler, New York, N. Y.

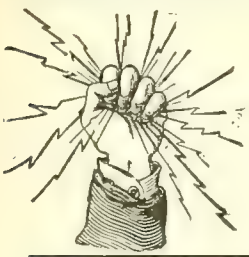
460,0[illegible]. Automatic Electro Pneumatic Tube System. William G. Collins, New York, N. Y.

460,0[illegible]. Electric Motor. Ernst M. G. Hewett, Boston, Mass.

460,[illegible]. Combination Fittings for Gas and Electric Lights. Olaf Strom, Brooklyn, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used. Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the Boston Fire Underwriter's Union, under date of March 21, 1886, he says: "A Thoroughly Reliable and Desirable Wire in Every Respect."

The rubber used in insulating our wires and cables is specially chemically prepared, and is Guaranteed to be waterproof and will not deteriorate, oxidize or crack and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid, and to a very great extent, fire proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS.

4 LaSalle Avenue, Chicago.

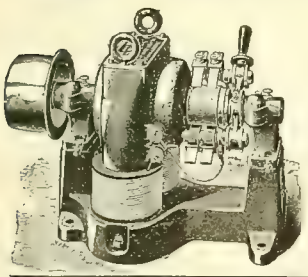
☞Write us for Prices.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

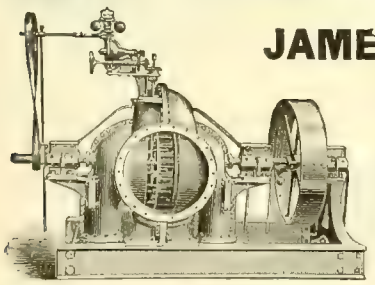
Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.



UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

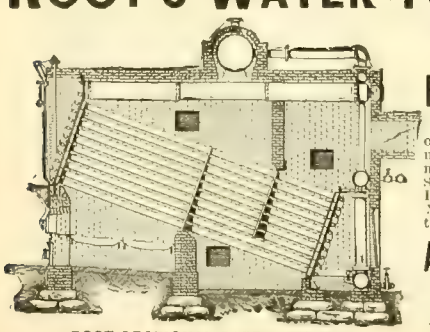
Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ROOT'S WATER-TUBE BOILER.

SAFE ECONOMICAL DURABLE.



ROOT SECTIONAL SAFETY BOILER.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the Electric Light Companies of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass. and the Thomson-Houston Electric Co., Lynn, Mass.

Abendroth & Root Mfg. Co.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N. Y.**

73-75 W. Jackson St. RELIABLE

WE ARE FITTED WITH

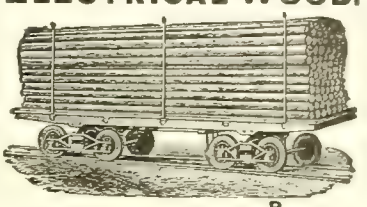
RELIABLE Machinery and Tools,

And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. 136 Liberty St., NEW YORK.

The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

THE ELECTRICAL ENGINEERING CO.,

322 DEARBORN ST., CHICAGO.

Contractors for all kinds of ELECTRICAL WORK.

GENERAL WESTERN AGENTS FOR

The Clark Wire.
The Interior Conduit and Insulation Co. of New York.
The Elektron Manufacturing Co.
Perret Motors.
The Standard Dynamo, Manufactured by the Fairbanks Scale Co.

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES A SPECIALTY.

L. BLATZ, 103-107 West Monroe St., CHICAGO.

Standard Laboratory Photometer.

For illustrations see WESTERN ELECTRICIAN of September 12th, Page 150.

This outfit is designed to measure accurately the candle power of Incandescent Lamps, and will be found of great value by Manufacturing Companies. Price for the complete set or separate parts furnished upon application. Correspondence solicited.

Send for Illustrated Descriptive Catalogue 1-66.

QUEEN & CO., PHILADELPHIA.

AN EXPENSIVE DELAY

Will Not Occur If You Order Supplies from Us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers; Packard High Grade Lamps; Eddy Motors; "Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

931 Rookery, CHICAGO. 413 Jackson St., ST. PAUL. 409 W. Michigan St., DULUTH.

SEND FOR CATALOGUE AND DISCOUNT SHEETS.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.
FITCHBURG, MASS, U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES. ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

BINDERS

—FOR THE—

WESTERN ELECTRICIAN,

ONE DOLLAR.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

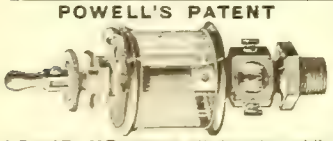
If you wish to use electricity for any purpose whatever, write us for full information.

ROOM 422
Electrical Exchange Building,
NEW YORK CITY.

REMEMBER

That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

POWELL'S PATENT

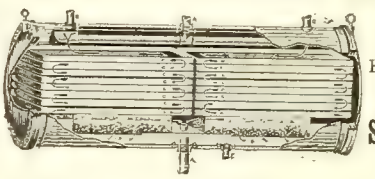


LEVER UP shows oil dropping while machinery runs

SIGNAL OILERS

Still in the Van as the BEST for **HIGH-GRADE ENGINES and DYNAMOS.** The stop-feed features prevent waste of oil which item alone will more than save their cost in a short time. **HAS OTHER EXCEPTIONAL POINTS OF MERIT.** Send for full descriptive circular. Address THE WM. POWELL CO., CINCINNATI, OHIO.

Stilwell's Patent Live Steam-Feed Water Purifier.



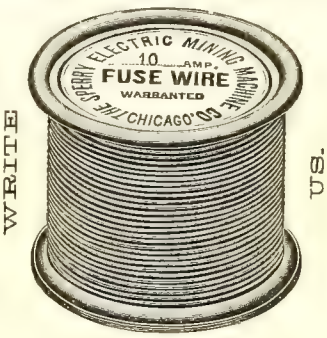
Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

EVERYTHING IN

WIRE—FUSE— STRIPS.



WRITE US.

MANUFACTURED BY
The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingo's, Slabs, Sheet Wire and Castings at lowest market rates.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.

ELECTRICAL BOOKS

OF ALL KINDS.

Send for Complete Catalogue.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO, ILL.

Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,
17 VIRGINIA ST., EAST SOMERVILLE, MASS.

A NEW BOOK.

NOW READY.

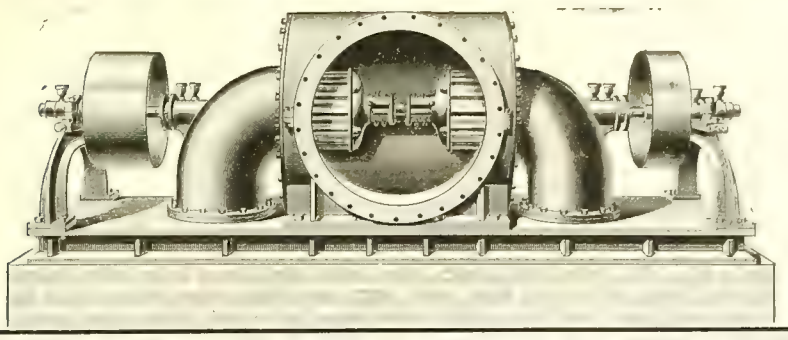
ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

VICTOR TURBINE WATER WHEEL.



The attention of [illegible] CELEBRATED WATER WHEEL [illegible] on account of its remarkably steady motion, high Speed and great Efficiency, [illegible] large Capacity [illegible] diameter, being double the Power [illegible] by a number of the [illegible] economical use of water [illegible] of useful effect guaranteed.

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal [illegible] and it can be belted directly to dynamo.

The accompanying [illegible] VICTOR TURBINES arranged [illegible] Tubes, End Bearings for Shaft [illegible] a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),

DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

FOR HANDLING

GRAIN, COAL, TAN BARK, SEEDS, ETC.

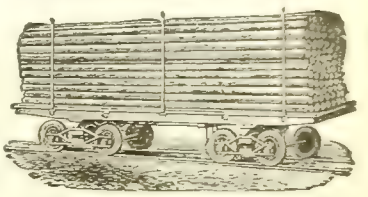
Will convey all kinds of grain without mixing.

Will carry two different kinds of material in opposite directions at the same time.

Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

VULCANIZED FIBRE CO.

ESTABLISHED 1878.

SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

State of Iowa }
Benton County } ss.

I, B. B. Burley being duly sworn upon oath depose and say, that I am a resident of Belle plaine Benton County Iowa, and proprietor of the "Burley House" in said City — That Sept. 20th 1889, the Wm. A. Hunter Electric Company placed a 32 Candle power — 82 volt incandescent lamp, of the Thompson-Houston System, on the porch at my said Hotel — That said lamp burned continuously for 4620 Hours, burning out July 15th 1891. —

B. B. Burley

Subscribed in my presence and sworn to before me August 10th 1891

John H. Milner

Notary Public in & for Benton Co. Iowa.

MILLS NOTARIAL SEAL IOWA

BEST ECONOMY VS. LONG LIFE.

WHICH IS DESIRED?

If the sole aim of the users of incandescent lamps is to save themselves as much trouble as possible in replacing lamps, a long-lived lamp may suit them best, as, instead of having to make their lamp renewals every two or three months, it will be necessary to do so only about once a year. The longer the life of an incandescent lamp (beyond the point of best economy) the more will it cost to produce light, both in coal, and, what is sometimes more important, investment. Our expert thinks that a lamp to give the best economy should burn 600 hours, or less, according to the different conditions, and that a lamp that will burn 4,620, 5,000, or 10,000 hours, is not a lamp of the best economy. We make this statement with some hesitation, as it seems to be so directly contrary to the opinion of the lamp expert of one of the large manufacturers, whose portrait and statement we have taken the liberty of reproducing from their advertisement.

We shall say more in reference to this subject next week.

THE SUNBEAM INCANDESCENT LAMP CO., Chicago, Ill.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

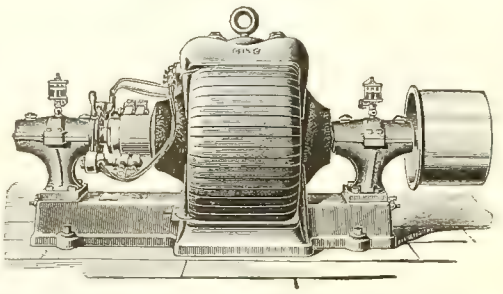
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

"THE PURE SARSAPARILLA."

PERRET DYNAMOS AND MOTORS.

OFFICE OF JERSEY CITY MILLING CO.
MANUFACTURERS OF FLOUR,
542 & 544 Henderson Street.

JERSEY CITY, N. J., August 3d, 1891.

THE ELEKTRON MANUFACTURING CO.

GENTLEMEN:—The dynamo bought of you last February has run up to the present time without any attention whatever beyond oiling it. It is simply perfect. We would not accept a high speed dynamo as a gift after using yours. It is truly "the pure Sarsaparilla." None other can be found like it.

Very truly,

W. R. WATSON, Manager.

THE ELEKTRON MANUFACTURING CO.,

New York Office, 89 Liberty Street. SPRINGFIELD, MASS.

SELLING AGENTS

Washington, D. C., J. U. BURKETT & CO., 1409 N. Y. Avenue.
New Orleans, La., GEORGE BAQUIE, 140 Gravier Street.
Chicago, Ill., THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.
St. Paul, Minn., F. J. RENZ, 95 East 4th Street.
Philadelphia, Pa., PENNSYLVANIA MACHINE CO., 29 North 7th Street.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

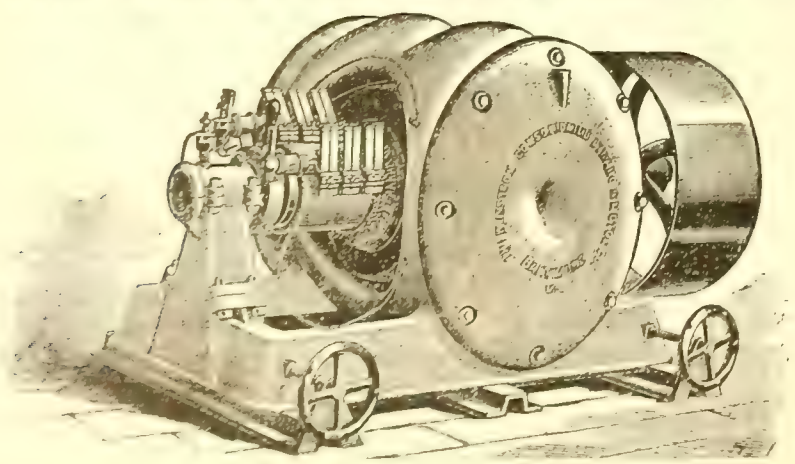
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

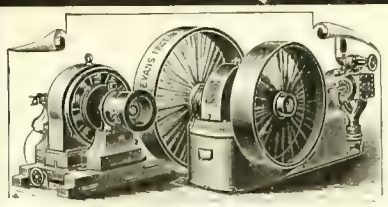
ELECTRIC MOTORS
For All Work.

DYNAMOS
For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

THE WENSTROM CO., Baltimore, Md.

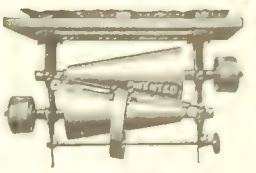


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire. Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

NORTHWEST THOMSON-HOUSTON ELECTRIC CO.,

—GENERAL AGENTS FOR—

ALL PRODUCTS

—OF THE—

THOMSON-HOUSTON ELECTRIC CO.,

—FOR—

Northern Wisconsin,
Minnesota,
North Dakota,
South Dakota,
Montana,
Wyoming,
Idaho,
Washington,
Oregon.

PRINCIPAL OFFICE:

403-405 Sibley Street, St. Paul, Minn.

H. M. BYLLESBY, President. HOWARD C. LEVIS, V.-P. and Treas. B. F. MEEK, Jr., Secy. and Asst. Treas.

GEO. C. DUFFIE, Asst. Secy.

BRANCH OFFICES:

Cor. A and Front Streets, PORTLAND, ORE.
H. W. COODE, Manager.

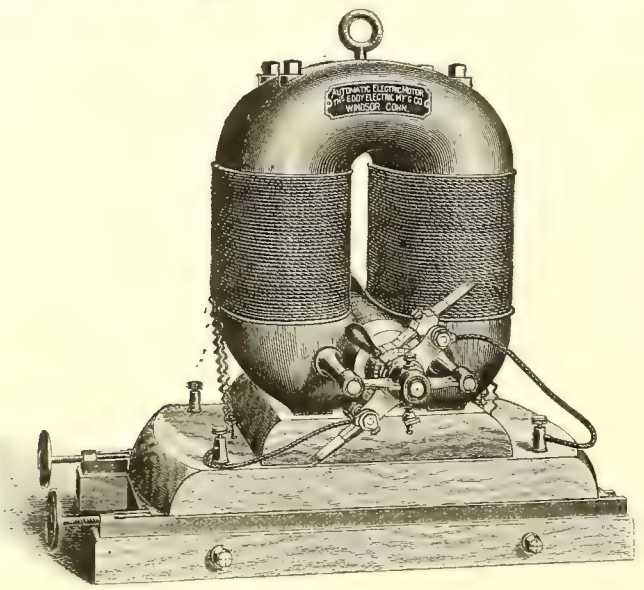
Thompson Block, HELENA, MONT.
H. W. TURNER, Manager.

THE

EDDY ELECTRIC MFG. COMPANY

MAKES A SPECIALTY OF THE COMPLETE EQUIPMENT
OF FACTORIES WITH

ELECTRIC POWER.



EDDY POWER GENERATORS,

ANY SIZE UP TO 300 H. P. AND ANY VOLTAGE.

THE EDDY ELECTRIC MOTOR

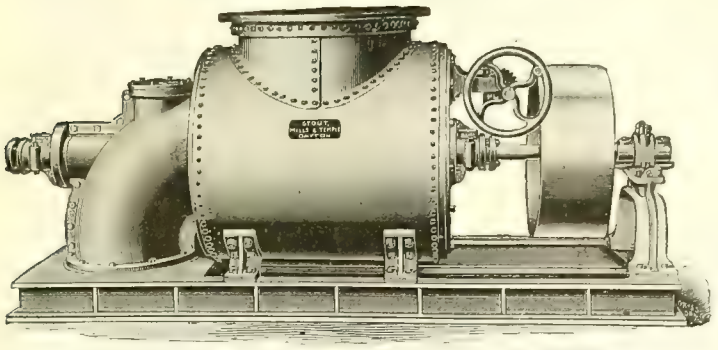
Is Simple, Efficient, Durable, Economical and Always Reliable.

THE EDDY ELECTRIC MFG. CO.,

WINDSOR, CONN.

136 Liberty Street, - NEW YORK.
92 Franklin Street, - - BOSTON.
506 Commerce St., PHILADELPHIA.
341 The Rookery, - - CHICAGO.
Rialto Building, - KANSAS CITY.
413 Jackson Street, - ST. PAUL.
409 West Michigan Street, DULUTH.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shafts.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

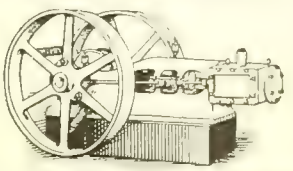
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS' No. 447 North Street, BALTIMORE, MD.

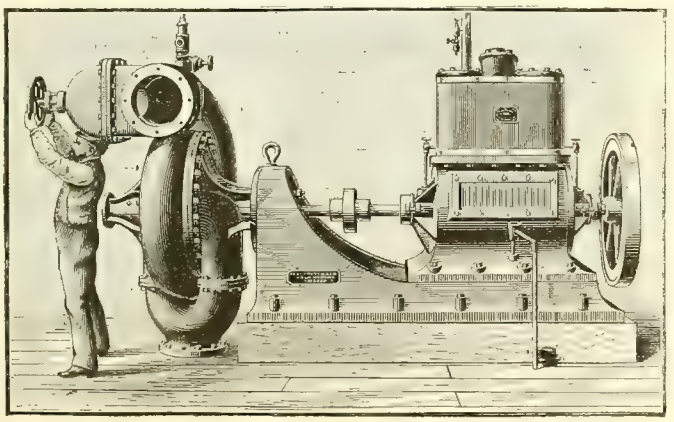
BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES

A SAMPLE INSTALLATION.

Standard Automatic Engine coupled direct to a Centrifugal Pump.
Speed 280 Revolutions.



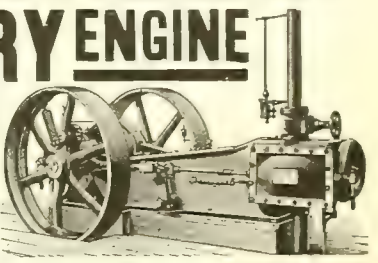
Over 4000 Westinghouse Standard Engines in use.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application.

STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES | Philadelphia, 942 Drexel Bldg.
San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST.
HALF TONE PLATE SPECIALTY
CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

"BE YE THE JUDGE."

HAVE YOU TRIED THE

ECONOMIC INCANDESCENT LAMP?

If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again*. Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

GEO. L. KIRKHAM, Manager. 1017 Chamber of Commerce, CHICAGO.

A MARVELOUS INNOVATION

THE THOMSON-HOUSTON ELECTRIC COMPANY

HAS REVOLUTIONIZED THE ELECTRICAL EQUIPMENT OF STREET RAILWAYS.

The Intermediate Shaft, Pinion and Gear have been discarded.

The Armature Pinion and Axle Gear are now inclosed in a dust-proof case filled with oil.

Reducing to a minimum the cost for repairs and absolutely eliminating the objectionable noises incident to all other systems.

The Armature speed has been reduced from 1200 to 500 revolutions per minute.

The Railway Motor, as now constructed, comprises less than a dozen parts.

The construction of the Armature avoids the possibility of a burn-out, except by malicious carelessness, and when damaged, can be readily repaired by a novice.

Don't make a mistake by contracting for Railway Equipment before seeing or understanding this marvelous machine.

Prices for Repairs, Parts and Supplies materially reduced.

Information, Prices and Literature furnished on application.

THOMSON-HOUSTON ELECTRIC CO.

CHICAGO OFFICE:
148 MICHIGAN AVENUE.

BOSTON OFFICE:
620 ATLANTIC AVENUE.

What Wire Do You Use?

YOU
SHOULD
USE

SAFETY

SEAMLESS
RUBBER
INSULATED.

It is the Best. Wise Men are using it. Write for our Lists and Discounts. . . . .

THE

KNAPP ELECTRICAL WORKS,

54 and 56 FRANKLIN STREET,

. . . . . CHICAGO, ILL. . . . . .

LONGEST LIFE, HIGHEST EFFICIENCY. THE GREAT MONEY SAVER.

. . . . THE . . . .

PERKINS LAMP

WE KNOW TO BE THE BEST. SEND US AN ORDER FOR A BARREL.

Indications:

Chicago, Wednesday, September 30, 1891.

Weather slightly cooler, fair, with stationary barometer.

How we would slash things if we could only control the weather, but we can't and that's why we have been sacrificing those Stanley Fan Motors at such ridiculously low figures. We are content, however; it brought trade and Trade makes bigness; that's of course, and Bigness makes trade, which is *not* always of course.

Then over in the south aisle, such a jam; we don't know why either. We didn't mention Transformers, but they went—shipping clerks tired and overworked—perhaps they are *better* than other transformers you've bought? But Stanley makes them, and they are all wool and about two yards wide, we should say.

Basement, Randolph St. side.

Here's where we keep most of the Wire stock—plenty of room—and have you noticed how we hang onto that "Moisture-proof" phrase? That's Shield Brand. It's a fact, though—and facts count ahead of most things—anyhow, Shield Brand doesn't wear a parasol in wet weather.

Neither does Habirshaw—it's rubber covered. We were going to say that it was better to-day than yesterday—quality we mean, but we are not sure—it was *good* yesterday, and for several days before—don't see how it could improve.

Third Floor, Michigan Ave. Front.

Have you been a little bit foggy on Electric Railway Supplies? No need to have been if you had one of our No. 31 catalogues, but perhaps you didn't have one. Now is your time to get a copy—there's everything you want to know, and that's a good deal, isn't it?

Here is just a handful, picked up haphazard:

The Safety Span Wire Tightener—only two pieces—strong, perfect. List, 16c.

The Crook and Davis Automatic "Reed" Feed Trolley Wheel Hub. One traveled over four thousand miles—just a common brass wheel, and shows no wear. Ask for special circular about this—we have exclusive right in United States.

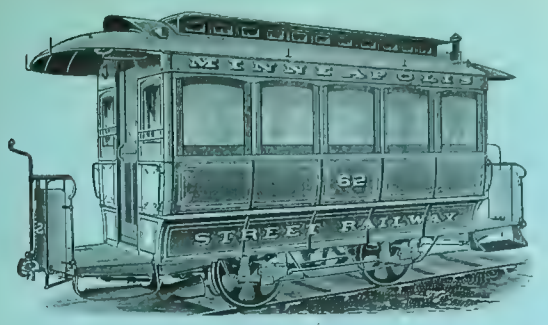
The McTighe Overhead Switch—perfectly reliable, light, compact right or left hand turn-out; no solder. List, $7.50.

Feeder and Trolley Wires—all sizes, but only one grade of copper—that the best—at lowest market price.

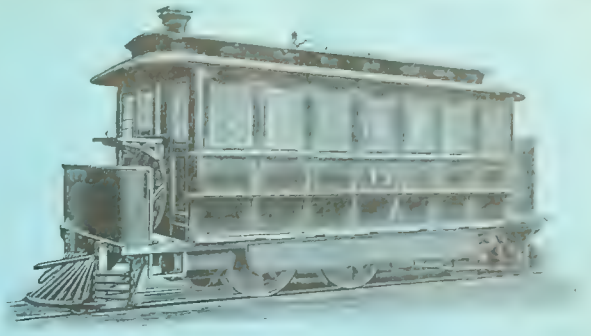
Then there's cross-arms, in pleasing varieties of 4, 6 or 8 pin style, and glass and porcelain insulators. Tools of best materials.

Most people come in at the Michigan Ave. entrance—building is *corner* of Randolph St. and Michigan Ave.

THE ELECTRICAL SUPPLY CO.



STREET CARS



FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

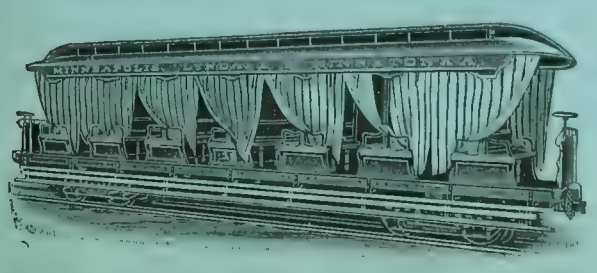
MINNEAPOLIS STREET RAILWAY CO.,

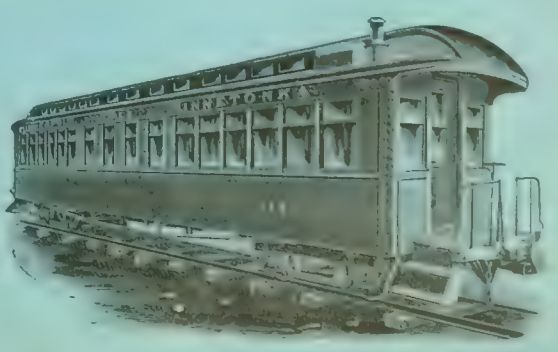
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

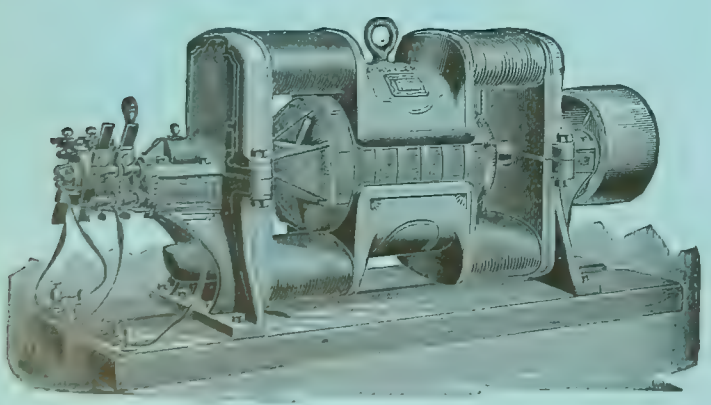
NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

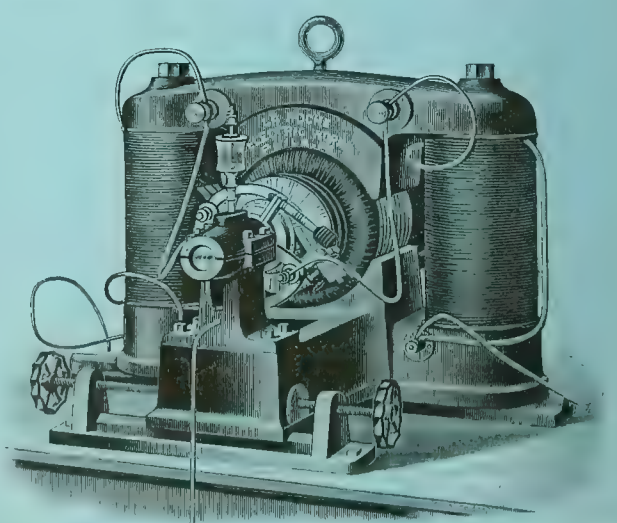
THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,

FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, OCTOBER 10, 1891. No. 15

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

AGENTS
J. W. Peale, - - No. 1 Broadway, New York.
Electric Eng. & Supply Co., - - Syracuse, N. Y.
Central Electric Co., - - - - - Chicago.
The Electrical Eng. & Supply Co., St. Paul, Minn.
St. Louis Electrical Supply Co., - - St. Louis.

CLOWER, HARRIS & CO.,
CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.
The largest Electrical Supply House west of the Mississippi River.
Everything Electrical
289 ELM STREET. - - DALLAS, TEXAS.

FOR SALE.
One 3 Horse Power Electric Motor.
One 6 Horse Power Electric Motor.
Both in excellent condition, having been used but little.
ERIE ELECTRICAL SUPPLY CO.,
ERIE PA.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.

The International OKONITE COMPANY, LIMITED.
13 Park Row, New York.

OKONITE TRADE MARK

INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

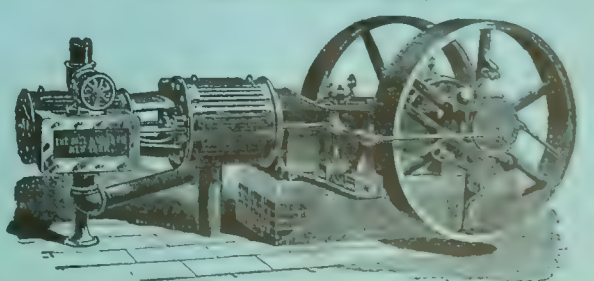
WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

THE 1891 ELECTRIC MOTOR AND BATTERY.

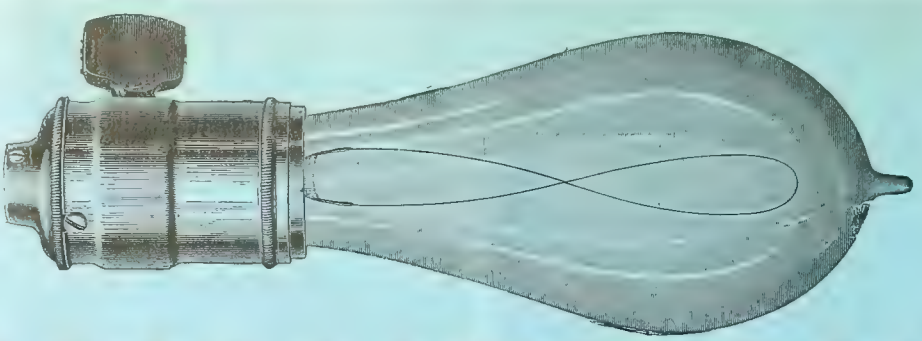
SIMPLE. DURABLE.
ECONOMICAL. EFFICIENT.
For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at
ONE-HALF PRICE.
Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IMPROVED BALL ENGINES,
BUILT BY THE BALL & WOOD CO., NEW YORK.



W. B. PEARSON, Selling Agent, Home Ins. Bldg., Chicago, Ill.



LONG LIFE

INCANDESCENT LAMPS.

SEE WHAT PURCHASERS SAY:

BURLEY HOUSE,
Belle Plaine, Iowa,

State of Iowa }
Benton County } ss.

I, B. B. Burley being duly sworn upon oath depose and say, that I am a resident of Belle plaine Benton County Iowa, and proprietor of the "Burley House" in said City — That Sept. 20th 1887, the Wm A. Hunter Electric Company, placed a 32 Candle power — 52 volt incandescent lamp, of the Thomson-Houston System, on the Porch at my said Hotel — That said lamps burned Continuously for 4620 Hours, burning out July 15th 1891. —

B. B. Burley

Subscribed in my Presence and Sworn to before me August 10th 1891.

John H. Miller
Notary Public in
& for Benton Co. Iowa.

B. B. BURLEY,
Prop. BURLEY HOUSE,
Belle Plaine, Iowa.

Extract of letter from Manitou Electric Co., Manitou Springs, Colo.
DATED AUGUST 23, 1891:

"We have got T. & H. Lamps burning and giving good light that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston Lamps still burning that have burned 5,000 hours. The lamps were all I could ask. Have tried 'Sunbeam,' 'Edison' and other lamps made in Chicago, and the 'Perkins,' all of which are no good on earth."

MANITOU ELECTRIC CO.,
By C. F. TINGLEY, Manager.

THE IRON MOUNTAIN ELECTRIC CO., IRON MOUNTAIN, MICHIGAN, state that they have lost but 2 lamps in three months, with one thousand installed.

In the face of these Facts, why do you buy lamps that are of Short Life, Low Candle Power, and that quickly Blacken?

We make our own lamps and can furnish them at once

From 45 to 116 Volts,
From 6 to 150 Candle Power.

Write for Price Lists.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Avenue, BOSTON, MASS.

148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co.. ——
Alexander, Barney & Chapin. . .i
American Electrical Works. . . . xiii
Andrews & Co., A. H. xix
Baggot, E xiv
Bain Electric Mfg. Co. vii
Ball Engine Co. xix
Ball & Wood Co., The i
Bernstein Electric Co. . . . . ——
Blatz, L. . . . . ——
Borden & Selleck Co. xv
Braun Illustrating Co xix
Brownlee & Co. xii
Brookfield, Wm. xii
Brush Electric Co. xvii
Butler Hard Rubber Co . . . . . ——
Buxton, Geo. B xiv
C. B. & Q. R. R. . . . . xiv, xix
C. & C. Electric Motor Co. xvi
Card E. Motor & Dynamo Co. . ——
Central Electric Co. v
Chicago Electric Mfg. Co. x
Chicago Electric Motor Co. xiii
Clower, Harris & Co. i
Chicago Insulated Wire Co. . . xvii
Colburn Electric Mfg. Co. xiv
Columbia Electric Co. xxiv
Coolidge, Fuel & Supply Co. . . ——
Consol. Elec. Mfg. Co., The. . ——
Cowles Electric Smelting and Aluminum Co. xiv
Crocker-Wheeler Electric Motor Co. xiii
Day's Kerite Insulation. i
Dayton Globe Iron Works Co. . xix
Densmore Typewriter Co. xii
Eastern Electric Cable Co. xiii
Easton Electric Co. xiv
Edison General Electric Co. vi
Edison General Electric Co., Cable and Wire Department. vi
Eddy Electric Mfg. Co. viii
Electric Construction & Sup. Co. . . ix
Electric Merchandise Co. x
Electric Secret Service Co. xvi
Electrician Pub. Co. . . . ix, xv, xviii
Elec. Construction Co., The. . . . xiii
Electrical Engineering Co. . . . . ——
Elec. Eng. & Supply Co., The. ——
Electrical Supply Co., The. . . xxii
Elektron Mfg. Co. xvi
Empire China Works. x
Erie Electrical Supply Co. i
Evans Friction Cone Co. xvii
For Sale . . . . . ——
Foster, O. A. i
Fort Wayne Electric Co. xxiv
Franklin Electric Co. vii
Freeman, Coleman & Co. xiv
Gleason & Bailey Mfg. Co. Ltd. x i
Globe Carbon Co. xv
Great Western Elec. S. Co. ix
Greeley & Co., The E. S. i
Hale Elevator Co. xiv
Heisler Electric Light Co. . . . . ——
Hill Clutch Works vii
Hine Eliminator Co. . . . . ——
Holmes, C. H. xiii
Holmes, Booth & Haydens. . . . xvii
Hood, Wm. x
India Rubber & Gutta Percha Insulating Co. xxiii
Interior Conduit & Insulation Co. x
International Okonite Co. i
Kartavert Mfg Co. xii
Keller & Degenhardt xii
Knapp Electrical Works. xxi
La Roche Electric Works. iv
Law Telephone Co. xiii
Leonard & Co., H. Ward. xiv
Leffel & Co., Jas. xiii
Loud, H. M. & Sons Lumber Co. . xiv
McLaughlin, James xiii
Mason, James H. xiii
Milliken Bros. iv
Minneapolis Street Railway Co. ——
Monitor Electric Co. x
Munsell & Co., Eugene. xiii
Murphy, T. J. xiii
N. W. T. H. Electric Co . . . . . ——
National Carbon Co. iv
National Electric Mfg. Co . . . . ——
N. Y. Belting & Packing Co. . . . ——
New York Insulated Wire Co. . . . x
New York & Ohio Co. i
N. W. Elec. Specialty Co. . . . ——
Nuttall Company, R. D. i
Ostrander & Co., W. R. vii
Palste, H. T. xii
Page Belting Co. vii
Partrick & Carter Co. iv
Payne & Co., Geo. W. vii
Pearson & Co., W. B. xix
Pelton Water Wheel Co ix
Phoenix Glass Co. vii
Pond Engineering Co xix
Powell Co., The Wm. . . . . ——
Queen & Co. xiii
Ries Elec. Specialty Co., The. . . x
Rockford Electric Mfg. Co. xii
Royal Electric Co. . . . . ——
Sargent & Lundy. xiii
Sawyer-Man Electric Co. xi
Schawel & Co., Jas. xiv
Schieren & Co. Chas. A. xii
Schoonmaker, A. O xii
Schuyler Electric Co. iv
Short Electric Railway Co xii
Schultz Belting Co. . . . . ——
Sperry Elec. Mining Mach. Co.. xiv
Standard Underground Cable Co. . . i
Stanley Electric Mfg. Co. xxiii
Star Iron Tower Co. . . . . ——
Stearns Mfg. Co. xix
Sterling, W. C. xv
Stilwell & Bierce Mfg. Co. . . xiv, xv
Sunbeam Incand. Lamp Co xv
Taussig, S. . . . . ——
Temple, J. C. xv
Thomson-Houston Elec. Co. . . ii, xx
Turner Brass Works. xiii
Union Electric Mfg. Co., The. . ——
Union Electric Works. iv
Union Hardware Co. xii
U. S. Electric Lighting Co. xi
Van Nuis C. S. i
Vulcanized Fibre Co. xv
Wenstrom Consolidated Dynamo & Motor Co., The xvi
Western Electric Co ix
Westinghouse Elec and Mfg Co——
Westinghouse Machine Co. . . . xix
Weston Electrical Instrum't Co. . . xii
Williams Engine Works. xix
Woodbridge & Turner Engineering Co xv
Woodhouse & Rawson, Ltd. . . . ——
Worthington, Henry R. xii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelt. & Alum. Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Brush Electric Co.
Columbia Electric Co
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
N. W. T. H. Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Franklin Electric Co., The
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Franklin Electric Co., The.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spooters.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cable, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co. The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene
Schoonmaker, A. O.

Cars Railway.
Minneapolis St. Ry Co

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Edison General Electric Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Keller & Degenhardt
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
N. W. T. H. Electric Co.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Roya. Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Palste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Columbia Electric Co.
Easton Electric Co
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
La Roche Electric Works
National Electric Manufacturing Co.
N. W. T. H. Electric Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt
Leonard & Co., H. Ward.

Electrical Specialties.
Columbia Electric Co.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co. The
Turner Brass Works.

Electric Railways.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Wenstrom Consolidated Dynamo & Motor Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrollers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Co burn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Columbia Electric Co.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Northwestern Electric Specialty Co.
N. W. T. H. Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co. The.
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phoenix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Monitor Electric Co.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd
Holmes, Booth & Haydens.
Interior Conduit & Insulation Co.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Columbia Electric Co.
Edison General Electric Co.
Electrical Supply Co., The
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
E. & E. Mfg. Co.
Brush Electric Co.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Clower, Harris & Co.
Columbia Electric Co.
Card Electric Motor & Dynamo Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co.
Erie Electrical Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
La Roche Electric Works
Rockford Electric Manufacturing Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Western Electric Co.
Motor Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Turner Brass Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Engineering Equipment Co.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co
Electrical Supply Co., The
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Stephenson Co., Jno.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Typewriter Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. **THE NATIONAL CARBON CO.** CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

UNION ELECTRIC WORKS,

207 South Canal St., CHICAGO, ILLINOIS.

The **Best Electric Bell** in the market; Nickel plated Gongs; Double magnet, Platinum Contacts, side adjustments with set screw. The simplest and most durable Annunciator, all sizes, for elevators, hotels and offices.

WRITE FOR PRICES.

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class work.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY **MILLIKEN BROS.**

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

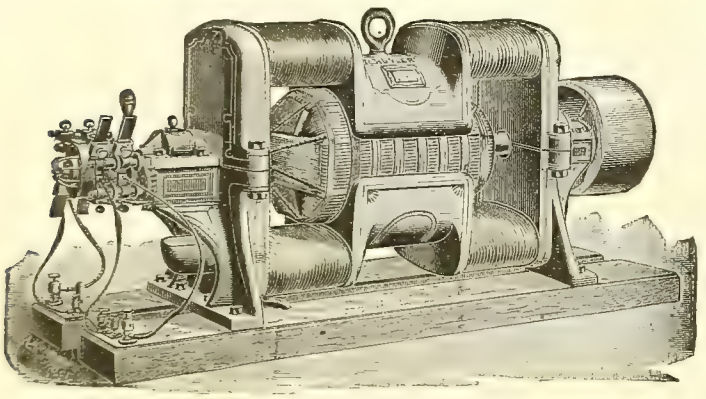
WRITE FOR CIRCULAR AND CATALOGUE.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

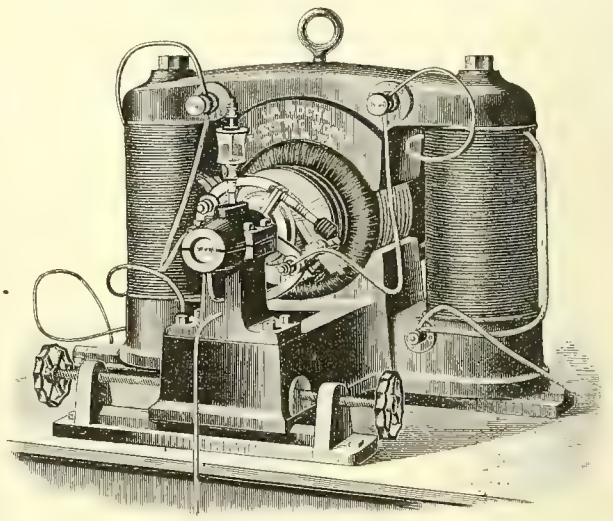
THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,

FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

ESTABLISHED 1867.

FRANKLIN S. CARTER. CHARLES M. WILKINS E. WARD WILKINS.

—TRADING AS—

PARTRICK & CARTER CO.,

125 South Second Street, PHILADELPHIA, PA.

SOLE PROPRIETORS OF THE PATENT NEEDLE ANNUNCIATORS.

Manufacturers of and Dealers in all Kinds of

ELECTRICAL SUPPLIES.

—WE MAKE A SPECIALTY OF—

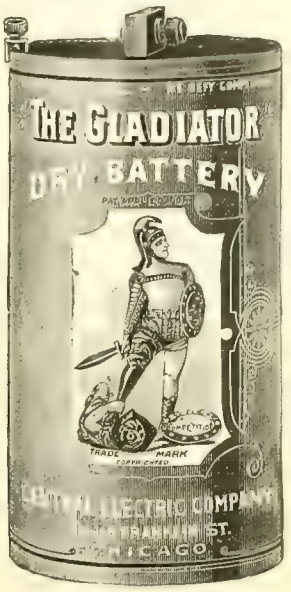
Bells, Disque Leclanche Batteries, Gas Lighting Apparatus, Bronze goods and a full line of supplies for hotel and house work.

Agents for Canada: The Toronto Construction and Electrical Supply Co., Toronto.

Catalogues and Discounts will be sent to those in the trade upon receipt of Application and Business Card.

DRY BATTERIES.

We have spent a lot of money and time in testing this dry battery, and believe it to be the best in the world. . . . .



$$C = \frac{E}{R}$$

In the Gladiator the
E = 1.6
R = .4
C = 4.

OUR ST. LOUIS BRANCH.

OKONITE

TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

OUR KANSAS CITY BRANCH.

OKONITE

TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OUR OMAHA BRANCH.

OKONITE

TRADE MARK.

WESTERN ELECTRI AL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

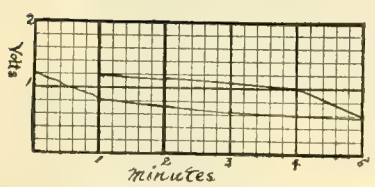
OUR DENVER BRANCH.

OKONITE

TRADE MARK.

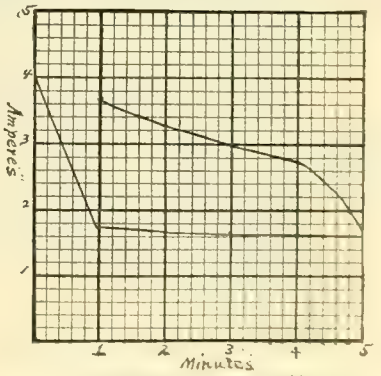
ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St, Denver, Colo.

GET ON TO OUR GLADIATOR'S CURVES.



E. M. F. CURVE.

Showing drop of potential and recovery through 2 ohms of external resistance.



CURRENT CURVE.

Showing drop and recovery on short circuit

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

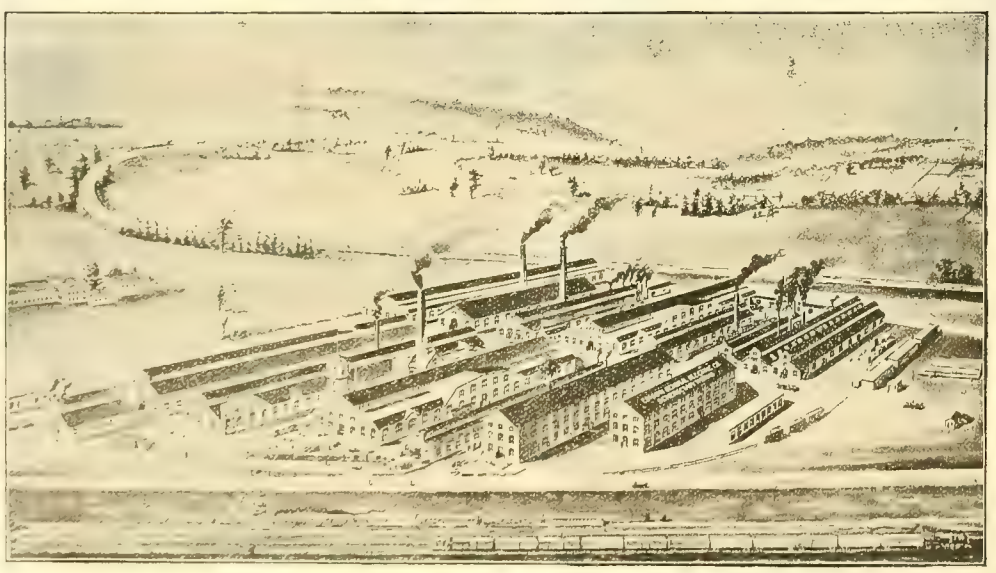
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Circulars sent on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

A NOVELTY. A NOVELTY.

A REVERSIBLE BATTERY,

EITHER PRIMARY OR STORAGE.

Electromotive Force, 2.4 Volts; Internal Resistance, .006 Ohm. Capacity Unlimited. 26 Different Styles [illegible]

THE FRANKLIN ELECTRIC COMPANY, 126 Liberty St., New York.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

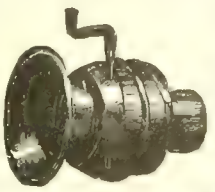
BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

BINDERS

—FOR THE—

WESTERN ELECTRICIAN,

ONE DOLLAR.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS & BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

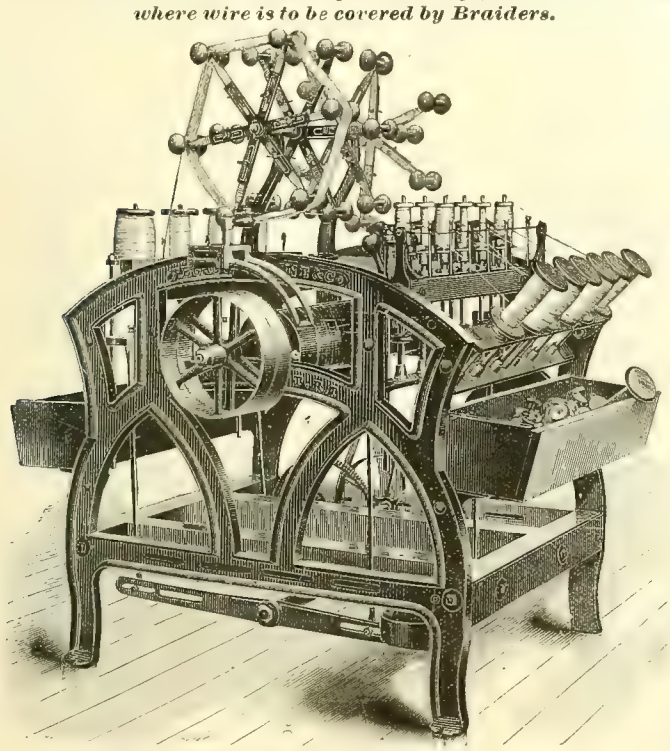
Send for NEW CATALOGUE. Out August 1st.

GEORGE W. PAYNE & CO.,

MANUFACTURERS OF

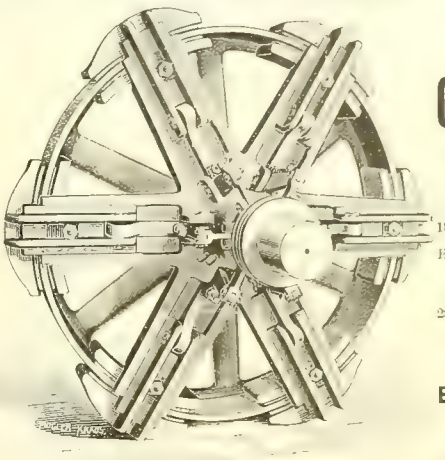
BRAIDER SPOOLERS,

Used in connection with Braiding Machinery for Electrical Work where wire is to be covered by Braiders.



Machines built when required to double two or more ends, with drop motions to stop spindle when end breaks, also when bobbin is full.

Works 102 Broad St., PAWTUCKET, R. I.



HILL

Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.

18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 625 Kasota Building.

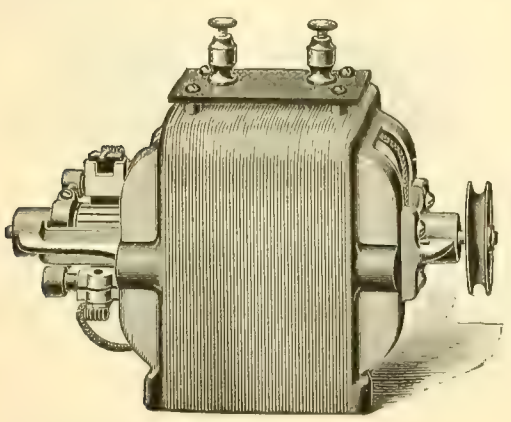
KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

BAIN ELECTRIC MFG. CO.,



FOREE BAIN, President and Engineer,

47 and 49 S. Jefferson Street, CHICAGO.

DYNAMOS AND MOTORS

1-12 to 500 Horse Power.

Highest Class in Efficiency, Mechanical Design, and General Utility.

Experts in applying Electricity to New Uses.

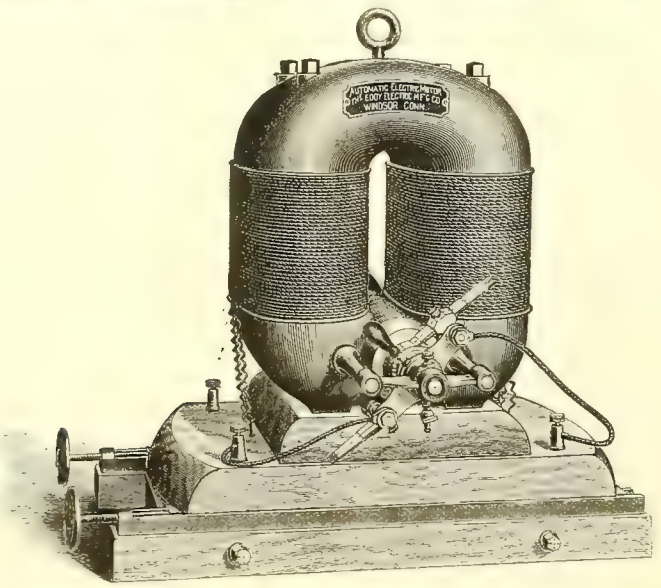
SEND FOR CATALOGUE.

THE

EDDY ELECTRIC MFG. COMPANY

MAKES A SPECIALTY OF THE COMPLETE EQUIPMENT
OF FACTORIES WITH

ELECTRIC POWER.



EDDY POWER GENERATORS,

ANY SIZE UP TO 300 H. P. AND ANY VOLTAGE.

THE EDDY ELECTRIC MOTOR

Is Simple, Efficient, Durable, Economical and Always Reliable.

THE EDDY ELECTRIC MFG. CO.,

WINDSOR, CONN.

136 Liberty Street, - NEW YORK.
92 Franklin Street, - - BOSTON.
506 Commerce St., PHILADELPHIA.
341 The Rookery, - - CHICAGO.
Rialto Building, - KANSAS CITY.
413 Jackson Street, - ST. PAUL.
409 West Michigan Street, DULUTH.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

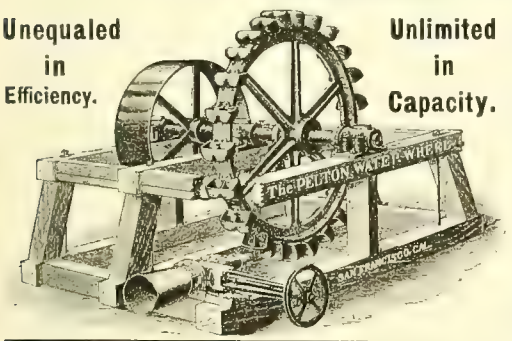
227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS., NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency. Unlimited in Capacity.



Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 20 up to 2,000 or more feet. From 20 to 30 per cent better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,
121-123 Main St., San Francisco, Cal., U. S. A.
143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

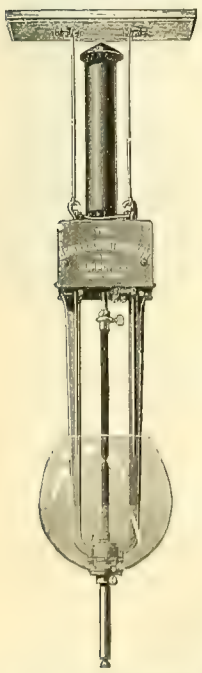
ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

SOMETHING ENTIRELY NEW. SIMPLE, EFFICIENT, ECONOMICAL.

Indorsed by the Electrical Press and Prominent Electrical Engineers and Electricians. For Particulars and Prices write to

THE RIES ELECTRIC SPECIALTY COMPANY, PATENTEES AND SOLE MANUFACTURERS

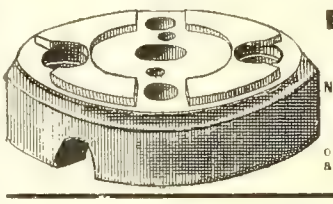
Baltimore and Eutaw Sts., BALTIMORE, MD. REGULATING SOCKETS.

73-75 W. Jackson St. RELIABLE

WE ARE FITTED WITH RELIABLE Machinery and Tools, And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

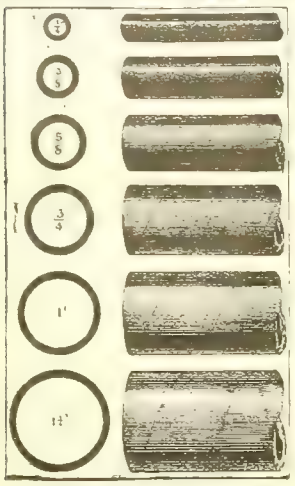
MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

THE INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Thos Day & Co., 222 Sutter St, San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 226 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co, 27 E Main St, Rochester, N. Y.
Glover Elect Co, 127 W. 8th St, Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kipler, 531 Chestnut St, Philadelphia, Pa.
Electrical Supply & Construction Co, Pittsburgh, Pa.
Southern Electric Co, Baltimore, Md.

THE "JEWEL"

WM HOOD, GEN'L AGENT. JEWEL INCANDESCENT LAMP 239 LA SALLE ST. CHICAGO.

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

16 C. P. Less than 100 lots, 55 Cents.
" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

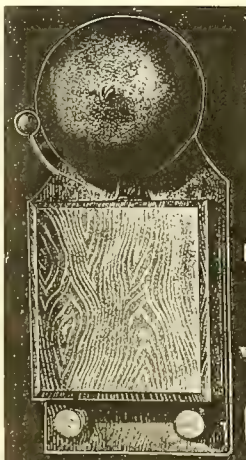
EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.



MONITOR

WOOD-BOX

BELLS

ARE THE BEST.

Polished Case, Nickel Plated Trimmings, Heavy Magnets, Quick Stroke, Clear Ring.

Write for Quotations to

C. A. HARMOUNT, M'gr,

MONITOR ELECTRIC COMPANY

149 Wabash Av., CHICAGO, ILL.

Western Agents Alfred F. Moore's Wires and Cables.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC,

All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street,

CHICAGO.

MAIN OFFICE. 649 and 651 Broadway, New York

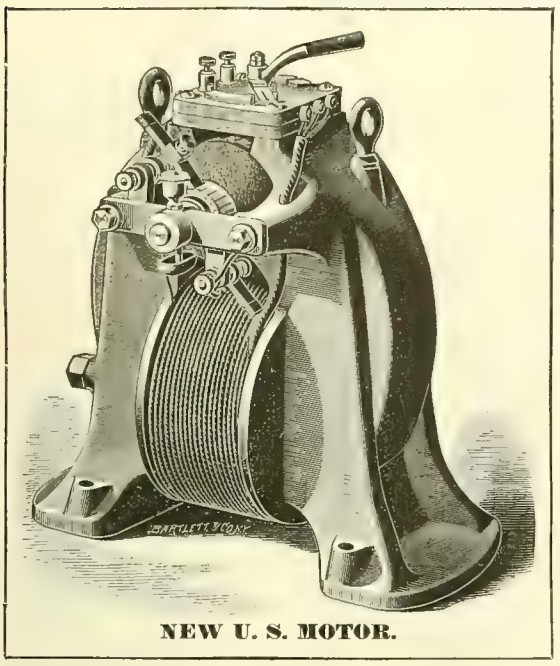
Geo. H. Meeker, Western Manager.

NEW YORK INSULATED WIRE CO. NEW YORK MOISTURE-PROOF VULCA ELECTRICAL WIRE-DUCT NON-INFLAMMABLE TRADE MARK AND CHICAGO.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos. — Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

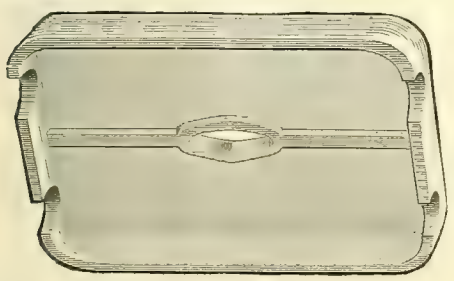
MOTORS and GENERATORS

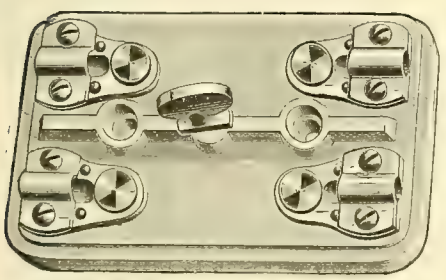
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

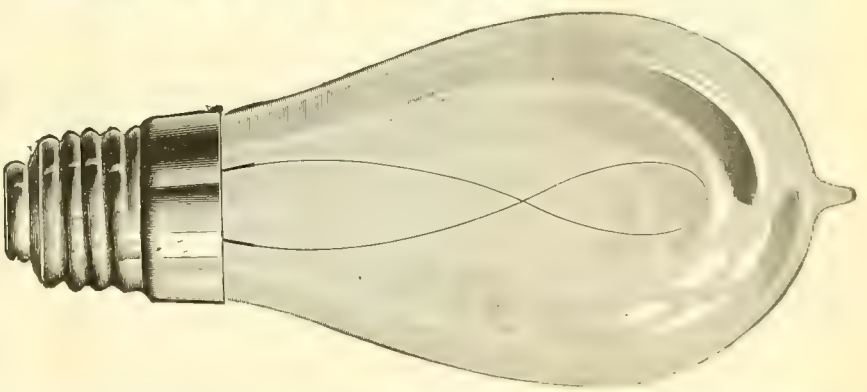
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

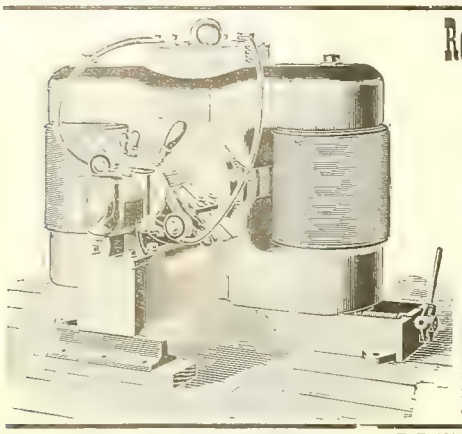
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway).

Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery. Chicago, Ill 1201 Market St., Philadelphia. Pa.

See our full page advertisement in issue Sept 12, for Illustrations, prices, etc.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

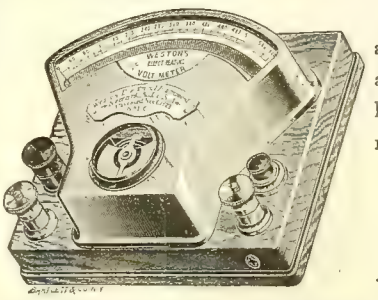
CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

The "DENSMORE,"

The World's Greatest Typewriter,

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type bar machines.

Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Steel throughout.

STANDARD KEY BOARD, with shift carriage for capitals. Call or send for catalogue.

"The best all typewriters. The height of perfection. To buy any other than the 'DENSMORE' is a mistake." —O. T. BRUMENSCHEIN, Stenographer, National Park Bank.

We want a reliable dealer in all cities as soon as possible, and in the meantime will ship machines to parties having a good commercial rating.

DENSMORE TYPEWRITER CO., 202 Broadway, New York.

KARTAVERT

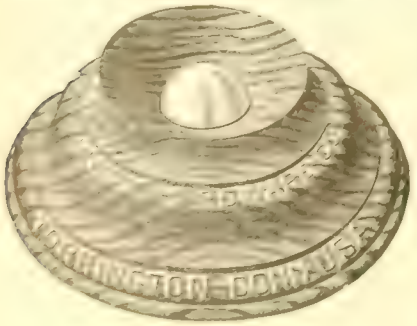
THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.



—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

AND

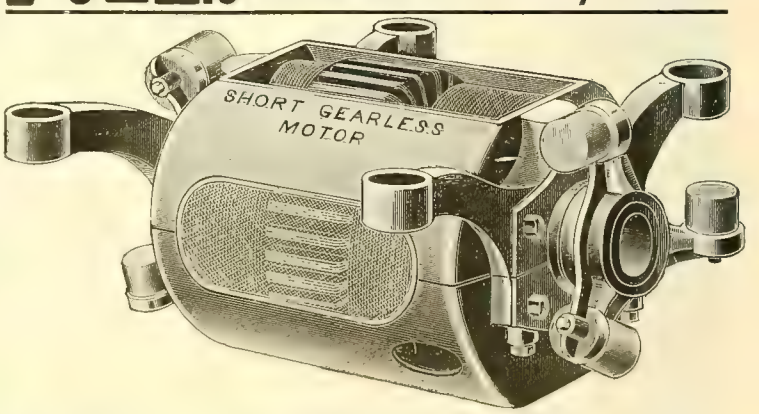
95 CHAMBERS STREET, NEW YORK.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.



Gleason & Bailey Mfg. Co.,

(LIMITED.)

GENERAL WESTERN AGENTS FOR THE

STEUBEN INCANDESCENT LAMPS,

The best in the Market,

Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.

Rubber Covered, Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and catalogues.

Western Electrician.

EVERY SATURDAY.

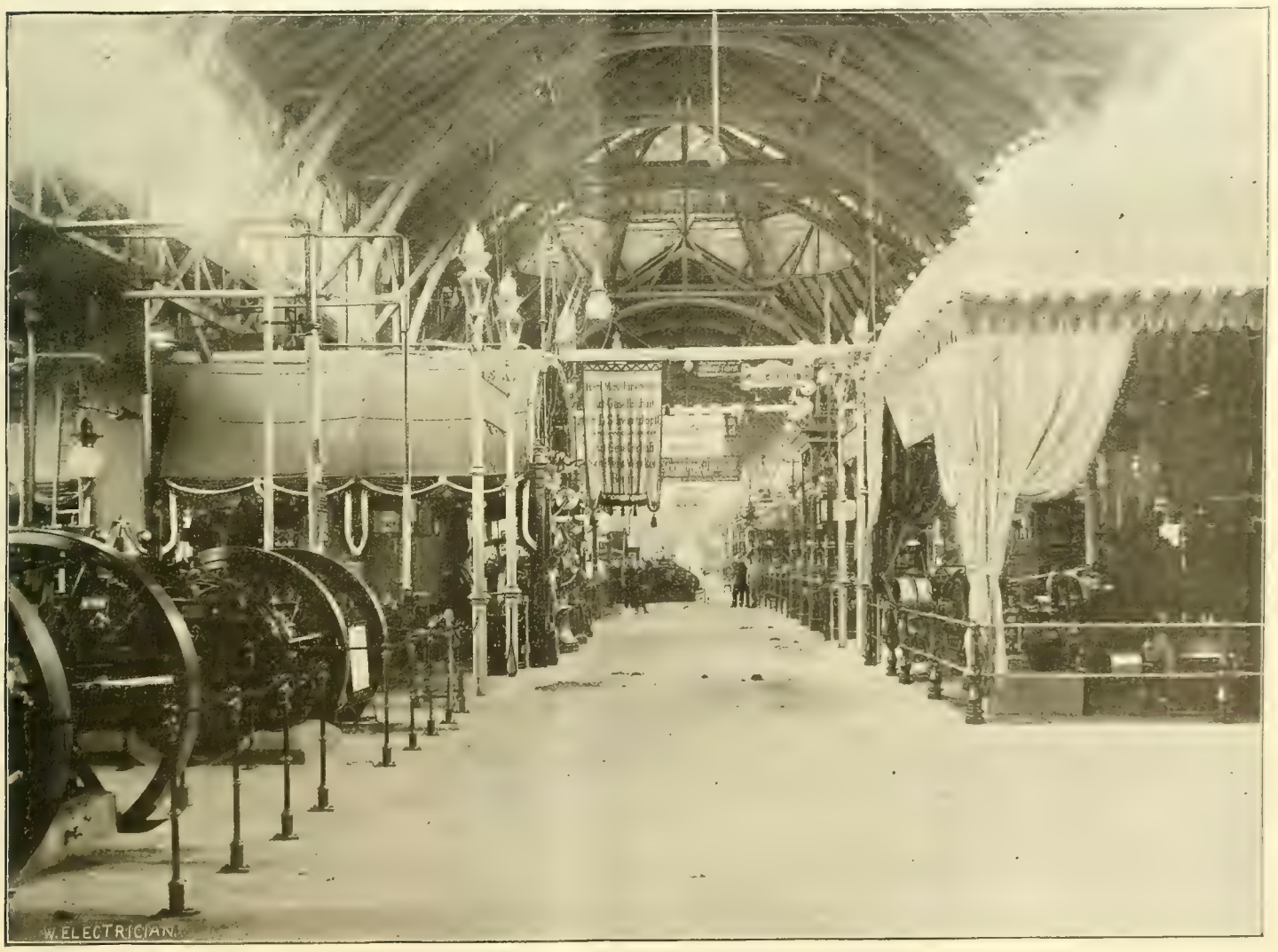
Vol. IX. CHICAGO, OCTOBER 10, 1891. No. 15

Frankfort Electrical Exhibition.

In the accompanying illustration is shown an excellent view of the interior of Machinery hall at the Frankfort electrical exhibition. In this department, it will be noticed, is arranged the heavy machinery, but the decorative effects have not been neglected. Throughout Machinery hall and in fact in all the buildings and grounds the lighting arrangements are on an elaborate scale and electric power is used exclusively.

The displays in this exhibition have attracted the attention of electrical engineers throughout the world, and the experiments in long distance transmission have added to the general interest in the affair. In another column this subject is treated in detail. A correspondent of the WESTERN ELECTRICIAN at Frankfort writes that the scheme is working successfully at present but that "they are only using 16,000 or 17,000 volts, and the plant is not operating at its utmost capacity." Furthermore he announces that the weather has been fair throughout the experiment; there has been no rain and therefore the test is not as yet complete.

Americans who have visited Frankfort commend the exhibition generally and say there are many features that could be adopted by the management of the World's Fair. In fact the representatives of the exposition who visited Frankfort recently appear to be of the same opinion. It will be recalled that Secretary Butterworth in a communication to President Baker presented in the WESTERN ELECTRICIAN called attention to the excellent features of the Frankfort exhibition and suggested their adoption by the World's Columbian Exposition. Undoubtedly many of the exhibits now at Frankfort will be reproduced in this country in 1893. Thus far the Frankfort electrical exhibition has proven highly successful.



FRANKFORT ELECTRICAL EXHIBITION.—VIEW OF MACHINERY HALL.

To Utilize the Power of Niagara.

A. P. Brayton, president of the Pelton Water Wheel company of San Francisco, has just returned from London, where he devoted much time to matters of interest to electrical engineers. In conversation with a representative of the WESTERN ELECTRICIAN Mr. Brayton said that the Ferranti system was still a subject of interest in London. The people had not yet ceased to wonder at the magnitude of the undertaking, and while the project had not proved as successful financially as was anticipated, Mr. Brayton said that the blame could not be attached to Ferranti but rather to the company, which had failed to secure subscribers. Mr. Ferranti has severed his connection with the London Electrical Supply company, but he has not left the country — he is, in fact, conducting a prosperous business in London, on his own account.

"Ferranti met with considerable opposition in England," said Mr. Brayton. "The fact of the matter is he was too far advanced for the English. Of course, the gas interests opposed him and that [illegible] swamp any [illegible] of the extent of the influence of the gas interests of London. They are all powerful and to this more than anything else may be attributed the poor illumination of the city of London. We hear much about electric lighting in London. There is nothing worthy the name. They haven't any idea of what electric lighting is on a vast scale and that is why they do not fully appreciate Ferranti's project."

During Mr. Brayton's visit in London he consulted the projectors of the schemes for utilizing the power of Niagara. The company that has secured the Canadian rights has interested Mr. Ferranti in the project and he has given considerable thought to the matter. He estimates that he can deliver 20,000 horse power [illegible] tricity at Buffalo at an outlay of $2,000,000 for the plant. If this power were sold at the uniform rate of $50 per annum, it would realize $1,000,000, [illegible] each year. In view of the fact that the operating expenses of such a plant would be insignificant, the value of the company's rights, according to Mr. Ferranti's figures is certainly very great.

Mr. Brayton considers the [illegible] for more valuable than [illegible] though the latter is also very valuable. The plans of the companies differ. The American company proposes to build

a manufacturing town at the works and for the present develop only the amount of power required by these factories but eventually it will consider the advisability of transmitting power by electricity to Buffalo and other manufacturing centers. The Canadian company has secured a ruling from the treasury department at Washington on the subject of transmitting electricity from Canada to this country, in which it is held that no tax can be levied.

It is expected that operations will be begun by this company at an early day and that Mr. Ferranti himself will visit this country in the interest of the London capitalists. Had it not been for the recent panic in the money market in London Mr. Brayton says the project would now be well under way.

Electricity at the World's Fair.

The power house which will contain the temporary lighting plant at Jackson Park, is practically completed. It is shown in Fig. 1. There is much activity displayed in the work for the electrical building. The decorative effects are well under way; and, as will be seen from the cuts, they will be of a most interesting character. Fig. 2 represents a figure of Franklin watching the lightning. Action is suggested in every line of the huge model. The upturned face, the outstretched hand, the drapery of the coat and the loose end of the neckerchief blown back by the wind are all part of the story which the sculptor has told in clay. It is a grand figure which Carl Rohl Smith has modeled, and when it is cast in plaster and mounted on its pedestal, standing twenty-one feet from the ground, it will attract the attention due to such a noble work of art.

The committee on electricity has decided that there shall be no arc light circuits on the World's Fair grounds north of the central line of Fifty-ninth street, except in the art gallery, if it shall prove that such circuits are needed in that building. All arc lights in that portion of Jackson Park are to be taken from incandescent circuits. This is the portion of the grounds to be occupied by state and government buildings, and it is thought that a single system is desirable.

It is proposed to utilize the elevated railroad structure to convey the cables from the power house to different portions of the grounds. The plan contemplates branch cables to the buildings laid in conduits.

The matter of the method and the amount of compensation to be paid electrical exhibitors for lighting and power service is a perplexing problem that is engrossing much of the time of the electrical committee and the departments of electricty and construction. It has, however, been decided that competing companies must bid on all the buildings for the particular type of service to be furnished, else their questing "that its formal approval be secured for all expenditures, for the payment of which the certificate of its chairman is required before said expenses are incurred."

All electric wires in buildings will be laid under the aisles and the heads of the departments have been requested to furnish at the earliest moment the amount of horse power and number of motors required in the different buildings.

Sale of a Municipal Plant.

Some of the cities that have gone into the business of generating electricity for lighting purposes are now regretting their action, wishing that they had not invaded the field of private enterprise. Vancouver, Wash., is one of these cities, and it recently advertised for proposals for the purchase of its electric light plant. In the notice it was stated that "Each bid must be accompanied by a bond in the sum of $1,000, conditioned that, if the bid is accepted by the city, the successful bidder will enter into contract with the city to make the purchase as proposed within thirty days. The city reserves the right to reject any and all bids. Bidders must state the rates they will charge for street and house lights in the event of purchase, which rates must be graduated for a series of not less than ten years, decreasing to an agreed minimum upon the attainment by the city of a certain population. The purchaser will be required to give adequate bonds for the faithful performance of this contract."

FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

An extensive electric power plant is being installed under the direction of C. L. Hart at Grand Falls, near Joplin, Mo., by the Southwestern Electric Light & Water Power company, whose principal office is at Kansas City, Mo. Water power is utilized by a massive dam of concrete, and electric power is furnished for lighting and mining operations.

How the Western Telegraph Company Obtained Its Racing News.

During the last week or ten days New York electrical men and, in fact, the public in general, have been very much amused and interested in the various attempts which the Western Union Telegraph company has been making to obtain the news of the races of the Brooklyn Jockey club. Without going into the merits of the case, it may said that the spectacle of a great and rich corporation descending to artifice to attain its ends is not one calculated to excite admiration. But the Telegraph company made such determined efforts that toward the last the play between the parties interested became most exciting. One could but wonder what would be the next move.

The majority of the readers of the WESTERN ELECTRICIAN, no doubt, already have a general idea of the controversy. The Western Union company wished to obtain news of the races and telegraph it to the pool rooms throughout the country. The Brooklyn Jockey club took the stand that it was the sole owner of all the information which might be obtained on its property, and therefore wished the telegraph company to remunerate it for such news. There was considerable bargaining before the event, but the Jockey club realized the value of the information and demanded a good price. The Western Union company considered the news of the races valuable, but not worth the money asked for it. So things went on until the racing began, and still no agreement was reached.

Meanwhile, the Western Union management began operations in another direction. To prevent the telegraph company from obtaining reports through the agency of messengers sent from the track, the Jockey club gave notice that all spectators entering its grounds must buy tickets under the special agreement that no one was to leave the track while the races were in progress. This was to checkmate the Western Union Telegraph company. But that corporation was not to be turned from its course in that way. Up went poles and towers outside the grounds, from which it was intended operators should telegraph the news, but up went fences and screens to obstruct the view of the track. Then came women and men in various disguises, some having hidden about them carrier pigeons, which could be liberated to carry the news to the Western Union operators. At one time it was even rumored that a balloon was to be raised near the track. But all was of no avail. Pinkerton had been hired by the

racing people and was successful in exposing every scheme. It looked as though the telegraph company's efforts were doomed to fail.

For several days there was what seemed to be a lull in the exciting performances, but the apparent cessation of hostilities was soon discovered to mean that the Western Union company was accomplishing its purpose and getting the news to the pool rooms. There was a leak somewhere, and the information was telegraphed from the track for four successive days. Then came an exposure which revealed one of the most ingenious schemes which could be imagined.

During this lull there had been stationed on the lawn near the horse sheds and just beyond the betting ring, a barouche drawn by well-groomed and nicely harnessed horses driven by a man dressed as a coachman and gotten up in the most approved style of the driver of a private turn-out. The barouche contained what seemed to be a

FIG. 6. HOW THE WESTERN UNION TELEGRAPH COMPANY OBTAINED ITS RACING NEWS.

family party consisting of two ladies, one gentleman and a small boy, besides a footman and the coachman, who always sat stiffly on his box, while one of the other men of the party ran back and forth from the carriage to the betting ring.

On the following Thursday morning Pinkerton's suspicions were aroused, but it was almost impossible to prove that the members of this party were doing any signaling. However, they were marked for watching. Finally the barouche was raided, and in a few moments the ingenious scheme was revealed. The carriage was nothing more or less than a Western Union telegraph office. The apparatus, though, was of the most novel type imaginable, but it is needless to say that it differed very materially from that usually employed for telegraphing the Morse alphabet.

The coachman was the stand for a most cleverly devised telegraph instrument, which consisted of a hat with a hole in it and an incandescent lamp on the inside. Underneath his seat was a battery, and concealed in the hand of one the occupants of the carriage, was a key which connected with the battery and lamp. This was the sending apparatus on the race track.

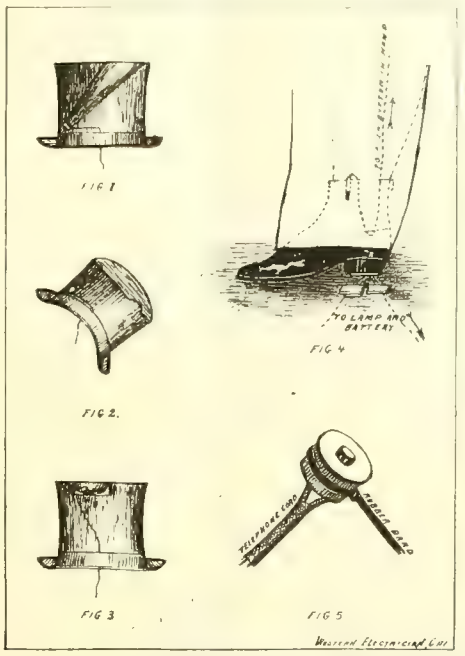
The receiving apparatus was, of course, without the racing grounds. On top of an old hotel not far away from the track a scaffolding had been erected, and on top of this there had been constructed a little cage covered with black cloth. Within this cage were men who read off with the aid of a telescope the signal flashes from the lamp in the hat. The Morse alphabet was used. This was the scheme in a nutshell.

There have been published a number of accounts of how this unique system was operated, but up to the present time, little or nothing has been said relative to the details. With a view of giving the readers of the WESTERN ELECTRICIAN the minutiæ of the scheme, and of the apparatus employed, a representative of this journal called upon the gentlemen who projected this most successful and unique attempt at news gathering, and from them obtained the information herewith presented.

The party in the carriage consisted of J. W. Frost, secretary and treasurer of the National Fire Alarm company, New York, and wife, his little son, an old lady seventy five years of age, and George S. Pearsall, who impersonated the coachman. There was also a footman. J. W. Frost and C. C. Frost—who, by the way, is secretary and manager of the National Automatic Fire Alarm company, of Washington, D. C.—devised the rigging, and through them the accompanying cuts of the apparatus were secured.

As was before briefly stated, the paraphernalia consisted in the main of a battery, an incandescent lamp and a key. The most important portion of the device was the incandescent lamp. This was mounted in the hat as shown in Figs. 1, 6 and 7. It will interest many to know that Figs. 6 and 7 are a reproduction of photographs of the original hat, which was employed successfully for four days. At the last, for some reason or other, it was decided to do away with the cone from the lamp to the hole, and use a hat like that shown in Fig. 2. In this hat an incandescent lamp was attached on the upper edge of the sweat band, and the hole was in the top of the hat. Fig. 2. shows the arrangement of this hat, which the Pinkerton men confiscated.

Fig. 3 is a cut of an arrangement which was furnished



FIGS. 1–5. HOW THE WESTERN UNION TELEGRAPH COMPANY OBTAINED ITS RACING NEWS.

Mr. Frost, before the scheme was put in operation, by the Franklin Electric company, of New York. This company, it may be mentioned, furnished the batteries, and most of the rigging employed was designed by Prof. Frank K. Irving. A number of modifications, however, were made from time to time while the scheme was in operation. The battery employed was specially made for this purpose. It was contained in a box which was 4¼x6½x5 inches It weighed 4⅞ lbs. and contained 12 cells, which were connected to give an electromotive force of 9.6 volts. This battery is of a special type, described by the makers as a "combined primary and storage cell." During part of the time however, another battery was used of a different type and was concealed beneath the clothing of the coachman.

The lamp in the [illegible] the Western [illegible] Fig 1 [illegible] rriage [illegible] times he sent the Morse signals in this manner. Often time[s] [illegible] top of [illegible] the plates in the [illegible] small push button, Fig. 5, which he kept concealed in his sleeve. A rubber band attached to the push button kept it well out-of sight except when wanted.

Connection from the lamp to [illegible] plates were made by means of fine insulated wires. The wires, where they passed from the hat down underneath the coachman's coat collar, were tinted a sunburnt flesh color to prevent detection.

FIG. 7. HOW THE WESTERN UNION TELEGRAPH COMPANY OBTAINED ITS RACING NEWS.

The signaling was carried out under a most carefully considered plan. The four days' success of the scheme is an indication in itself of the thoroughness of the work.

In order that the reader may have a clear understanding of the method of operation, the accompanying map, Fig. 8, is presented. This diagram shows the track, the grand stand, the carriage stand, the position of Mr. Frost's carriage relative to the spectators, the old hotel outside the grounds and the nest on the pole to the left.

In operation the coach was drawn in on the outer edge of the carriage stand with the horses' heads facing the track. The hotel was about three hundred yards in the

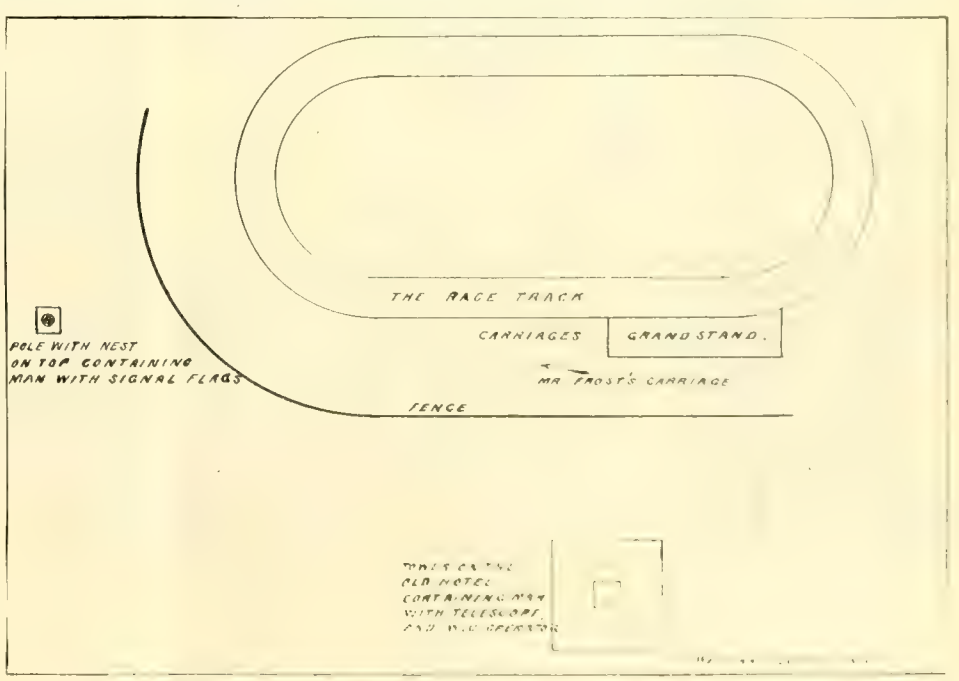


FIG. 8. HOW THE WESTERN UNION TELEGRAPH COMPANY OBTAINED ITS RACING NEWS.

rear, and upon it was a [illegible] seventy-five feet, there was a [illegible] square, covered on all sides with black cloth. The black covering of the cage was [illegible] racing people from seeing what was going

[illegible] In the sides of the cage slits were cut, through which field glasses might be pointed without a chance of detection by those on the track. Within this inclosure was a Western Union operator who handled the telescope. C. C. Frost was there also. Another Western Union operator with a Morse outfit was in a room below. The operator at the slit would read the dots and dashes made by J. W. Frost in the carriage, and C. C. Frost

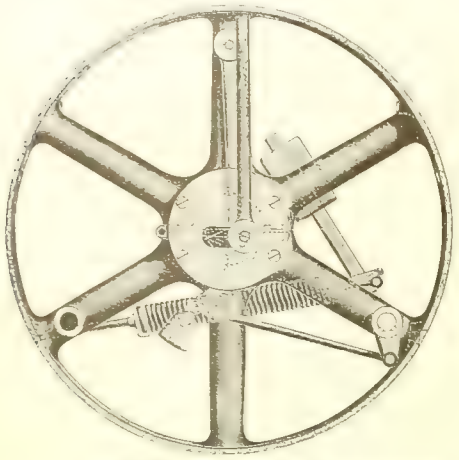
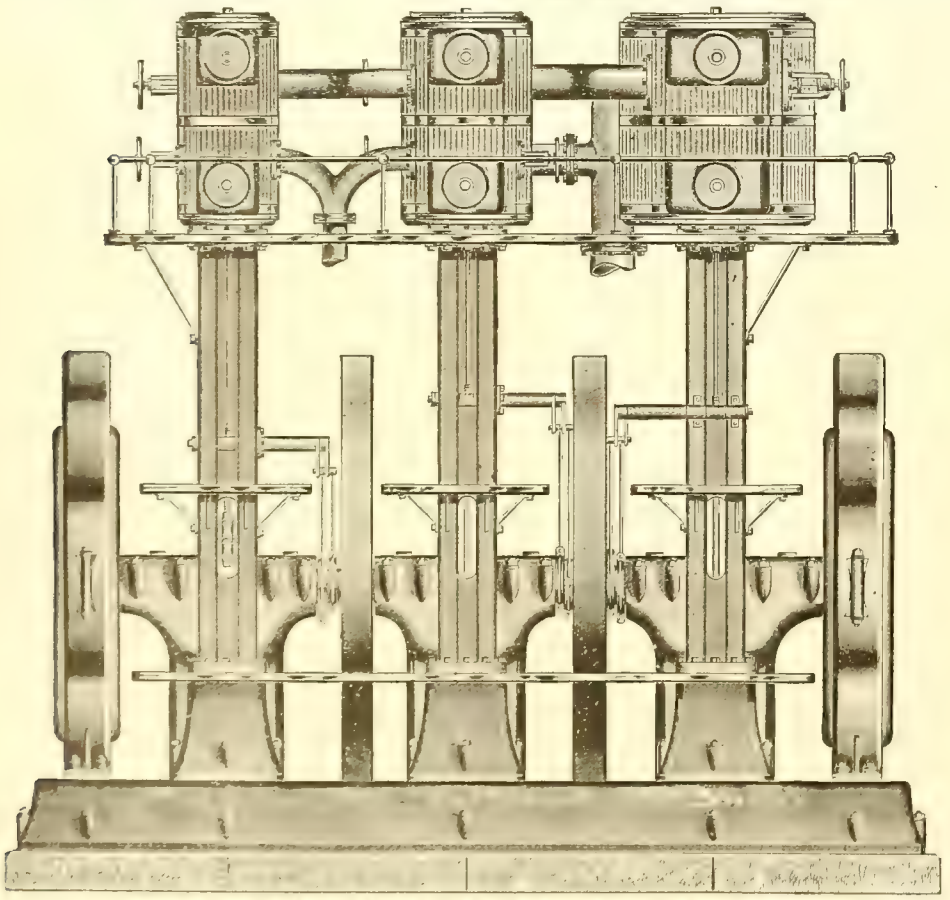


FIG. 4.—NEW ENGINE FOR CENTRAL STATION PLANTS.

would take the message and pass it to the Western Union operator down below. In this way the news was telegraphed to New York.

Away off at the left of the hotel at a distance of about five hundred yards, was a pole one hundred feet high, and on top of this also was a cage covered with black cloth. In this "nest" on the pole there was a man with colored signal flags. His business was to let the party in the carriage know by means of flag signals whether the man in the tower with the telescope could see the lamp.



[illegible] STATION PLANTS.

[illegible]

focus;" yellow, "repeat;" waving a yellow flag, "start over again;" red, "stop," etc. No signals, except through the lamp in the hat, were made at the carriage, and from this very fact the Frosts are confident that the scheme would have worked successfully all the way through to the end had not some one let the cat out of the bag.

New Engine for Central Station Plants.

In the accompanying cuts are shown a new type of engine, designed by the Lake Erie Engineering Works, for central station electric lighting and railway work.

The rotative speed chosen is somewhat above the limitations imposed by the releasing valve gear of other engines,

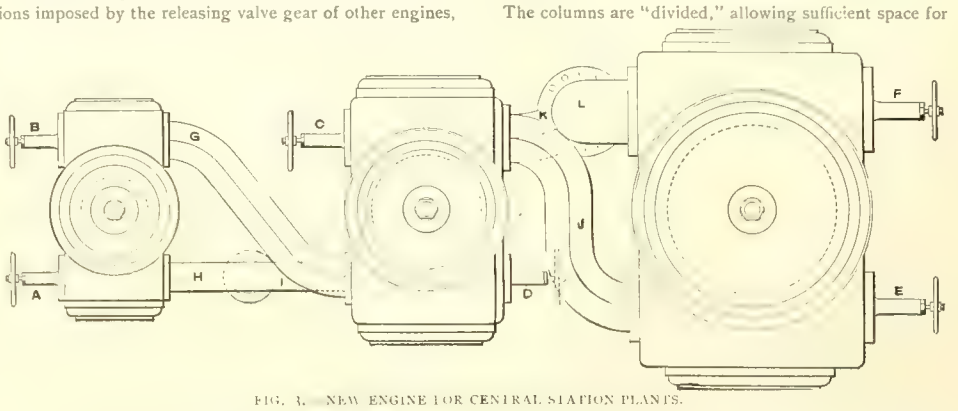


FIG. 3.—NEW ENGINE FOR CENTRAL STATION PLANTS.

but is not what is called high speed. The engines occupy a middle ground in this particular. The piston speed is universally 650 feet per minute, and the stroke is reckoned from the diameter of the shaft and its consequent rate of rotation.

The accompanying illustrations are from scale drawings of triple expansion engines, and are shown connected directly to two 500 horse power generators, and are intended to work under from 140 pounds to 160 pounds steam pressure when connected with condensers and from 180 pounds to 200 pounds steam when exhausting into the atmosphere.

They are rated at 1,000 horse power when most economically loaded, but are capable of performing 1,200 horse power or more very easily should they be called on to do [illegible] to obtain as good economy with these [illegible] from [illegible] pounds to 200 pounds [illegible] condensers, as with compound [illegible] from [illegible] to 160 pounds steam. Their adaptibility, therefore, to situations where water can[illegible] apparent.

Figs. 1 and 2 are front and side views of the three cylinder type. It will be seen that each cylinder acts on an independent set of cranks on a common crank shaft; this is 9¾ inches diameter and carries at each end an armature, having two intermediate wheels. In this manner the weight is distributed evenly along the shaft upon bearings, tending to bring equal wear upon each journal along its length, thus keeping the shaft straight and free from undue strains.

Each cylinder has an independent framing and pedestal, the whole, including the generators, standing on a common bed plate.

The columns are "divided," allowing sufficient space for the valve stems and rock-arms of the high pressure and intermediate pressure cylinders and bringing the valve chest at right angles to the crank shaft. These valve chests form the receivers between the cylinders. Four valves are used on each cylinder, the steam and exhaust being independent of each other, and the steam lap and exhaust lap adjustable, so the admission, lead, closing and opening of exhaust, or point of cut-off, may be easily altered by adjustment. In this manner the engine is easily adapted to any service either condensing or non-condensing.

The clearances are small, averaging from 2½ to 6 per cent., according to sizes of cylinders, and the valves are adjusted to fill the clearance by compression, neutralizing the small loss that would occur in these limited clearance

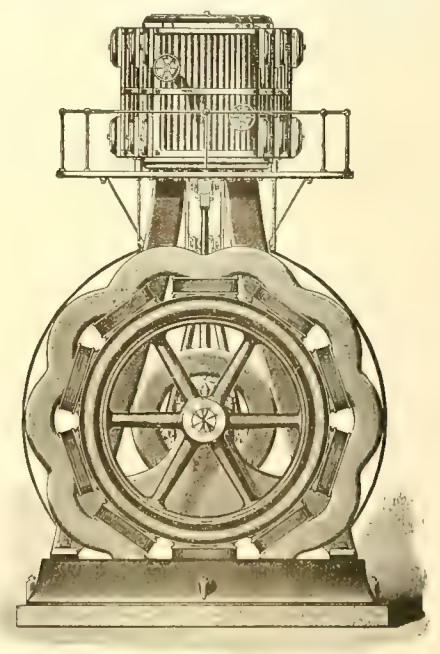


FIG. 2.—NEW ENGINE FOR CENTRAL STATION PLANTS.

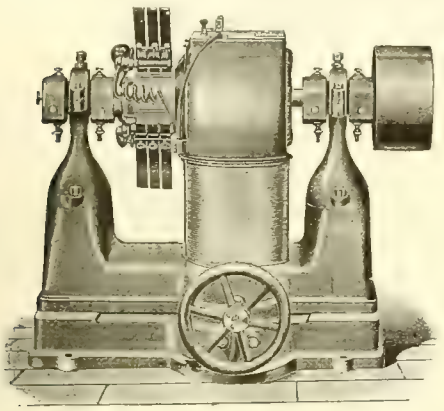
spaces, and at the same time insuring against "knocking" on the rod bearings and main journals.

The valves are four-ported, therefore small and light, flat faced and nearly balanced, pressing against their seats just sufficiently to keep tight and are allowed to follow their wear. The engines are of the disconnective type.

By referring to Fig. 3 it is seen that the hand wheels *A*, *B*, *C*, *D*, *E* and *F* are places on the steam chest opposite the pipes *H*, *G*, *K*, *L*, *J* and *I* respectively, the valves being placed upon seats at the ends of the pipes and operated by their respective hand wheels. By the use of these valves the engine can be converted into either a small compound engine, by disconnecting the low pressure cylinder, or it may be made into a large compound engine by disconnecting the high pressure cylinder and the change can be made

while the engine is running, the governor being connected to the intermediate steam valves when using the intermediate and low pressure cylinders as a compound. By this arrangement but one governor is used, and its action can be thrown on to the intermediate steam valves either in full or in part as desired. The main bearings are provided with babbitt-lined shells and are water jacketed, a water jacket being provided in the back of guides also. The engines are equipped with a complete system for grease lubrications. The cranks and shafts are forged and of the built-up pattern, with counterweighted crank arms.

The governor, shown in Fig. 4, is used at the end of the shaft, the valves being driven from an outside pin as shown. A similar governor is placed in one of the inter

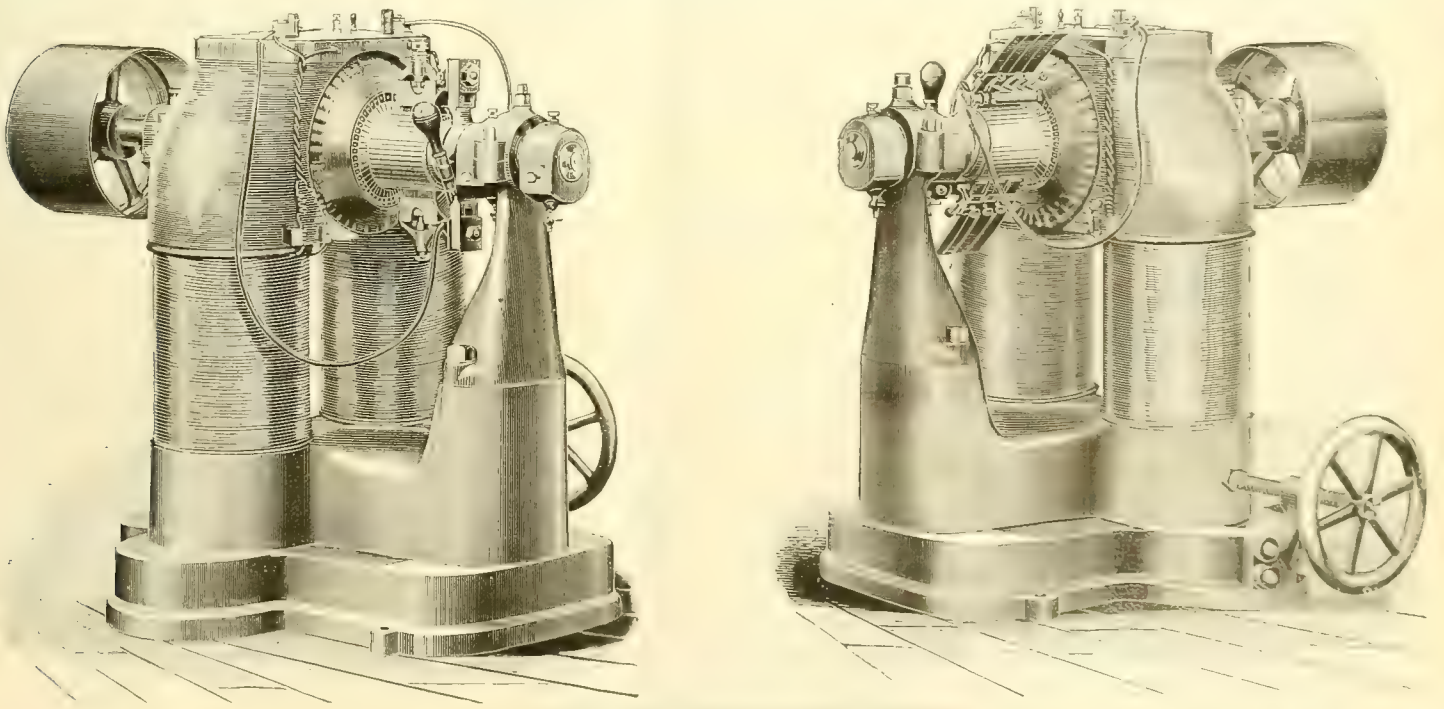


THE COLUMBIA SYSTEM. INCANDESCENT DYAMO

mediate wheels in the triple engine shown herewith. The Lake Erie Engineering Works are building these engines in sizes from 150 horse power to 10,000 horse power.

The principal dimensions are as follow: Diameter of high pressure cylinder, 16 inches; diameter of intermediate pressure cylinder, 26 inches; diameter of low pressure cylinder, 40 inches; stroke, 34 inches; diameter of shaft, 9¾ inches; height above cap stone, 21 feet 9 inches; length over generators, 23 feet 6 inches; breadth, 14 feet; revolutions per minute, 115.

The Field Engineering company of New York has con-



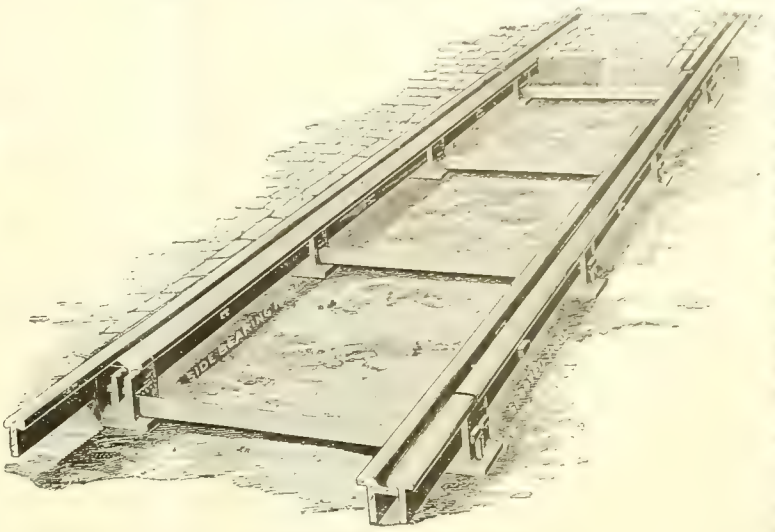
THE COLUMBIA SYSTEM.—MOTOR AND POWER GENERATOR

cluded arrangements to represent this engine in electric station work. The Lake Erie Engineering Works are building two large engines of this type in two cylinder compound for the Field Engineering company, soon to be installed in the power station of the Buffalo Railway company.

The Columbia System.

The Columbia Electric company of St. Paul, Minn., has perfected a light and power system including arc, incandescent and railway apparatus. Several of these devices have already been illustrated in the WESTERN ELECTRICIAN, including the arc lamp for direct and alternating current and a snow sweeper and plow operated by electricity. In addition to these machines the company has recently completed the devices illustrated in the accompanying [illegible]

It will be noticed from the cuts that the generators and motors are of the same general design. The magnets of these machines are made of the best quality of charcoal wrought iron. The armature cores are thoroughly insulated with pure asbestos and mica; the commutators are also thoroughly insulated. It will be seen by reference to the accompanying illustrations that the machines are provided with self oiling bearings, self aligning journals, and in large sizes a belt tightening device. Carbon brushes [illegible] employed on all the motors when wound for 220 volts or over. The carbon brushholder is extremely simple, and is



DUPLEX STREET RAILWAY TRACK.

so constructed that the uniform pressure of the brushes against the commutator may be maintained until the brush is entirely worn out. All the motors over 5 horse power have sub-bases, and a screw for belt tightening. In all the machines the electrical details are carefully calculated, and the mechanical construction so proportioned as to conform strictly to electrical requirements.

The company manufactures motors from 1 to 50 horse power; power generators from 25 to 100 horse power; and direct current dynamos from 25 16 candle power lamps to 500 16 candle power lamps' capacity.

The Columbia Electric company of St. Paul, Minn., has established a commodious factory building and foundry, equipped with everything necessary from a mechanical standpoint. The officers of the company are: President, Egbert G. Handy; secretary and treasurer, Jos. A. Humphreys; attorney, F. S. Kirkpatrick; superintendent and electrician, Frank Mulligan.

Electric cars have been placed on the Exchange and Hudson street routes of the Rochester, N. Y., electric railway. The southern terminus will be at Clarissa street bridge, as that structure is not strong enough to admit the passage of the heavy electric cars.

The Duplex Street Railway Track.

[illegible] engineers will be interested in the details of its construction. [illegible] its length, being therefore a most enduring construction. [illegible] head rail and the tram [illegible] between the tramparts [illegible] these two parts of the [illegible] member resembling the neck of the ordinary girder rail. [illegible] the flange or foot part of the rail. The flange of the ordinary rail is utilized to make the second vertical member of the duplex rail. The result of such construction is that the complete rail has a box shape, instead of the spindle form of the ordinary girder type. The two parts of the rail breaking joints are mounted on metal chairs, which have a broad base, like an inverted saucer, 12 inches in diameter. These chairs are transversely connected by metal tie bars, giving them, it is claimed, a greater bearing surface and the track [illegible] can be obtained with wooden cross ties.

The rails, chairs and tie bars are locked to each other by automatic spring [illegible] practically a trussed girder [illegible]

There is specially [illegible] tion to its joint, the permanence of an all metal system, a construction which enables the renewal of only the worn or damaged part of the [illegible] laying a track which has no bolts, nuts or spikes, such continuity of metal as to render unnecessary the bonding of joints for electrical traction.

It is said that [illegible] took part in the electrical congress [illegible]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - Editor and Publisher.
J. B. O'HARA, }
F. L. PERRY, } Associate Editors.
W. E. KEILY, }
J. L. BAKER, - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions. foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
Frankfort Electrical Exhibition. Illustrated	213
To Utilize the Power of Niagara	213, 214
Electricity at the World's Fair. Illustrated	214
Sale of a Municipal Plant	214
How the Western Union Telegraph Company Obtained Its Racing News. Illustrated	214, 215, 216
New Engine for Central Station Lighting Plants. Illustrated	216, 217
The Columbia System. Illustrated	217
The Duplex Street Railway Track. Illustrated	217
Editorial	218
Western Automatic Engine. Illustrated	219
American Institute of Electrical Engineers	219
Boston Street Railway Officials in Chicago	219
Electrical Currents from the Sun	219, 220
Electrically Operated Dental Drill. Illustrated	220
The [illegible] Dry Battery. Illustrated	220
Overhead Trolley Wheels. Illustrated	220
Electric Lighting in Coal Mines	220
Franklin Experimental Club	220
A [illegible] Opinion	220
On the Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo Electric Machinery. Am. Ins. El. Eng.	220, 221
A [illegible] System. By H. Ward Leonard. Illustrated	221, 222
[illegible] Power Transmission. By Gisbert Kapp. Illustrated	222, 223
A [illegible]	223
The Montreal Electrical Exhibition (Communication from the [illegible])	22[illegible]
[illegible] (Communication from George [illegible])	223

DEPARTMENTS.

[illegible]	224
N[illegible]	22[illegible]
[illegible]	225
[illegible]	225
[illegible] M[illegible]	2[illegible]
[illegible]	2[illegible]
[illegible]	[illegible]
[illegible]	2[illegible]
[illegible]	[illegible]
[illegible]	22[illegible]
[illegible]	22[illegible]

T[illegible] announcement made on another page that Mr. [illegible] probably soon visit this country in [illegible] of electrically tran[illegible] power of Niagara Falls, will be received with [illegible] engineer. [illegible] the scope of this talented young engineer's ability, and he may be sure that the [illegible] to be appreciated [illegible] England.

THE experience of the little city of Vancouver, Wash., [illegible] furnish street and commercial lights, the prices to decrease to a given minimum as the city increases in proportion. If the town is large enough to sustain a central station of any sort the change can hardly fail to be beneficial in every way. The installation will be conducted on business principles; it will not be operated by political place-holders, and there will be an incentive to legitimate expansion and growth. It will be strange if many other cities that have tried the experiment of municipal ownership of electric plants do not shortly follow the example of Vancouver.

THERE is every prospect that the coming convention of the American Street Railway association at Pittsburg will be a great success. The indications are that the attendance will be unusually large, and an instructive programme has been arranged. As usual the discussion of methods of electric traction will take up the greater part of the time at the disposal of the convention. The idea of having the exhibits arranged on a steamboat moored to the wharf is novel and attractive, and altogether, the street railway men have reason to anticipate a pleasant and profitable meeting in the enterprising Smoky City.

The fact that so much attention is being given to electrical equipment by managers of street railways shows the direction in which these companies look for advancement. As a matter of fact the Pittsburg convention will be almost entirely devoted to the consideration of electrical topics.

THERE is every indication that there will be an unusually large amount of electrical construction work in Chicago during the fall and the coming winter. This fact was recently remarked by an electrical engineer whose position gives him exceptional opportunity to inform himself as to the amount of work in sight. This gentleman stated that the number of real estate owners and business men who proposed to avail themselves of the advantages of electric lighting was astonishing. Much of this activity is caused by the number of large office buildings now in process of construction. In Chicago these palaces of commerce attain a size and elegance unknown in other cities. Electric lights contribute very materially to the latter attribute, and they are specified as a matter of course. The number of lights in these structures varies from installations of 10,000 or 12,000 down to the few hundred lamps wired in the least pretentious buildings. The introduction of the modern light in edifices previously supplied with gas—such as churches, factories and residences—also forms no inconsiderable part of the business that has now assumed such gratifying proportions, and of course the natural growth of the city contributes largely to the increase. The outlook for a prosperous season for the electrical interests of Chicago is good, and undoubtedly other cities can report a similar condition of affairs.

THE misunderstanding between the Western Union Telegraph company and the Brooklyn Jockey club over the collection of race track news was not without sensational features. Both parties bitterly contested every point and brought all their resources into play, the telegraph company to secure the news and the club to prevent it unless its claim for remuneration was allowed. The most interesting feature of the entire controversy was the last plan resorted to by the Western Union company for securing the news. The details of this ingenious plan were carefully prepared, and they show that the projectors of the scheme were determined to secure reports despite the opposition of the Jockey club. There was a thoroughness about these preparations that only a powerful corporation like the Western Union could afford to make, to establish the fact that it would accomplish its purpose at any cost. It was certainly a great effort, although it is a question if the Western Union company might not have displayed its enterprise in a more commendable direction. Aside from the merits of the case, the subject is interesting, as it shows how a system of signaling under difficulties may be accomplished. details of the Western Union company's plan, with illustrations of the devices used and a diagram showing the relative position of those engaged in transmitting the news, are presented elsewhere in this issue.

THE electric railroad is growing in favor on the Pacific coast according to reports received in the East. The fact that it has supplanted the cable in many cases shows the confidence street railway managers feel in it.

Last week the announcement was made that the "oldest cable road in the world" had been dismantled. This road was built in 1870 in San Francisco, and has since been in operation.

Despite the unfavorable laws which have been in force throughout California the electric road has gained a foothing, and is now gradually forcing its merits into prominence. Our San Francisco correspondent announces that the North Beach and Mission Railroad company is to change its equipment from horses to electricity, and that it is hoped to have the entire system changed by May 1st. A cable system was recently built by a rival company to parallel the North Beach and Mission road. This led the latter company to consider the advisability of adopting improved methods of transportation, and it was at first the intention of the managers to introduce a cable system. But reflection and examination of the systems employed elsewhere resulted in the determination to substitute electricity as a motive power, and this decision has been officially announced.

Of equal interest is the announcement from Portland, Ore., that a company of local capitalists have invested $1,000,000 in the purchase of the Willamette Bridge Railway, and the Transcontinental Street Railway companies' systems, embracing over forty miles of track on both sides of the river in the recently consolidated cities of Portland, East Portland and Albina. These lines cross the river over two different bridges. On the east side the roads are both electric and steam motor lines, but the latter will immediately be converted into electric roads. In Portland proper the two roads just purchased are horse car lines, and these will also be converted into electric roads. The new company claims that when this is done it will have one of the most complete electric systems in the country.

THE official "supplementary" report of the execution of the four criminals in New York state, July 7th, has been filed. The law prohibiting the discussion of the topic in the newspapers was universally disregarded. Undoubtedly the physicians who assisted in the execution will regret that this provision of the law could not be enforced. Their secret proceedings and subsequent attempt to suppress the facts and create a false impression have been generally condemned.

It is a curious fact that this report differs from the original account filed by the doctors and the statement of the officials for publication, in that in the original report only a part of the truth as now presented was given. It is also interesting to note where the press dispatches differed from the original report in details, the supplementary report confirms the accuracy of the newspaper accounts. Thus in the first report it was stated that "in each case unconsciousness was produced instantaneously by the closure of the circuit, was complete and persisted without interruption until the heart's action had entirely ceased and death certainly occurred. In each case death was manifestly painless."

In the supplementary report this is virtually contradicted and the medical gentlemen it is acknowledged indulged in considerable experimental work. Thus, for instance, in the case of Slocum, who was first executed, the current was turned on twenty seven seconds, but after it had been switched off "the pulse was still found to be beating strongly, and between one and two minutes later a noisy respiration became established with considerable regularity." After another trial Slocum was pronounced dead. The physicians then determined to change their tactics and they gave Smiler, their next victim, three shocks, each of ten seconds duration, but this was not successful, and it was found necessary to turn the current on again for nineteen seconds before the job was complete. After comparing the effects of the two plans described, the report says: "It would appear from this that the duration of the current was quite as important an item as the making and breaking of the contact. It was, therefore, determined to make the contact in the next case a little longer, interruption being necessary to permit of moistening the sponges." The next blunder was in Wood's case, the third trial, when three shocks of twenty seconds each were given with results not entirely satisfactory even to the executioners, for the report says, "Feeling that the contacts had been unnecessarily prolonged, it was determined to make them a little shorter in the next case." Jugiro, the Jap, in whose case the medical men brought to bear the knowledge acquired in the experiments already referred to, was given "three contacts of fifteen seconds, each followed with two intermissions of twenty seconds each," according to the official statement. One effect of this style of treatment is described in the report filed last week. It says: "In this case extreme heat was noticed in the region of the knee above the point where the lower electrode had been applied, and a thermometer held against the skin for only fifteen seconds ran up to 115 degrees, the highest point it registered, while the sensation it conveyed to the hand was such as to render it probable that the temperature had run up to the boiling point of water, if not higher." All of which goes to show that the people are only beginning to get at the real facts attending the executions at Sing Sing.

Weston Automatic Engine.

In the accompanying cuts are shown views of the automatic engines made by the Weston Engine company of Painted Post, N. Y.

The bed is made especially heavy, having interior ribs running across and lengthwise in sufficient number to make it rigid and to guard against springing tendency. The

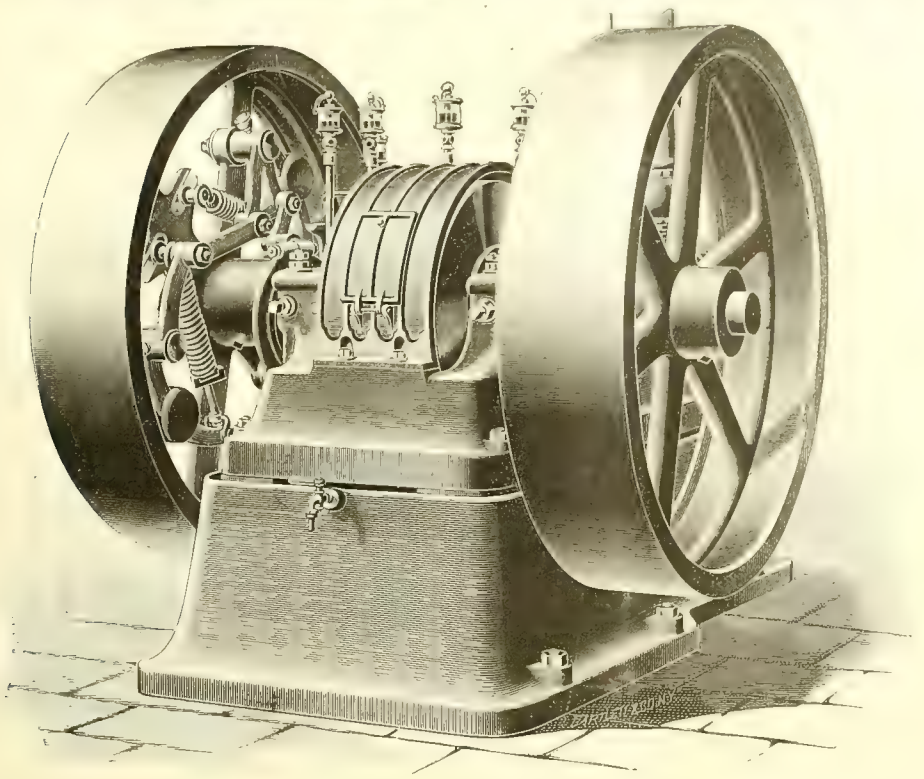


FIG. 2. THE WESTON AUTOMATIC ENGINE.

guides are a fixed portion of the bed, planed and accurately scraped. The cross head shoe is adjustable to accommodate wear of any magnitude, and an adjustment will always leave the engine in correct alignment. The main bearings have adjustable cheek pieces, and all bearings are sufficiently generous to satisfy the most radical advocate of large wearing surfaces. The reciprocating parts are balanced by weights in the crank disks. The cylinder and steam chest are in one casting and made from the best charcoal iron. The piston is made hollow and cast-iron rings are sprung in for packing. The cast-iron jacket allows the cylinder to be covered on the outside with mineral wool to prevent radiation of heat. Interchangeability of parts of these engines forms a valuable feature.

The governor, which is shown in Fig. 3, is of that class which has a laterally movable eccentric surrounding the

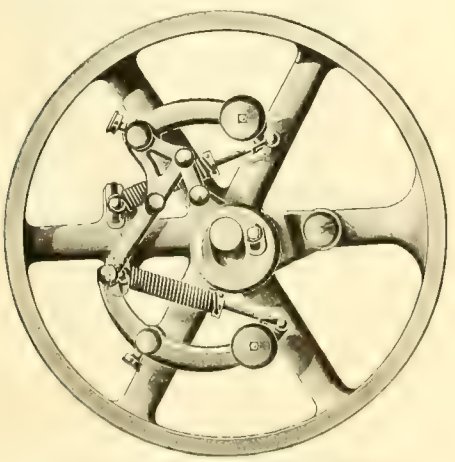


FIG. 3. THE WESTON AUTOMATIC ENGINE.

crank shaft of the engine, by which the admission of steam to the cylinder is regulated through the variation of its throw. This variation is effected by the movements of centrifugally acting weights connected by levers to the eccentric, while the centrifugal motion of these weights is resisted by centripetally acting springs, the free ends of which are attached to weight levers, the other ends being attached in an adjustable manner to the fly-wheel.

With the governor at rest the tension of the springs will hold the eccentric in position of the greatest throw, but in action the centrifugal force of the weights moves the eccentric across the shaft, reducing its throw as increased rotary motion takes place, until it reaches the point where the valve [illegible] in accordance with the amount of steam necessary to drive the load. It is apparent that for any nicety of regulation, the centrifugal force and the centripetal force, as supplied by the weights and springs, should be in equilibrium. This is a requirement very difficult to meet, and a further complication arises from the position of the eccentric constantly changing to accommodate the variable loads thrown on the engine, thus requiring the spring and weights to be in equilibrium at any possible position. Centrifugal force increasing in a certain ratio makes it necessary to attach springs to wheels at points that will increase the tension, as the springs are distended, in the same ratio. Front and end views of this engine are shown in Fig. 1 and 2.

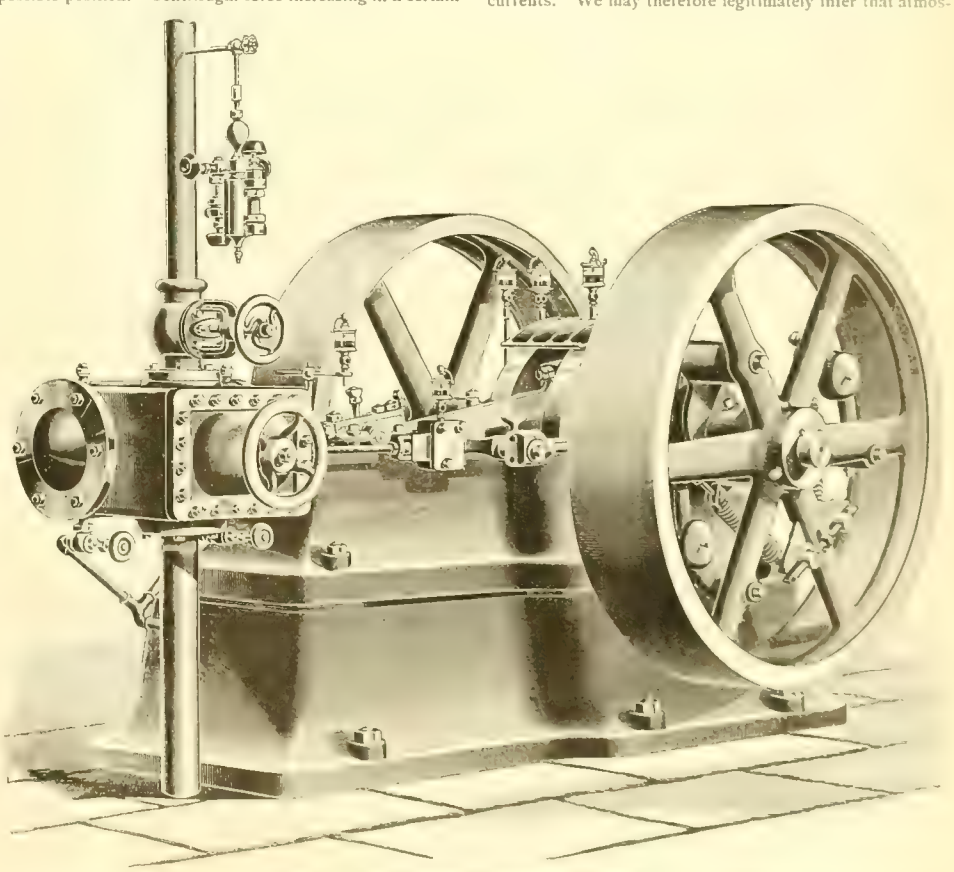


FIG. 1. THE WESTON AUTOMATIC ENGINE.

American Institute of Electrical Engineers.

[illegible] the paper was discussed.

[illegible] will be held October 20th, when a paper will be read by H. Ward Leonard, [illegible] any Desired Speed or Torque, and with Maximum Efficiency Under all Conditions."

Boston Street Railway Officials in Chicago.

Henry M. Whitney, president, Henry F. Woods purchasing agent, and several directors of the West End Railway company Boston Mass. spent [illegible] Chicago last week. The party came on the invitation of George M. Pullman, in his private car, for the purpose of examining the new patent double locked [illegible] Pullman company, and which will be [illegible] for use on the West End company's system. Mr. Whitney left for the Pacific coast on Friday, and the rest of the company returned to Boston. Mr. Whitney had several conferences with W. R. Mason, president of the [illegible] tric company. The West End company is equipping several of its lines with the Burton heater.

Electrical Currents from the Sun.

Dr. Henry Raymond Rogers thinks that the moon is "undoubtedly another world of activities like unto the earth." He recently read a paper at Dunkirk, N. Y., before the Chautauqua Society of History and Natural Science in support of this view. In it he said: "It is now demonstrable that electrical currents, both instantaneously and incessantly, come from the sun to the earth, and, through the resistance offered by our atmosphere, become awakened into dazzling light and burning heat. Only an atmosphere is capable of thus reflecting the sun's vivifying currents. We may therefore legitimately infer that atmos-

[illegible] that a moon without [illegible] The same is equally true of the sun itself. Inferentially, therefore, the moon possesses an atmosphere, with all the

[illegible] itants of an atmosphere, viz: heat, light, animal life with intelligence, vegetable and mineral life, the property of reflection of great cosmical currents, etc."

Electrically Operated Dental Drill.

The accompanying illustration shows an electrically operated dental drill, in which the old pivot is utilized to fix a strip of steel upon which can slide the $\frac{1}{12}$ horse power motor, arrangement being made to clamp it in any position, so that the belt which is placed around the fly wheel and pulley of the motor can be kept at any desired tension.

ELECTRICALLY OPERATED DENTAL DRILL.

The motor, therefore, occupies one of the legs, and the other two legs are used to support the reversing and resistance switch. The handle of the switch is of a special construction so that the operator can use it as readily as the treadle. It is arranged to project over the edge of the resistance coil, and the operator can, by a slight movement of his foot, switch it over to either side, so that the motor runs in either direction at will.

If the arm is in the central position the current is "off." If between the central position and one side the motor runs in one direction, but not at "full" speed.

Catch clips are arranged so that the operator can tell immediately he has reached either the "off" position or the "full on" position on either side. He can also obtain four different speeds below full speed. The motor is designed to run on 125 volt circuit, so that it can be used on a local electric light circuit. A wall socket is fixed near the dental chair and a flexible cord led from this to two terminals on the motor. Motors wound to be operated by a battery have also been perfected.

The great value to the operator of an electric motor to give him the necessary motive power is that it obviates the jar to the hand when the foot is working the crank. It also insures better and safer work, as it enables the dentist to concentrate his whole attention and effort upon the work before him.

The motor shown in the cut is of the Edison type, and the combination is placed on the market by the Edison General Electric company.

The Gladiator Dry Battery.

The [illegible] battery placed on the market is known as the Gladiator. It is claimed for this battery that on open

[illegible] CURVE.

[illegible] ve force of 1.6 volts, with [illegible] giving an initial cur[illegible] The [illegible] current of 2 [illegible] electromotive [illegible]

Oiler for Trolley Wheels.

An ingenious device for automatically oiling Trolley wheels is shown in the illustration. It consists of the usual form of hollow axle, but has a novel arrangement for feeding the oil. Advantage is taken of the peculiar structural growth of rattan. Short pieces of this are placed transversely through the hollow axle, a notch is cut in the surface of the stick to admit the oil into the longitudinal pores. In this manner the oil is conducted to the bearing surfaces by capillary attraction, the amount of oil which is fed depending upon the depth of the notch, as of course, oil will only feed through those pores, which are opened in this manner.

OILER FOR TROLLEY WHEELS.

The Electrical Supply company of Chicago, which manufactures the axles, shows a trolley wheel and axle which were run over 14,000 miles with very little wear, the wheel apparently fitting the axle as snug as when new. The company claims that any kind of oil can be used and that the rattan will successfully feed the heaviest grades without clogging up.

Electric Lighting in Coal Mines.

The H. C. Frick Coal & Coke company of Pittsburg, Pa., the largest coal operator in the world, has just completed arrangements for the illumination of its many mines by electricity, in fact the plans have already so far advanced that the lighting of two mining plants has been successfully accomplished. The contract for the work has been awarded to the Westinghouse Electric & Manufacturing company, under whose supervision the work of installing the lighting plants was conducted. The first two mines to be lighted by electricity were the Leisenring No 1 and Leisenring No. 2. The operation of the lights was commenced a few days ago. Everything turned out to the greatest satisfaction of the Westinghouse and the Frick companies.

The mines of the company are mostly situated in the Connellsville region, in Westmoreland and Cambria counties, Pa., and a number of them are shaft mines, varying in depth from one hundred to nearly one thousand feet. Owing to the accumulation of fire damp and gas in many of these mines the lighting has always been a very grave problem, because almost every known method of illumination included danger from fire. This led at last to electric lighting.

The Frick company has adopted the method of lighting each mine independently, and at every mine is installed Westinghouse direct current apparatus of sufficient capacity to light up the mine below, and the buildings above the ground. The lamps are distributed underground throughout the main walks leading to the shaft. In addition, the engine house and other surface buildings are also lighted. The lamps range from 16 to 50 candle power.

Electric light plants are now being put up at Leisenring No. 3, Trotter and Standard mine—the last named, by the way, is said to be the largest coal mine in the world—but it will probably be a year before the plants for all the mines are installed.

Franklin Experimental Club.

The Franklin Experimental Club of Newark, N. J., held its first regular meeting since the summer vacation on Tuesday evening, Sept. 29. There is every indication of an increased interest in the society and its work. The club is preparing to move into larger quarters, and with a view of increasing largely the growing membership. It has decided to make the initiation fee $[illegible] for the next three months. The dues are but $1 and $1.50 per month for active and associate members respectively; and each member is entitled to the use of any and all apparat[illegible] books, papers, use of room by day or night, and other privileges of the society. A large increase in the membership is confidently [illegible].

After the regular meeting on Tuesday evening the members [illegible] remarks by President Ham[illegible] upon the convention and exhibition of the National Electric Light association at Montreal. Following this [illegible] gave some interesting and entertaining accounts of his summer tour in Europe, where he visited the [illegible] Exhibition at Frankfort. He also discussed many [illegible] topics of interest [illegible] in the large cities of England, France, Germany, Switzerland, Holland and elsewhere. His remarks were listened to with much interest.

The society then adjourned to Oct. 13th at the rooms of the club. The meetings are held on the second and fourth Tuesdays in the month.

A Scotchman's Opinion.

In writing to the *Glasgow Herald* in reference to the proposed introduction of electric cars in that city, Walter M. Galbraith says: "I visited the United States in the spring, traveling right across the continent to the Pacific, and I had ample opportunity of testing and comparing the American system of street cars with our own, and it requires no very practical electrician to see that we are about as far behind 'Brother Jonathan' in this respect as we possibly can be. The objection has been raised that electric cars are not adapted for steep gradients, such as Renfield street or New City road, in Glasgow. But this is quite a mistake. I spent a Sunday in Tacoma, which is built on a very steep slope, most of the streets being quite as precipitous as those leading up to Garnethill, and I watched with great interest the electric car going up and down the steep incline, and no one but myself seemed to be aware that there was any danger, as there was absolutely none beyond that which existed in my own imagination."

On the Relation of the Air Gap and the Shape of the Poles to the Performance of Dynamo-electric Machinery.

Prof. Harris J. Ryan's paper before the American Institute of Electrical Engineers, which was presented in the last issue of the WESTERN ELECTRICIAN, provoked a lively discussion, a report of which follows:

T. D. LOCKWOOD: I would like to call attention to Prof. Ryan's statement that "Mr. Esson in his valuable paper, above referred to, discussed the requisite features for a generator for constant current, with closed coil armatures, in which regulation is effected by shifting the brushes. He stated that the field should be uniform at all points, under the poles, and that the armature core should be saturated. These statements are a little misleading. The magnetizing force impressed by the field ampere turns must be uniform at all points between the poles faces."

It seems to me that there is some foundation for remarks there, from any member who has made that point a study.

TOWNSEND WOLCOTT: It seems to me that Prof. Ryan simply explains what Mr. Esson means there. Mr. Esson says that the field should be uniform at all points, and Prof. Ryan states that that part of the field which is due to the field winding should be constant; that is, it might indicate total resultant field in the air gap as due to the field and armature windings; that should not be constant, but the component due to the field windings should be

THE GLADIATOR BATTERY.—CURRENT CURVE.

constant. That is what Prof. Ryan means, and I think that is what Mr. Esson meant.

PROF. ANTHONY: The difference in that case between Prof. Ryan and Mr. Esson seems to be that while Mr. Esson says the armature core should be saturated, Prof. Ryan says this would be true whether the core is saturated or not.

C. O. MAILLOUX: With all the theories which we have, and while paying proper deference and respect to the very able work of such men as Hopkinson, Swinburne, Esson and others, I cannot believe that we have not, after all, much more than working hypotheses; only provisional theories, which are good so far only as they cover the facts now known to us. The truth is, we do not yet know all the facts pertaining to the physics of the air gap, and it will probably be some time before we understand them all.

I will refer to one point presented by Prof. Ryan "When the armature ampere turns are equal to the ampere

turns on the field, whose magnetizing force is impressed between its pole faces through the armature." It is quite evident from the sentence which immediately follows that the author wishes to imply what is sometimes spoken of and what is generally understood, as difference of magnetic potential. Mr. Swinburne, I believe, has given it that name. and as we have the exact analogue of it in relation to the electric circuit, I see no reason why we could not use the term in relation to magnetic circuit, and thus express the author's meaning at least as clearly and more succinctly. It is mathematically the line integral of magneto-motive force for that part of the circuit. It means, so to speak, the magneto motive force lost in the air gap, or the whole magneto motive force minus the portion that is lost in the field reluctance itself.

The much mooted question as to the length of the air gap and its relation to the phenomenon of sparking, of course, forms one of the principal subjects that the author has discussed. I have given that subject a great deal of attention in my professional work, and I have taken great care to examine the literature on the subject. I find that there is considerable divergence of opinion, and that while theorists are telling us that we should not make the air gap too small, and that we must have a certain minimum of resistance there, yet machines are made which are very successful, not to say most successful, in which the air gap is exceedingly small. The Oerlikon dynamo works in Switzerland is perhaps one of the most successful firms building dynamos in the world to day, and they are noted for the extremely small air gap used in their dynamos; the armature iron being perforated near the edge, and the wires passing through the perforations near the periphery of the armature, so that the air gap may be, and is, very small. Mr. Ravenshaw in England has, I believe, cited some experiment with a given machine, which he first tried with a very small air gap; he then bored out the field and tried the experiment over again, maintaining the same magnetic density. If I remember correctly he found that it did not make any practical difference as far as limiting the output of the machine within which sparkless running occurs was concerned. One would conclude from this that it does not make very much difference what is the length of the air gap if certain other apparently equally important factors receive due consideration in the design. Among the factors which a comprehensive theory of armature reactions should include, in my opinion, and which are somewhat neglected by the author, are the number and length of armature reactions, the width of pole pieces, the mode of winding, etc.

PROF. ANTHONY: I should like to say one word with reference to the width of the air gap here. It was something of a surprise to me to have it implied, it seems to be in this paper, that the air gap must have somewhat of a magnitude in order to make the dynamo work well. My idea has always been that we must make the air gap as small as possible, and the smaller we could make it the better the dynamo would work. I do not know that I have ever seen anything in my experience that would indicate the necessity of making the air gap any larger than was necessary for getting in the wires, and in fact in a machine that I have recently constructed we made an armature two feet in diameter for the very purpose of getting the wire in one layer, and leaving the air gap only one quarter of an inch, with about 100 amperes normal output. When the generator was running street cars, and the current was jumping from 0 to 200 amperes and back continually, it was almost impossible to tell by watching under the brushes when the generator was doing work.

MR. MAILLOUX: I am in accord with Prof. Anthony on the point of the air gap, because I have not only advocated, but I have practiced, short air gaps for several years. I have found practically the same result as Prof. Anthony. I have never thought that a short gap necessarily made a sparking machine if rightly designed. I have in mind now some railway motors which were run with an air gap of scarcely a sixteenth of an inch and having armature teeth at that; and the machine was quite sparkless at any load for which it was designed. According to theory one would expect such a machine as that to spark very badly. My own experience and the results reported from Europe, particularly from the house that makes the Oerlikon machine in Switzerland, have made me less afraid of a small air gap than I used to be.

MR. WOLCOTT: I would like to ask Mr. Mailloux inregard to that machine if the teeth were saturated.

MR. MAILLOUX: The teeth were not any more saturated than the armature core, which had a very low magnetic density. I think that the highest density ever reached through the armature core did not exceed ten thousand lines per square centimetre and that at the normal run it was scarcely six thousand.

MR. WOLCOTT: That makes it all the worse for the small air gap theory. If the density were very high in the teeth, it might serve the same purpose as the resistance in the air gap, but if the density were low in the teeth it seems to knock the theory all to pieces.

MR. MAILLOUX: There have been cases where I have been compelled to use high magnetic density in the Pacinotti teeth, so high a density that the permeability fell down to about five; yet I have not noticed that it had any material influence on the sparking.

THE CHAIRMAN: I should have wished for myself that the author of the paper had been a little more particular to classify the different machines in question, for while he speaks in a general way at first, and subsequently speaks of a constant potential machine, it is rather difficult to tell what machine he is referring to most of the time, until on the last page but one, he speaks of "Mr. Esson's valuable paper" to which I referred before. He speaks there of a generator for constant current, evidently a series machine with closed coil armatures, by which regulation is achieved by adjusting the brushes. I have a very distinct idea that sparking in dynamos is largely due to a lack of harmony between the short-circuited current, as an individual coil passes under a brush, and the current in that side of the multiple coil armature which the short-circuited coil is approaching. And it has further appeared evident to me that if we could produce at the moment when the front segment of the commutator leaves the brush—if at that moment we could produce a zero, by opposing the short circuited current against the current to which the short-circuited coil was about to be introduced, we should have a perfect neutralization, and in consequence, an absence of sparking. I am well aware that there has been a kind of hazy doctrine circulating, or at all events existing among electricians that the sparking upon a change of current, and when brushes were used to compensate for that change of current, is largely due to the fact that the neutral line had moved forward, and that, therefore, the brushes would have to be moved forward to catch up to the neutral line, and when the brushes did catch up with the neutral line, the sparking would cease to exist. But when you pursue that theory to its lair you find it is moving in a circle. It may not be out of order to recount an experiment I witnessed, showing that in reality as the current in a series machine changed under a difference in load, the neutral line remained stationary as long as the brushes were not moved. For example, suppose a machine was working on a load of forty arc lamps and some ten of those would be cut out,—the load would be very much less, the current would be much stronger—and in a machine furnished with an automatic regulator, the regulator would move forward to cut down the electromotive force developed, of course, in bringing the current down to its constant figure once more. It was supposed by many that the neutral line of the machine moved forward when the current changed; that is, when the current increased, the neutral line moved forward. It hardly seemed to me that it was a possible thing, seeing that the current was strengthened not only in the field helices, but also in the armature, the machine being a series machine. A single wire was rigged around the armature. One end was attached to a fixed ring, while the other end was attached to a movable commutator, and the circuit of this wire included a telephone receiver. When the machine was working on a full load, we found a place where there was a zero of current. It was absolutely on the neutral line of the machine as it was working then. By the neutral line I mean the moment when a given coil passes over from the influence of the pole upon one side, to the pole upon the other—when it is at the exact point between the two; that is when it ceases to cross lines of force in one direction and begins to cross them in the other direction. We found that point, and found that the telephone gave forth no sound at all upon changes of resistance and consequent changes of current. Just as long as the brushes were unmoved the telephone gave no sound, no matter how many lamps were put out or how much the current was changed, showing that the neutral line did not move. But when we changed the position of the brushes, and moved them forward to compensate for the increased current we found that there was a change, and that the neutral line did not move forward as it was supposed to do, but actually moved backward. Now, that was the result of absolute experiment, and I think when we reflect upon it, we will find that experiment is in accord with the best theory, and therefore I think the gap has such a relation to sparking in the constant current machine only in so far as it may modify the form of the pole pieces, and instead of using the phraseology here, I should rather be inclined to use the phraseology that "the requisite feature for a generator for constant current on closed coil armature, in which regulation is effected by shifting the brushes, is that the field should be uniform throughout the range of movement of the brushes."

NIKOLA TESLA: I have had excellent opportunities to study the importance of the air gap, particularly in some types of my motors in which the armature coils are closed. Such a motor is of course a transformer and following the analogy the first idea was to secure in it as good a closure of the magnetic circuit as practicable In the early experiments I constructed motors in which the air gap was often as low as a sixty-fourth of an inch at the start, and was gradually increased. This was the result arrived at: Up to a certain point the diminution of the air gap would act very favorably; then the approach of iron or the reduction of the air gap would begin to be a great drawback; and it has always been my idea, that the real cause of that was the unsymmetrical position of the armature to the field, and the impossibility of making the motor so mechanically perfect that the pull on both sides would be equal. Some time ago I did some work on unipolar dynamos with iron disks and I found that the lateral thrust was very difficult to overcome and it was impracticable to work with very small air gaps, a fact which, of course, is well known. In the results presented by Professor Ryan there is a point which he has not considered and which, if I may be permitted to say it, I think ought to have been considered, because it is of enormous importance, so important that it radically changes the whole result and that is that in a motor or generator, in which the polar faces and the armature core both are smooth we can reduce the air-gap indefinitely, and the smaller it is the better, and in many experiments I have found that we cannot reduce it far enough disregarding mechanical difficulties. But directly we put projections on the field, as, for instance, Professor Ryan has done, where he mentions an experiment in which there were six slots across the field, we cannot work with a very small air gap. The putting on of these air gaps brings the whole investigation on a different field. If the polar faces be smooth, no matter how close you approach the iron to iron the armature undergoes a gradual change, but directly you have the grooves, each part of the armature surface has to get out from the very intense field into a weak field and then from the weak into an intense field and so on, repeatedly, six times, as in Professor Ryan's experiments. I have made a great many experiments which confirm my position. You can take a smooth field, put a laminated armature without projections in it, and work with a certain magnetization, revolving the armature at a given speed. It will not get hot to a high degree. Now put in grooves through the [illegible] a different cause.

[illegible] dicting that in a comparatively short time most of the present constant current machines will be replaced by machines of a more modern and improved construction. The old types of these machines [illegible] ious men who, rather instinctively, hit upon the right thing —right at that time but not right now. The main object in these machines is to maintain a constant current in the most efficient and simple manner [illegible] machines in accordance with my view, which is to produce a great rate of change in the current, and to replace the ohmic resistance required for steady working by impedance. In this manner you can construct an arc light machine with only one single layer, no matter how large it is, and you can make it maintain a constant current, within two or three per cent, without any external regulator. One of the ways of obtaining this result is the following: Take for instance, a two pole machine, selecting a type which allows you to use an armature of the greatest possible diameter. By all means make the armature [illegible] sible. Then, instead of making the pole projections of the field smooth, make them with grooves parallel to the armature shaft. The more you make, in fact, the better it is up to a certain point. Then wind the armature symmetrically with reference to the pole projections or grooves, so that you get a great rate of change in the current. Now then, you have a direct current, which is commutated just the same as in the Gramme machine, but as to the rate of change it is equivalent to a rapidly alternating current, and of course you increase the impedance through the whole circuit to the extent that you can do away with the great ohmic resistance in the circuit, and you can make the impedance and the armature reaction so great that no matter what the load is the current is the same. Such a machine has numerous advantages, not the least of which is that it is more efficient, and then again it is easily repaired, only one layer being required. In all alternating generators almost without exception the armatures are built with one single layer of wire. The arc light machine must also be built with single layers and the right way to do this is to provide the pole pieces with projections and wind the machine in such a manner that a current of the requisite character is obtained. In regard to the shape of the pole pieces I had opportunity during the year 1885 to make some observations. I then worked at what is called the third brush regulation. It is a principle very interesting, but not very reliable. It may give a wonderful result for a short time, but when you want to show it to the stockholders it cannot do very much. It was original with me. One of the difficulties encountered in the third brush regulation was the excessive sparking of the third brush. To overcome this, the principal requisite was that the auxiliary brush should not bear on active coils. I then resorted to a means which was obvious. I put under every leading pole piece a good sized groove, which made the coils on each auxiliary brush comparatively inactive, so that the auxiliary as well as the main brushes would bear upon inactive coils. In this manner I obviated the sparking but the machine did not look particularly pleasing.

A Solution of the Block Signal Problem.

BY H. WARD LEONARD.

The attention of the public has been forcibly attracted of late to the importance of efficient automatic block signals by the recent terrible accident in the heart of New York city. Either the failure of the signal or the failure of the engineer of the following train to observe the signal was the cause of this, as has been the case in many other similar accidents. The purpose of this article is to call attention in a cursory manner to the state of the signaling art, and to indicate, if possible, the lines it will be necessary to follow in order to make a thoroughly reliable and practical block system for railways.

There are two general classes of block signals. The first class, the "simple block," is in use generally in England, and is well known in this country, owing to its use on the Pennsylvania railroad. For this system a telegraph operator is placed upon each "block," and the signals are set by hand. While this system is capable of being developed to a high stage of perfection, it can be done only at a very great operating expense [illegible] estimated by the best authorities that its cost of operation per block is about $1,500 per year. The great [illegible] establishing and maintaining this system, together with the fallibility of operators and inspectors renders [illegible] ble except in rare instances.

The second class of block signals is that known as the "automatic block," of which there are at least three forms in general use in this country. [illegible] what is known as a track circuit; that is, the rails form a portion of an electric circuit, and the current, which is supplied by batteries placed along [illegible] signal at "safety" until a metallic [illegible] tween the rails, as for instance [illegible] under which circumstance the current, normally passing through the signal, is shunted [illegible] train, and the signal goes to "danger."

In one of the systems the electric current is used to release a clock movement, which actuates the signal. This clock movement [illegible] maintenance is estimated at [illegible]

[illegible] system makes use of the electric current to actuate a valve which controls the admission of compressed air, and which is the motive power used to set the signal. The cost of operating this system is estimated at $135 per [illegible] The [illegible] system does not use the "track circuit," but has an independent wire circuit. The signal is operated directly by the battery current. The cost of maintenance is estimated to be about $65 per year per signal.

In all three of these automatic systems there is a lack of that simple, direct, powerful, reliable action which should characterize an automatic signal. The batteries which they all use are themselves a fruitful and serious cause of annoyance, if not failure. The electric contacts and relays and the electro magnets and signal mechanism are frequent causes of failure and necessitate constant and rigorous inspection.

A careful study of the whole subject, with the help of some recent publications too lengthy to be condensed within the limits of a magazine article—including a series

D_1, D_2, D_3, etc., are the red lamps connected to rear ends of the sections 1, 2, 3, etc., respectively. S_1, S_2, S_3, etc., are the green lamps connected to the forward ends of the sections 1, 2, 3, etc., respectively. G_2 and G_4 are the generators on trains in sections 2 and 4 respectively. P_2 and P_4 are the Pilot lamps in series with the generators and placed in the locomotive cabs. T_2 and T_4 are the telephones. W_2 and W_4 are the trolley wheels making connection between the signal conductors and the generators.

Under the conditions shown in the diagram the train in section 2 will light its Pilot Lamp P_2, the forward green lamps S_2 and S_3 and the rear red lamps D_2 and D_1. The preceding train in section 4 will light its Pilot Lamp P_4 and the forward green lamps S_4 and S_5 and the rear red lamps D_4 and D_3.

A SOLUTION OF THE BLOCK SIGNAL PROBLEM.

of articles in the *Railroad Gazette*, compiled in a volume entitled "American Practice in Block Signaling," and a paper read by G. H. Paine before the New York Railway club on April 16, 1891—leads to the following specifications indicating the desirable features of an automatic block system:

1. There should be signals both on the train and along the track.
2. The signals on the train should give a continuous and positive indication to the engineer.
3. The signals both on the train and along the track should be actuated from a source of energy constantly under the observation and control of the locomotive engineer.
4. The signals should be distinctive both by form and color, and should be audible under certain instances when desired.
5. Any two trains on the same block should each give a danger signal to the other.
6. The power for actuating the signals should be positive, strong enough to operate any desired signal, and should not depreciate and require renewal, as in the case of batteries.
7. The operation of the signal should not depend upon the movements of any mechanism beyond the observation and control of the locomotive engineer while at his post.
8. Any train should have to disregard more than one danger signal before being able to reach a preceding [illegible]
9. Any locomotive engineer should be able to communicate with any station or any other train in the same [illegible]
10. There should be a signal constantly before the engineer and in the locomotive cab whose indication would always be "danger" unless all the signals were working perfectly.
11. The form and color of the signal should change from "safety" to "danger" under the observation of the engineer as the train passes the signal.
12. The absence of any signal should indicate danger, but there should be a positive danger signal which would only and always give positive and continuous indications to both engineers when two locomotives were in the same [illegible]
13. In case of failure of the train or track signals at any point, means should be provided whereby signals [illegible] sent to a following train.
14. A misplaced switch should set danger signals on any train in that block and also along the track in that [illegible]

[illegible] should be the same by day or night, and any light at the signal should always indicate the presence [illegible]

[illegible] able to signal danger to approaching or receding trains in that block while it is [illegible] and without any light or special [illegible]

[illegible] suggested a block system, [illegible] with the above specifi[illegible] to improve [illegible] of it is offered [illegible] blocks of [illegible] one [illegible] the [illegible] one half [illegible] and contin[illegible]

[illegible] other terminal of the lamp will con-[illegible]

with the metal work of the locomotive. A conductor leading from the other pole of the generator passes through an ampere meter for indicating the current being generated, and thence on through a low resistance series incandescent lamp, which, when supplied with the current of four of the track signal lamps, will operate at a moderate incandescence. After passing through the series lamp, which we may call the pilot lamp, the current passes to a trolley carrying a large wheel made after the style of a bicycle wheel, and this wheel makes rolling contact by a concave rim upon two parallel conductors stretched along the track.

Now it will be evident that if the generator be operated the electric current will pass through the pilot lamp and up the trolley to the two conductors; thence it will divide equally between the four lamps connected to these two conductors, passing through two green lamps ahead of the trolley, and through two red lamps to the rear of the trolley, the green lamps as well as the red being half a mile apart.

As the train moves forward the trolley will finally roll off the conductor of the block it is leaving, and both the red and green lamp of that block will be extinguished. At the same time the trolley will roll on to a new block and the red lamp at the rear end of this block will light up just as the locomotive reaches it and will then pass to the rear. At the same time the green lamp at the forward end of this new block will light up at a distance of one mile off.

It will be seen that a following train would have to pass the two red lamps of the preceding train before a collision could take place; also that whenever two trains would get within a mile of each other the generators would be acting in concert to divide the combined loads of the two, and whatever the current of each had been previously, it would immediately become different, the generator having the higher pressure taking the larger portion of the combined load. Thus the pilot lamp of one locomotive would flash up and its ampere meter would indicate a greater current than usual, and this by a contact on the ampere meter needle would cause an alarm bell to ring in the cab. Similarly the pilot lamp of the other locomotive would be reduced in candle power, the ampere meter would show a reduced current, and the alarm would ring on the lower contact. At the same time the locomotive engineer of the following train would see before him the red lamps of the preceding train in addition to his own green lamps, and a rear guard on the preceding train would see in addition to the red lamps of his own train the green lamps of the following train. On each locomotive a line containing a high resistance is led from the trolley and around the generator to ground, and this circuit in shunt to the generator contains a telephone. It will thus be possible for either locomotive engineer to talk to another engineer preceding or following in the same block, and regardless of whether either or both are in motion. If telephones in the various stations be similarly connected from the signal conductors, communication can be carried on between the station master and passing trains.

If it be desirable to stop an approaching train it is only necessary to interrupt one of the signal conductors or connect the two together, or ground either. If the conductor be broken or disconnected, the engineer when a mile away finds his pilot-lamp dim and his alarm ringing because the current from his generator is reduced by one quarter.

If a signal conductor be grounded, as soon as the trolley makes contact with that conductor the generator is short circuited, and its pilot lamp first flashes up brightly and the bell rings, and then the current runs down rapidly, and the bell rings by the lower contact. If the two conductors be crossed, the load of two more signal lamps is added to the normal load of the generator and this increase of 50 per cent in the current causes the pilot lamp [illegible] up and the alarm [illegible] at the same time the [illegible] the red [illegible] of the abnormally supplied block burning before him.

[illegible] alarm rings.

[illegible]

signal by its alarm bell and the increased current of its pilot lamp. If the disabled train is followed by another into the same block, an abnormal red signal is set be tween the two trains, green lamps light up in advance of the disabled train, and the pilot lamp and alarm on both the trains indicate danger.

If two trains near each other both had their apparatus broken down, both would, of course, be moving very cautiously and endeavoring to ring the telephone call of any other train which might come into the same block with them.

A misplaced switch would make a contact which would light a red lamp in front of an approaching train.

Now as regards the signals along the track, the incandescent lamps should be arranged in a proper signal box, and the green lamp should show a vertical band of green lights whereas the red lamp should show a horizontal band of red light, thus giving a signal defined by both form and color.

Two possible objections which may be raised against this method of signaling are:

First. The presence of a car on a track without any accompanying attendant would not give a danger signal as it would with a track circuit system. This, however, is a rather remote contingency, and in any event could not lead to an accident with much loss of life. The unreliability of the track circuit is so great in other ways, as to make this slight defect almost negligible by comparison.

Second. The action of sleet might interfere with the action of the signal by preventing electrical contact between the trolley and wire. This trouble would be rare, in any event, and it is not likely to occur, as the heating effect of the strong current on the wire would tend to eliminate this trouble, just as it does with electric railway systems. If, however, it became necessary to provide against this, it could be done by placing the conductor beneath a semi-circular structure, such as a tube sawed longitudinally and concave downward.

It will be evident by examining the specifications as to the requirements of a safe system that this plan avoids the defects of the present system.

The next consideration is as to its first cost and maintenance, and it will be evident that the advantages on these points are conspicuously in its favor, for the simplicity of the signals and the cheapness of the small bare conductor make its first cost less than that of any existing system. The cost of operating will be almost *nil*, as there will be almost no need of inspecting the signals, having no batteries, electromagnets, relays, weights, clockwork, compressed air, oil lamps, or the various other possible causes of failure of the existing systems.

It will be evident that by connecting along the signal conductors white incandescent lamps, and increasing the size of the generator, the track can be perfectly and uniformly lighted, both in advance of and behind the train as it moves forward; and that also all crossings and stations can be lighted while a train is within a mile of them. Two and-a-half horse power would in this way be all that would be necessary to keep a track illuminated by a 16 candle power lamp every 200 feet, and for a space of not less than half a mile in both directions from a moving train.

Trains having an electric plant for illumination of the cars require a plant of about fifteen horse power, so that the additional power required in such a case would be hardly worth mentioning, and no special generator beyond that for train lighting would be needed.

The Lauffen-Frankfort Power Transmission.[1]

By Gisbert Kapp.

The distance between the generating station at Lauffen and the receiving stations in the Frankfort electricial exhibition is 175 kilometres, or about 110 miles. Power was transmitted over this distance for the first time on August 25th, when the current was supplied to about 900 16 candle power lamps in the exhibition, and a few days later the output was increased to 1,100 lamps. There are

FIG. 2.—LAUFFEN-FRANKFORT POWER TRANSMISSION.

in the exhibition two receiving stations, side by side, one for the production of power and the other for the production of light, both being connected in such a way that either power or light, or both together, may be obtained at will. The generator at Lauffen is a Brown "three-phaser," made and supplied by the Oerlikon works, and the line consists of three hard-drawn copper wires of 160 mils diameter, supported on oil insulators fixed to wooden poles 26 feet high. There have been erected in all about 4,000 poles at an average distance of 200 feet and the total weight of copper in the line is 60 tons. At Lauffen there are three transformers. One of these has been made by the Oerlikon works, and the two others by the Berlin Electricity works. At Frankfort there are also three transformers, two made by the Berlin and one by the Oerlikon works. The transforming ratio of all the six

[1] From the London *Electrician*.

transformers is 1-160, and they are oil insulated. In the power station at Frankfort, which was fitted up by the Berlin works, the current is used for working a 100 horse power three-phase motor, designed by Herr von Dolivo-Dobrowolsky. The motor is coupled directly to a centrifugal pump, which supplies water to an artificial cascade 30 feet high. The lighting station at Frankfort has been fitted up by the Oerlikon works, and the lamps are arranged partly on a large signboard of ornamental design in the exhibition grounds, and partly on lampboards, in the exhibition building, which serve for varying the load within certain limits

Mr. Brown's generator at Lauffen is separately excited, and a rheostat is provided, so that the attendant can compensate the loss of pressure in the line by adjusting the excitation. The common junction of the three armature windings is connected to earth, and the excitation of the field is so adjusted as to obtain from 45 to 60 volts between each branch and earth, according to the amount of power flowing out of the station. The common junction of the low pressure primary circuits in the transformers is solidly connected to the common junction of the armature windings, and by means of a fuse,* to the common junction between the secondary or high pressure coils of the transformers. According to the voltage of the three-phaser, the pressure between any line wire and earth is from 7,200 to 9,600 volts, and the pressure between any two line wires from 12,000 to 16,600 volts, being 2 × sin 60 deg. of that in each branch.

The general arrangement of the circuits from the generating station at Lauffen up to the branches which lead to the power and lighting stations in the exhibition may best be described by the diagram Fig. 1, in which G represents the generator or "threephaser," the three sets of coils being diagrammatically indicated by the three thick lines $O\ I$, $O\ II$ and $O\ III$ forming angles of 120 deg. with each other. The primary or low pressure coils of the transformer T, are similarly represented by thick lines, and the three thin dotted lines o 1, o 2, o 3 represent the high pressure or secondary coils of the transformer. The generator coil $O\ I$ is connected with the transformer coil o, first by the earthed wire $O\ O$, as already mentioned, and also by an insulated circuit which contains an

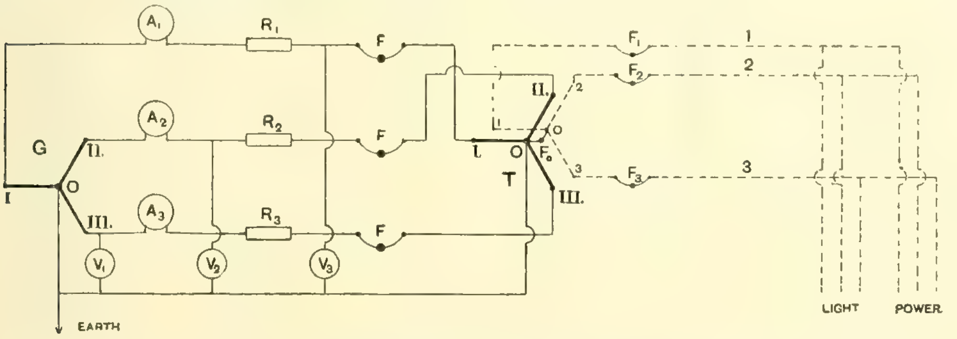


FIG. 1. LAUFFEN-FRANKFORT POWER TRANSMISSION.

alternate current ampere meter A_1, a relay magnet R_1, and a fuse, F. The other two sets of coils on the three phaser and transformer, respectively, are similarly connected. The voltage in three branches is indicated by the three voltmeters V_1, V_2, V_3. The relay magnets are arranged for minimum and maximum current, and if the current in any of the three branches of the three phaser should fall short of the minimum, or pass beyond the maximum value for which the relays are set, the relay in that branch cuts off the exciting current from the field of the three phaser. The voltage obtained then in the low pressure circuit at the generating station is simply that due to the residual magnetism in the three phaser, and therefore perfectly safe even in case of a short-circuit in the primary wires. It would, of course, have been possible to so arrange the relays that in case the current in any branch becomes abnormal from whatever cause, the motive power (in this case a 300 horse power turbine) is automatically shut down. This would, however, be a somewhat drastic remedy, especially if the disturbance is of a trivial character and capable of adjustment without stopping the machinery. As soon as the exciting power and with it the load is taken off, the turbine begins to race, and this is, of course, immediately noticed by the man in charge at Lauffen, who may then use his discretion whether he will shut down or not.

The fuses, relays, ampere meters, and voltmeters belonging to the low pressure or primary circuit at Lauffen are mounted upon one board, which also contains the voltmeter and ampere meter for the exciting circuit, and the rheostats for the latter, by which the voltage of the three phaser is adjusted. In order to compensate for the ohmic resistance of the line, the attendant works by a table giving the primary voltage corresponding to various currents, so as to keep the pressure at Frankfort constant at varying loads.

It will be seen that the arrangements of switchboard and instruments at the generating station are of the simplest possible character. In the high pressure or secondary circuit there are no switches, but merely three fuses, F_1 F_2 F_3, as shown in the diagram. To make a fuse for 10,000 volts is not an easy problem, but it has been solved by Ferranti and others, and any of the existing forms of fuses might have been accepted for Lauffen. Since it is, however, the intention of the two firms who have carried out this transmission plant to work later on at double the present pressure (by using two transformers at each end with the thick wire coils in parallel and their thin wire coils in series) it was thought safest to arrange the fuses in such a way that there can be absolutely no doubt as to their satisfactory working even at 20,000 or 30,000 volts. The method of mounting fuses on a board inside the station has, therefore, been abandoned, and the fuses have been placed outside, where they form part of the line. As already mentioned, the line wires are 160 mils in diameter. Close to the generating station there is a short piece of line in which each of these circuits consists of a pair of copper wires of only 6 mils diameter, and about 8 ft in length. There are two posts placed that distance apart to which the line wires are shackled, and the fuse wires serve to bridge the space between the posts. To facilitate the renewal of the fuses the posts are provided with steps. This provision is necessary because the line is at Frankfort frequently short-circuited on purpose to advise the man in charge at Lauffen that he may shut down. For this purpose there is suspended over the three line wires at the exhibition an angular stirrup or bridge of iron, which can be lowered by a cord so as to make metallic contact between the three wires. The fuses at Lauffen are thereby melted, and the man in charge stops the machinery. Telephones are then switched on at both ends, and the line wires are used to speak between the two termini. As long as the stirrup is on the wires in the exhibition, it is perfectly safe to use the telephone, even if by some mistake the machinery at Lauffen were started while a person is at the telephone. The only effect in this case would be to immediately melt the fuses again, and as their replacement gives some additional trouble to the man in charge, he will in his own interest take care not to start the machinery before the appointed time.

It remains yet to describe the provision made to guard against accidental injury to life or property in case one of the line wires should break and fall to the ground, or an earth should occur on the line through some other cause. As will be seen from the diagram the common junction O of the thick wire coils of the transformer at Lauffen is joined by means of a fuse F_0 with the common junction O of the thin wire coils. The electrical center of the whole system is, therefore, permanently connected to earth. Suppose now that the line wire 1 should break at any point between Lauffen and Frankfort and fall to the ground, the broken end will make earth, and the corresponding fuse F_1 in the line at Lauffen will go. Possibly the junction fuse F_0 will go. The line 1 is thus cut out. In all probability the fuse in the low pressure circuit I will also melt; but should this not be the case, the current in this branch will be very much reduced, and set the relay R_1 in action, whereby, as already explained, the excitation is cut off, and the dangerous pressure is immediately taken off all the three line wires.

We have yet to describe the general arrangement of the circuits in the power station at Frankfort, Fig 2. The primary and secondary of the transformers (of which only one is shown, the other being a spare transformer at present) are again earthed at their electrical center, and the same remark holds good for the field and armature of the motor. The latter is shown diagrammatically in the same way as if it were a transformer, though this representation is not quite correct. The armature and field coils do, of course, remain in the same relative positions to each other, but for the sake of simplicity the diagram may be accepted as sufficient for our purpose. In reality, the field revolves with a greater speed than the armature, the difference in speed or magnetic slip producing the electromotive force in the armature. Now the torque of the motor is proportional to the strength of the armature current, which latter increases with the electromotive force, and, therefore, with the magnetic slip. If the magnetic slip were zero, that is, if the armature revolved with the same speed as the field, there would be no electromotive force in the armature coils, and, therefore, no current and no torque. A motor of this class can, therefore, not run synchronously, but must run the slower the more the load is increased. The variation in speed between full load and no load can, however, be made as small as desired by the simple expedient of using an armature of low resistance, so that even a slip of 5 per cent. or 10 per cent. shall produce the maximum current required at maximum load. In this respect the three-phase motor is identical with an ordinary continuous current motor with constant field, since also in this case the speed of the armature decreases as the load increases. To obtain more or less uniformity of speed is, therefore, simply a question of the amount of iron and copper which with the designer chooses to employ for a given output; but it should be remarked that by increasing the section of the armature conductors so as to get very little magnetic slip, there is danger of producing a machine which will not readily start at full load. The reason is obvious. A very low armature resistance means an enormous armature current at the moment of starting, when the magnetic slip is 100 per cent. Now, this enormous armature current reacts very strongly on the revolving field, which is, so to speak, blown aside by the ampere turns in the armature. This may, at first sight, seem a very serious drawback to the three-phase motor, but Herr von Dobrowolsky has hit upon a very simple and ingenious remedy. Instead of [illegible] the creation of abnormally strong armature currents, which [illegible] the motor works without external waste of energy. As regards [illegible] yet [illegible] make it [illegible] absence of heating, vibration, noise, and the general sweetness of the running of this motor, there is every reason to hope that the efficiency will be as high as with a direct-current motor of the same size. A rough test, which the writer was permitted to make on a three-phase motor of 2 horse power gave an efficiency of 82 per cent.

A Clever Swindler.

The officers of the Edison General Electric company, of 44 Broad street, says the New York *Sun*, are looking for a clever forger who is buying clothes at their expense. A week ago this young man presented an order from the Edison company on Rogers, Peet & Co., for $25 worth of clothes. The order stated that if the man who presented it didn't buy clothes to that amount the cash balance should be sent to the Edison company, and on no account be given to the bearer of the order. This looked so genuine that the young man's order was accepted, and he purchased $24 worth of clothes and departed. A messenger was sent to the office of the Edison company with the dollar. The officers of the company said that they had given no such order, and an examination of it showed that the young man who wanted clothes had been clever enough to change in several ways the officer's name that he signed to the paper, so that technically he didn't forge the name, and the $24 he got makes his offense just one dollar this side of felony.

The Writing Telegraph.

An exhibition of the Writing Telegraph took place Sunday, October 4, between Chicago and St. Paul over the wires of the Northwestern Telegraph company. W. E. Gump of New York, general manager of the company, was at the St. Paul end of the wire, with an operator in charge of the Chicago end. The exhibition lasted several hours and was highly successful. Representatives of the city papers and many visitors were "introduced" to Mr. Gump and questions were asked and answered rapidly.

A company for the introduction of the apparatus has been organized in Indianapolis, St. Paul and several other large cities, the promoters believing that it will be used in connection with the telephone, and not that it will take the place of that instrument.

The Montreal Electrical Exhibition.

To the Editor of the WESTERN ELECTRICIAN.

We wish to extend to you our thanks for your liberal mention made of our system in your convention issues, and at the same time, we wish to enter a mild complaint against the treatment that we received at the hands of the management of the exhibition.

As a matter of course, we did not determine upon making any exhibit until it was rather late. However, before taking any steps in the matter, we communicated with the officials in charge and we were assured by them that there was still available sufficient space to enable us to exhibit our apparatus. Upon its arrival there, we were very much disappointed at being alloted a space where we could procure no power for the purpose of operating our dynamo. We would, under no circumstances, have made any display had we known that it would be impossible to have shown the apparatus in full operation. We regret the circumstances exceedingly, not alone for ourselves, but for the many individuals who visited the exhibition, who were interested in our apparatus, especially in the operation of it. As it was, we were placed in the position of being practically shut out from making any display whatever. You will readily appreciate that the fact of the apparatus standing there to be looked at was not satisfactory to those interested in electric lighting, much less satisfactory to us. We think it was a serious oversight on the part of the management to have shut us out in this manner and give foreign corporations the preference, and we respectfully request that you take the first opportunity to mention this fact in the columns of your paper, extending our regrets at being unable to show our apparatus in operation. We made every effort possible to secure the necessary power, but failed.

Yours very truly,
HEISLER [illegible]
WALTER F. SMITH [illegible]

Philadelphia, Sept. 10, 1891.

Power Generator at Pullman.

[illegible] WESTERN E[illegible]

I notice in your issue of Oct. [illegible] a description [illegible] a new power generator at Pullman. [illegible] tially correct, except in one important particular, viz.: the name of the designer. [illegible] point, as the machines described were devised by me and are covered by a Brit[illegible] Feb 15, 1890. [illegible]

[illegible]

CORRESPONDENCE.

New York Notes.

NEW YORK, Oct. [illegible].—The attempt which was made some time ago to introduce the overhead trolley system into the city of Brooklyn, was renewed last week by Gen. Henry W. Slocum of the Brooklyn & Coney Island railroad. The protesting property-owners are the same persons who objected before the State Railroad Commission last May, and their objections were so powerful that the extension of the present trolley road within the city limits was refused. Hence the present commission was appointed, and a favorable report by it can be accepted by the General Term in place of all other consents. At the first meeting a protest was immediately instituted on the ground that two of the commissioners were interested persons, and therefore unfit to serve in such a capacity, but the objection was overruled. Evidence was then taken in favor of extending the trolley wires across the circle at Prospect Park and up Fifteenth street into the city proper, and from the present outlook the Brooklyn people will soon have what the opponents of the improvement term the "obnoxious" trolley system.

When I wrote last week in regard to "rapid transit" in this city, I thought that at a very early date the readers of the WESTERN ELECTRICIAN wouled be informed of the conclusions of the committee on the questions of route and plan of construction, but no such information is at hand. It is believed, however, that the commissioners have begun their report to the common council, but all their work is conducted with such secrecy that nothing definite can be ascertained.

The thunderstorm which visited this section last Saturday evening seems to have played considerable havoc in the telegraph and telephone offices in Orange and Elizabeth, N. J. Balls of fire darted into the telephone central office at Orange and frightened the operators from their desks, while the switch-board was burned out in several places and the instruments in several private residences were also damaged. In Elizabeth the operators in the telephone and telegraph offices were also driven from their keys, and the switch-board in the main telephone office was so badly damaged that it took a gang of men all day to repair the system.

The work on the tower of the Madison Square Garden is nearly completed, and the copper statue of Diana, of heroic size, with the hunting costume which mythology says she wore, and with drawn bow, has been placed in position. The statue is made of finely wrought copper, gilded, is 18 feet high, and weighs 1,800 pounds. The drapery of the goddess, which flutters behind her, is a big sheet of copper, which will catch the wind and swing the figure, while the arrow will point in the direction the wind is blowing. In her crown will be placed three 30 candle power electric lights, and on her forehead will be set a mirror in the form of a double crescent, so placed as to throw the light upon the tip of her arrow at night.

James Bigler of Newburg, N. Y., claims that the suit brought against him by the Electrical Dynamo company of Philadelphia, for $2,000 due on storage batteries used in propelling his boat, is of naught, as many of the cells furnished were found to be defective.

England is becoming so much Americanized that it is sending over here to have its cars built. The Gilbert Car company of Troy, N. Y., has just shipped to the Southwestern railway, England, a complete train of six drawing-room cars, including a buffet car. The cars are considerably smaller than American cars, are equipped with a [illegible], and are lighted by electricity, [illegible].

[illegible] of the Buffalo, Kenmore & Tonawanda Electric Railway company, having a capital [illegible] Albany. A railway about [illegible] from Tonawanda [illegible].

[illegible] of 2 per cent. on all the [illegible] company has been [illegible] payable November 21, [illegible] to holders of record [illegible].

[illegible]

Winchester Avenue company, for a syndicate of New York and Boston capitalists. The new proprietors propose to equip their new plant with electricity, and have it in working order by Jan. 1, 1892.

The Jersey City & Bergen Railroad company is having considerable trouble with the board of public works in that city. It will be remebered that about two years ago this company equipped its road partly with electric motors and partly with the trolley wire system, and now that it desires to extend the road to the ferry, the city authorities have interfered. The matter will be taken into the courts.

The war between the city poolrooms and the Western Union Telegraph company has come to an end, for the present at least.

The New York Jockey club has allowed the telegraph company to secure all the information it desires within the inclosure, and telegraph it to the city on payment of $1,600 a day. This sum is paid over to the telegraph company by the pool-sellers.

In addition to the range-finder and telescopic sight devices of Lieut. B. A. Fiske now in use aboard United States war vessels, the navy department is considering the advisability of adopting an electric helm and signal apparatus recently designed by this same officer. The new system includes numerous arrangements of apparatus. There are placed in the fighting tower two arcs of conducting material, over which moves two pivoted arms. The arcs are graduated on each side of their central points to indicate revolutions of the propeller of the vessel. The arcs and arms are connected in series with two indicating instruments, one arc and one indicating instrument being located either on the bridge or in the fighting tower, the other one in the engine room. In connection with the needle of the instrument of the engine room indicator are arranged two local circuits, each containing a bell or other suitable alarm. These circuits are respectively closed as the needle moves to its stops in one direction or the other. The steering of the ship is effected by a similar arrangement working on a steam steering engine controlling the helm. Lieut. Fiske has brought out four important electric devices for war-ship use, namely, the range finder, position finder, telescopic sight, and elecrical manœuver controller of a vessel.

The sixtieth annual exposition of the American Institute was opened on Wednesday evening, Oct. 7, at the Exposition building in this city. In the machinery department the power is supplied by a Whitehill-Corliss engine, built at Newburg, N. Y. The building is lighted by electricity, the dynamo being driven by a direct application of the power, without gearing or belts. The exposition will remain open until Nov. 28.

The rapid transit commission has at last made public the reports of the four expert engineers on the relative merits of the plans submitted by Engineers William E. Worthen and W. Barclay Parsons. Mr. Worthen's plan seems to meet with the most favor, but in all probability a modification of both plans will be adopted. A representative of the WESTERN ELECTICIAN interviewed Mr. Worthen. He said that nothing in the way of plans or drawings would be given out for publication until the end of next week, by which time the modifications would be made, and submitted to the commissioners, who would then make their report to the alderman. Mr. Parsons was out of town and could not be seen. The end of this long struggle for something definite is approaching, and the result will soon be submitted to the public.

F. L. P.

Spokane, Wash.

SPOKANE, Oct. 3.—The report of Edison Electric Illinois company of this city for the year was submitted to the annual meeting of stockholders on September 28th. The year has been an exceedingly prosperous one for the company, and has seen large extensions to its plant. The company occupies the entire lighting and power field of the city, without a rival, and this state of affairs is due to the exceedingly low rates it offers to consumers. It is enabled to offer these low rates by reason of the vast water power at its command.

The company took possession of its new water power station in December of last year, and part of its plant has been run continuously in it ever since, both night and day. This part supplies light and power to consumers in the day time, as well as running at night. This station is equipped for 3,000 horse power, and it now consumes 1,900. Within the last two months two Edison 80 kilowatt generators have been installed to run the electric [illegible] of the city and the addition of a third is contemplated. These generators are run from a pair of 17½-inch horizontal [illegible] turbine wheels developing [illegible] horse power.

The total number of lamps connected at the present date is 8,300, or one to every three and a quarter inhabitants. The system used is the Edison three-wire. The total number of poles owned and in use by the company to-day is 1,560, or an increase of 576 over the number last year. The total length of the Edison mains and feeders is 90,280 feet, or an increase of 48,080 feet over last year. The arc circuits, eighteen in number, extend a distance of 61.31 miles, or an increase of 17.64 miles over last year. The longest arc circuit is 14.9 miles, the shortest 1.6 miles. At present the company is still further increasing the main and feeder capacity of the plant by running conductors into residence portions of the city, as it makes a specialty of residence lighting. The number of arc lights at present connected is 400, Thomson-Houston arc machines being used. In June, 1890, the incandescent load of the company showed a total of 62,270 candle power; in June, 1891, the load showed 107,626 candle power, or an increase of 70 per cent. The motor load had increased in the same period from 86 horse power to 236 horse power, or an increase of 300 per cent.

The outlook of the company for the coming year is exceedingly good, and the increased demands for light and power are taxing its present capacity. It is contemplating various additions to the plant to keep pace with the rapid growth of the city.

M.

Cleveland, O.

CLEVELAND, Oct. 3.—An Edison single reduction motor is being successfully tried on an East Cleveland railroad company's branch line. H. A. Everett of the East Cleveland railroad company has been in Toronto for some time in the interest of the Everett Keily syndicate.

The electric railway from Ashtabula to Ashtabula Falls is almost ready for operation. Five motors and four trailers and a freight car built by the Brill company have already arrived. The Thomson-Houston and Short systems have been adopted. The engine is a "Buckeye" and the belting will probably be furnished by the Bodifield Belting company of this city. The new officers are: F. B. Wayne, president; W. W. Hazzard, vice-president; E. W. Savage, treasurer, and Thos. Tricker, secretary.

The electric railway which is being constructed by the Beaver Valley Traction company is nearing completion. Ten cars fitted with Thomson-Houston motors will be used. The road is about ten miles long and traverses five towns, Beaver Falls and New Brighton being the termini. A "Buckeye" engine has been ordered. W. W. Hazzard of this city has the contract. The Sperry motors at Youngstown give good satisfaction. An electric road is soon to be built to Leavittsburgh.

Cuyahoga Falls is to be made a test station of the long-distance telephone line.

That city will compel the railway companies to apply proper supports and circuit breakers to the trolley wires so that they can not fall down when burned or severed. A fare war is being waged through the council, but the companies seem determined to maintain the five-cent rate with the transfer extras now in force. The hostilities and bickerings of the municipality have suggested a plan by which all the railway lines in the city would pass under one directory.

It is said that electric light wires will probably have to come down from telephone poles.

Gillette & Lewis, local agents for the "Connecticut" motor, have just placed one of 25 horse power in a Syracuse, N. Y., machine shop and another of 10 horse power in a local dry goods establishment for elevator purposes.

The new King block on Euclid avenue is to have an electric light plant. The contract has not yet been awarded. The Merchants' Banking company of this city contemplates purchasing a motor to run its elevators.

The Youngstown council has inspected the fire-alarm and electric light systems in Canton with a view of introducing a similar system into its own city.

The Cleveland Ship Building company awarded the contract for the electric installation of the United States steamer Amaranth to W. R. Caulkins.

I. W. Newcomer, hydraulic and electrical engineer, has opened an office in the Society for Savings building.

A Cleveland electric club is spoken of as a probability.

The street railway project at Oberlin has been abandoned.

A new electric road is planned for Portsmouth.

B.

PERSONAL.

Thomas A. Edison was in Chicago for a short time last Friday.

A. W. Hall, 310 Rookery, Chicago, western representative of the Hall Signal company, has recently returned from the East.

D. M. Clower of Clower, Harris & Co., Dallas, Tex.,

has been engaged during the last two months in a tour about the country, visiting the principal electrical centers, including Chicago.

G. M. Little, general manager of the Interior Conduit & Insulation company, has been confined to his house for the last week by sickness. It is expected he will be able to attend to business in a few days.

A. C. Farrand, formerly of Oakwood, Wis., but now superintendent of the Gamewell Fire Alarm system at Atlantic City, N. J., was in Chicago on Tuesday en route to his old home in Wisconsin, where he will spend a vacation of three weeks.

J. S. Harding, recently with The Heisler company, Philadelphia, has been appointed manager of the Chicago Electric Manufacturing company. Mr. Harding had charge of Professor Alex. Graham Bell's laboratory in Washington for three years, after which he went to England and associated himself with the Acme Electric works, London, holding a responsible position with that company for some years. Returning to this country two years and a half ago, he went to Philadelphia and has since that time been connected with the Heisler and other electric companies in that city. Mr. Harding is a thorough electrician and an experienced workman.

NEW INCORPORATIONS.

Cornwall Electric Lighting & Power company, Cornwall, N. Y.; capital stock $15,000; manufacturing electricity for light and power.

Heat, Light & Power company, Chicago, Ill.; capital stock $20,000,000; to supply heat, light and power; David & Rand, room 409, 84 La Salle st.

Iron Cross Investment company, Basic City, Va ; capital stock $50,000; real estate and improvements; buildings, street railroads, gas and electric works.

Crown Electric company, Chicago, Ill ; capital stock $100,000; to manufacture and sell electric curative appliances; Crown Electric company, 127 La Salle street, Chicago, Ill.

Lewis-Mercer Construction company, Jersey City, N. J.; capital stock $200,000; to construct water works, sewers, gas and electric works; Edward H. Murphy, 11 Wall street, New York, N. Y.

Nicholson Electric Hoist company, Cleveland, Ohio; capital stock, $30,000; constructing, operating and selling machines for hoisting and conveying purposes, etc.; Garfield & Garfield, Cleveland, Ohio.

Kalispell Lumber & Water Power company, Kalispell, Mont.; capital stock $25,000; to engage in a general exploiting business, including the purchase and operation of electric light and power plants.

American Manufacturing & Engineering company, Elizabeth, N. J.; capital stock $100,000; manufacturing, operating and selling electrical and mechanical apparatus; Wm. M. Stillman, Plainfield, N. J.

Egyptian Pottery company, Trenton, N. J.; capital stock $14,000; to manufacture from the raw material, sanitary ware and electric supplies of all kinds and to sell the same; H. N. Barton, Trenton, N. J.

Ogden Street Railway company, Chicago, Ill.; capital stock $2,000,000; to build and operate street railways to be operated by any motive power except steam locomotives; Wilson, Moore & McIlvaine, 21 Borden block, Chicago, Ill.

Chicago Electric Wire company, Chicago, Ill.; capital stock $1,000,000; to manufacture and deal in insulated wire and cables and electrical apparatus and supplies generally; Dyrenforth & Dyrenforth, 225 Dearborn st., Chicago, Ill.

American Engineering company, Jersey City, N. J.; capital stock $1,000,000; to design and construct steam and electrict power stations and plants, equip railway lines, build underground conduits, manufacture machinery, etc.; Blair & Crowe, 76 Montgomery street, Jersey City, N. J.,

Edison Electric Light & Power company, Jersey City, N. J; capital stock $500,000; to construct, own and maintain and operate power stations and works for the manufacture, production, use, sale and supply and distribution of electric currents or electricity for electric light, heat and power.

ELECTRIC LIGHT.

Towson, Md., is thinking of treating itself to electric lights.

Leroy, N. Y., is now lighted by 46 2,000 candle power arc lamps.

Prof. Barrett says that there are 969 electric street lights in Chicago.

It is reported that an electric light plant is to be erected in Batesville, Ark.

The Key West, Fla., Gas & Electric Light company is increasing the capacity of its plant.

The power required for lighting the town of Bourganef in France is transmitted by electricity from a cataract nine miles distant.

A bill has been introduced in the Georgia legislature to authorize the town of Elberton to issue bonds for several improvements, including an electric light plant.

Push buttons are now used to some extent to switch incandescent lamps in and out of circuit. A white button is pressed to light the lamp and a black one to turn the current off.

The capacity of the lighting plant in Heywood & Morril's factory, Chicago, has been increased by the purchase from the Chicago Edison company of a 270-light addition to the plant.

An electric light plant is being installed at Monticello, Ill., consisting of 750 incandescent lamps of the Fort Wayne system, 100 transformers and 25 Wood arc lamps. Charles G. Armstrong of Chicago is the electrician.

ELECTRIC RAILWAYS.

It is proposed to build an electric road from Seattle, Wash., to Edmonds.

Surveys are being made for the proposed electric road from Rochester, N. Y., to Fairport.

The first electric railway in Russia is being constructed at Kiev by the Allgemeine Electric company of Berlin.

On October 1st a trial trip was run over the lines of the Citizens' Street Railway company of Vincennes, Ind. The Westinghouse system is used and proved entirely satisfactory.

The practicability of constructing an electric railway under Paris from the Bois de Boulogne to the Bois de Vincennes, on the same principle as the South London line, is being considered.

An electric road is building to connect Seattle, Wash., with Puyallup and effect a junction with the Tacoma and Puyallup electric line. The company building it proposes to do a large freight business, having box cars built for the purpose. The largest amount of freight hauled will be milk from ranches along the line. The passenger travel is very heavy between Seattle, Puyallup, Kent and Tacoma. A part of this the electric companies propose to capture.

The Ivanhoe Park electric line of Kansas City, Mo., has been sold at a foreclosure sale. The company has been in default in payment of interest on $100,000 issue of bonds since Jan. 1, 1891. These bonds were protected by a mortgage given in 1887 and another in 1890 The Thomson-Houston Electric company, owner of $85,000 worth of the bonds, bought in the road for $25,000. The property consists of a single track, poles, and wire, running from Eighteenth street three miles south to Ivanhoe Park, and four electric cars.

ELECTRIC MINING.

The Western Power & Mining department, Thomson-Houston company, is exhibiting some of its mining machinery at the Chicago Exposition building. This exposition will be open until Oct. 24th. There is at present in operation a percussion drill, a generator with rotary brush attachment and a solenoid coal cutter. A portable mining hoist, and an electric pump will be added.

TELEPHONE.

A telephone line is to be constructed between Leesburg and Yallaka, Fla.

D. W. Alderman & Co. of Alcoln, Ga., intend constructing a telephone line 10 miles long at that place.

A dispatch from Boston states that the American Bell Telephone company will, on Oct. 15th, pay a dividend of $3 per share.

TELEGRAPH.

Some idea of the falling off of interest in South African affairs is gleaned from the fact that, while for the year 1889–90 the Cape telegraph revenue amounted to £81,004, in 1890–91 it only reached £69,627.

The Barge Office, where immigrants are landed in New York, has an information bureau attached to it, but it is doubtful if it is as well patronized as the Western Union office next door to that establishment, which is a kind of annex bureau of information. Persons in search of relatives or acquaintances among the immigrants, or of information on almost any subject, invariably begin their inquiries at that office.

By a recent parliamentary vote the French government was granted about $140,000 for the purpose of improving the foreign telegraphic service. Two wires 500 miles long are to be run from Paris to the Pyrenees to directly connect Paris and Madrid and Paris and Lisbon respectively. A wire 150 miles long will be run between Bordeaux and Bilbao, and another of 250 miles will be run to the German frontier. Finally two 210 mile wires will connect Paris to Calais.

MISCELLANEOUS.

The Thomson-Houston Electric Light & Power company has been formed in Sharon, Pa, with a capital stock of $30,000. A manufacturing business will be done by the company, and current will be furnished to the borough of Sharon, Mercer county, for lighting, heat and power purposes.

Recently, in New York city, Policeman McCarthy saw a man sitting on the crossbar of a telegraph pole on Dey street at 11 o'clock at night. Two other men were waiting near by. Thinking it was a queer time for a lineman to be repairing the wires the policeman started for the pole. The two men on the ground disappeared, but before the one on the crossbar could slide to the ground the policman was on the spot. At the foot of the pole was about $100 worth of copper wire belonging to the United Electric Traction company. William Carroll, who was caught on the pole, afterward pleaded guilty to cutting the wire from the poles and was committed.

TRADE NOTES.

The We[illegible] has [illegible] ing of [illegible]

The [illegible] recently [illegible] Brother [illegible] sions are 48 inches by 112 feet.

The [illegible] ufacture, sell and use the Walker recording meter. Mr. Walker it [illegible] vice of the Edison company.

"One [illegible] former System" are mentioned in a neat little pamphlet just issued by the National Electric Manufacturing company of Eau Claire, Wis. Of these installations several are located in Canada, Mexico and Central America.

The Electrical Supply company, Chicago, reports steadily increasing sales of [illegible] enlarged its capacity for making these batteries and added several improvements. The new battery is a little smaller than the old, and delivers a larger volume of current.

The Norwich Insulated Wire company, 58 Cedar st., New York, has recently purchased the mill property known as the "Collendar Plant" at Harrison, N. J., and is making the necessary changes to meet the requirements of the business and expects to begin operation about November 1st.

The firm of Truex & Vail has secured the exclusive right to manufacture, sell and use the Walker direct reading ammeter. The sales of these ammeters by Messrs. Truex & Vail have already been large. The Truex & Vail swinging ball lightning arrester is meeting with great success.

The fact that the Main Belting company, 248 Randolph street, Chicago, has made a monster belt for the Manufacturing Investment company of Madison, Me., is destined to become pretty well known. The size of the "leviathan," as the belt is called, is being well advertised on a lot of blotters just issued by the makers and now being distributed broadcast.

Since the resignation of J. D Claghorn as manager of the Chicago Electric Manufacturing company, Irving Usner, secretary of the company has been acting in that capacity. The appointment of J. S. Harding relieves Mr. Usner, and he will resume his former duties, and in addition will act as treasurer. E. W. Hammer will be retained as electrician.

The Central Electric company, Chicago, is out with a new trade mark. The device represents the continent of North America, faintly outlined on a disk having the principal cities plainly shown all in connection with Chicago, the words "Central Electric company" boldly drawn across the continent, while the well-known trade-mark of the Okonite company encircles the north and south poles.

An idea of the magnitude of the interests of the leading electrical manufacturing concerns can be obtained from a glance at the list of patents controlled by these companies. A volume containing 397 pages, entitled "selected United States Patents Relating to Electric Railways Owned or Controlled by the Thomson-Houston Electric company" has just been issued. A perusal of the titles of these patents alone shows the wide range of this department.

The following-named gentlemen will attend the American Street Railway association at Pittsburg: J. L. Murray of Murray & Co.; Mr. Turner of Woodbridge & Turner; Thomson & Crawford; Reed & McKibben, G. H. McTighe of Barry & McTighe; E. T. Birdsall of the B. & S. Co.; J. D. Elwell of the Duplex Street Railway Track company. C. A. Lieb with H. H. Harrison will represent the Lieb Machine works.

H. N. Bates & Co. of Boston have secured several good contracts recently. They are making extensive repairs upon the Boston postoffice, and are placing apparatus for the Concord gas company. They are also furnishing the complete electrical plant for the Kearney Cotton Manufacturing company of Kearney, Neb. The increase in the firm's business has made it necessary to secure more room, and the large building at the corner of Purchase and Congress streets has been taken.

The Waterloo, Ill., Electric Light & Power company is making considerable progress with the installation of its plant, and expects to be ready for operation by November 1st. The work is in the hands of the Inter-State Complete Electric Construction company of St. Louis, and the steam plant will be furnished and erected by the Pond Engineering company of the same city. The latter contract covers Armington & Sims engine, steel boiler, Lowe heater, Blake boiler feed pump, and Universal injector. The Heisler system of long distance incandescent lighting is to be used.

Visitors at the Pittsburg convention of the American Street Railway association will be presented with souvenirs by the Electrical Supply company. They are aluminum medals, and bear the formula

$$H.P. = \frac{\quad}{\quad}$$

The legends, "The M[illegible] Street Railway Association," and "Compliments of the E. S. Co., Chicago," are also stamped on the medal.

The Electrical Engineering [illegible] Rookery, Chicago, has just completed a National transformer plant at Audubon [illegible]

of 750 lights for commercial purposes, and 300 lamps for street lighting. This company has just shipped the generator and other apparatus for an extension of 1,000 lights to a plant at Stansberry, Mo. The local company is putting in a new steam plant consisting of a Rice engine and other improved appliances, and the electric installation will be commenced this week and pushed rapidly to completion.

As a rule, when an advertisement of a new type of primary battery appears people expect to read the old, old story. There is now a company in the field, however, that makes some claims that merit attention. The Franklin Electric company, 126 Liberty street, New York, is now manufacturing a cell, the "Ben. Franklin," or "B. F," as it is marked, which is reversible in the sense that it can be worked as a primary battery or be charged like a storage battery. The cells are made, if ordered that way, so that when they are exhausted they can be re-charged by any electric current of sufficient voltage without the addition of any new solution, plates or material whatever. A combined storage and primary battery is thus obtained, which it is asserted is not affected by any of the recent storage battery decisions. The batteries can give 50 ampere hours to every pound weight of complete cell. They can be short circuited without any danger, as there are no pasted plates or grids. They can also be re-charged like a primary at any time.

BUSINESS.

C. H. Mailloux has completed the specifications, etc., attending a 1,300 light plant for Madison, N. J. He is very busy superintending work at Boston and Newport.

The Bishop Gutta Percha company have received the government contract for 17,000 feet of cable to be used in connection with the new electric buoys near Sandy Hook.

Jas. McLaughlin, 50 North Clinton street, Chicago, is having a very satisfactory run of work at his factory. Mr. McLaughlin has special facilities for rewinding old armatures.

The Interior Conduit & Insulation company will exhibit a new perforated manhole to be used in connection with street work, and a full line of its conduits at the Pittsburg convention.

Reed & McKibben are finishing up their contracts at Allentown, Pa., and Lockport, N. Y. They have also been favored with the work in connection with the new plant at Olean, N. Y.

The Central Electric company, Chicago, reports that eight of the large buildings now being constructed in Chicago, to contain in the aggregate 14,200 incandescent lamps and 650 arc lamps, are being furnished with Okonite wire.

The Chicago Motor company, in the Springer building, Chicago, is meeting with gratifying success in securing repair work of all kinds. Particular attention is being given to the rewinding of all kinds of street railway and stationary armatures.

The improved double cylinder Law battery, manufactured by the Law Telephone company, 85 John street, New York, is described in a lately issued pamphlet printed in brown and green. This battery is especially recommended for physicians' use.

The Chicago Wood Mat company is having a fairly good trade with its new rolling wood mat for electric street railway use. This mat is made of the best grade of seasoned maple, strung on a flax cord tarred so as to prevent rattling, and is as flexible as a piece of carpet.

Cutter's flexile tubing is said to meet the insurance requirements and to be heartily indorsed by inspectors. Unlike other makes of hard rubber tubes, this tubing is readily bent around sharp corners, and can be used in a hundred places where the rigid tubing will not answer.

L. Blatz, at his brass foundry, 103 West Monroe street, Chicago, is meeting with most satisfactory success in the manufacture of a high grade of copper, and also in the preparation of several special alloys that he has brought to a high standard of perfection for electrical purposes.

The Ries Electric Specialty company of Baltimore, Md., reports an increasing demand for the new regulating socket for alternating current incandescent lamps. This company is about completing an additional plant, and in a few [illegible] regulating sockets [illegible]

The [illegible] company, Chicago, is constantly [illegible] for attracting and handling trade. [illegible] show windows, one on [illegible] and two on the Michigan avenue [illegible] unlimited capacity for a [illegible] merchandise.

[illegible] the Bradbury stone storage battery plate is that for filling the support there is [illegible]

[illegible]

[illegible]

1112 St. Charles street. This company has been noted for the progress made since its organization about a year ago, many new and valuable appliances having been given to the street railway and lighting interests in that short time. The company has prospered, and in the future still better things may be expected.

The Ball Engine company of Erie, Pa., reports the following sales: A 100 horse power tandem compound engine to the Beatrice Rapid Transit company, Beatrice, Neb.; one 300 horse power cross compound to the Buffalo Street Railway company; one 100 horse power engine to the Citizens' Electric Illuminating company, Pittston, Pa.; one 300 horse power cross compound to the California Electric Light company, San Francisco, Cal.; one 35 horse power to W. F. & F. C. Sayles, Saylesville, R I.; one 150 horse power engine to the Falconer Manufacturing company, Falconer, N. Y., for running an electric light plant and operating the works.

The St. Paul, Minn., *Daily Globe* has displayed commendable enterprise in publishing over a page of advertising notices of business houses in that city which either deal in or use electrical appliances. This novel feature appeared in the issue of September 28th. Beside electrical concerns such as the Edison Electric Light & Power company, the Columbia company, Ames, Ebert & Co. and the Electrical Engineering & Supply company, the reader is also informed of the merits of, for instance, a fruiterer who "uses the Edison incandescent lamp throughout his building and operates an ice cream saloon also with electricity." Printers, boxmakers, coffee dealers, dentists, bakers, launders, engravers, saloonkeepers, tailors—in fact, all kinds of manufacturers and tradesmen who employ electricity—are "written up" in this way.

The Wheeler Condenser & Engineering company has recently filed articles of incorporation with the secretary of state at Trenton, N. J. The company has bought out the entire plant and business of the Colwell Iron works at Carteret, N. J., which is one of the largest concerns in this country manufacturing vacuum pans, and special machinery for sugar refineries, belt works, condensed milk factories, etc. The Wheeler company will continue to manufacture Wheeler's patent surface condensers, and other specialties. The capital stock of the company is $300 000, and the incorporators are as follows: Frederick Meriam Wheeler of Montclair, N. J.; Aaron Vanderbilt of New York City; Clifton H. Wheeler of Brooklyn, N. Y.; William H. Hampton of New York City and Chas. W. Wheeler of Brooklyn, N. Y. The headquarters of the company will be at 92 and 94 Liberty street, New York City.

The Great Western Electric Supply company, Chicago, reports large sales of K. K. wire to the Citizens' Street Railway company of Indianapolis, Ind.; the Des Moines Street Railway company, Des Moines, Ia.; the Eau Claire Street Railway company, Eau Claire, Wis., and the Des Moines Water Power company, Des Moines, Ia. The Great Western Electric Supply company is sole agent for this wire. This company is having considerable success with the Sun arc lamp. It has installed quite a number of these lamps in railroads throughout the West, and in every case the lamps are giving most excellent satisfaction. The company has just completed the delivery of the steel poles for the Citizens' Street Railway company of Indianapolis, Ind., the contract for which was awarded a few months ago. The Citizens' Street Railway company expresses satisfaction with the poles, and considers them an ornament to the streets through which the lines pass.

ELECTRICAL PATENTS.

Issued Sept. 22 and 29, 1891.

459,749. Guard for Incandescent Lamps. Harry E. Hipwell, Allegheny, Pa.

459,863. Electrical Recorder for Voltmeters, Thermometers, etc. Charles W. Ayton, St. Louis, Mo.

459,917. Contact for Electric Programme Clocks. Frank E. Smith, San Jose, Cal.

459,930. Duplex Telegraphy. John J. Gregan, Jersey City, N. J.

460,109. Telegraphic Transmitting Instrument. Chas. G. Burke, Richmond Hill, N. Y.

The primary object of this invention is to give the transmitting operator perfect control over the length of actual contact for each impulse, so that the character of the impulses may be varied to best meet the static conditions of a given cable.

460,110. Telegraphic Instrument. Charles G. Burke, Richmond Hill, N. Y.

The instrument consists, essentially, of two coils at approximately right angles suspended or supported in a magnetic field formed by four magnetic poles arranged in the order described, to exert simultaneously upon the coils attractive and repulsive effects co-operating to produce a given movement in one direction of the coils, when the latter are traversed by an electric current.

460,111. Telegraphic Instrument. Charles G. Burke, Richmond Hill, N. Y.

This invention consists in the combination, with two freely suspended coils movable in independent magnetic fields, and bars attached to said coils, of a vibrating contact or recording arm connected by thread to the said bars, and means for adjusting each coil to and from the contact-arm.

460,122. Process of an Apparatus for Generating Electricity. Thomas A. Edison, Menlo Park, N. J.

[illegible] a body of carbon or car[illegible] material to a high temperature in the presence of an [illegible] of a body of [illegible] capable of combining [illegible] and a positive element [illegible] upon by such active agent, but [illegible] therewith.

460,1[illegible]. Dynamo or Electric Motor. William M. Fink, [illegible], N. J.

460,[illegible]. Electric Safety Catch. John W. Howell, Newark, N. J.

460,163. Trolley for Electric Railways. Frederic F. Smith, Woburn, Mass.

This invention is designed to prevent the trolley from being thrown off the trolley wire when the car is passing around curves.

460,178. Hanger for Incandescent Lamps. James A. Matteson, River Point, R. I.

460,199. Circuit Controlling Apparatus. John P. Cushing and William J. Kelly, Boston, Mass.

The last claim follows:

"17. In a circuit controlling apparatus or switch-board, a cabinet having a door and provided with a plurality of resistance-heads located therein and having contact members or terminals, contact-arms co-operating therewith, a plurality of pilot-lamps, and independent switches located in said cabinet, and electrical connections joining said pilot-lamps with said switches."

460,235. Electrode for Secondary Batteries. John B. MacDonald, Chicago, Ill.

The claim reads:

"In a storage battery, a grid for the support of the active material; composed of a metal ribbon having indentations or raised portions upon its surface and bent back and forth upon itself to form the supporting frame."

460,245. Switch for Series Dynamo Electric Machine. Craig R. Arnold, Sharon Hill, Pa.

460,277. Method of Obtaining Fluids for Primary Batteries. Joseph B. Gardner, Nyack, N. Y.

460,287. Electric Alarm. Charles H. Shaffer, Rockford, Ill.

The last claim is presented:

"6. A signal box consisting of suitable gearing, an electro-magnet, an armature preventing the starting of the box and permitting the starting of the box when attracted by the electro-magnet, a portion of the mechanism of the box made movable for freeing the armature from its engagement with the electro-magnet upon the rewinding of the box."

460,289 Lightning Arrester. James J. Wood, Brooklyn, N. Y.

460,328. Printing Telegraph. John E. Wright, New York.

460,349. Printing Telegraphic Apparatus. Gilbert A. Cassagnes, Paris, France.

460,354. Apparatus for Electrolytically Separating Metals from Ores. Werner Von Siemens, Berlin, Germany.

460,364. System of Electrical Distribution. Edwin W. Rice, Jr., Lynn, Mass.

The invention consists in the combination of a multiple series distribution system with an equalizing machine connected in shunt around one of the multiple arc groups and serving as a motor or generator, according as the major load shifts from one side to the other side of the system, said machine being coupled mechanically with the main generator, so as to return and receive power from the same source of energy.

460,372. Dynamo. William H. Elkins, Cambridge, Mass, assignor, by direct and mesne assignments, to the American Electric Machinery company, Portland, Me.

460,390. Water Motor. Walter B. Higgins, San Francisco, Cal.

460,391. Electric Lock. William S. Hull, Sheffield, Ala.

460,416. Push Button. John E. White, Syracuse, N. Y.

460,428. Method of Soldering or Brazing by Electricity. Charles L. Coffin, Detroit, Mich.

The process consists in connecting one or both of the articles to be soldered or brazed with one pole of a generator, connecting the tool to the other pole of the generator, bringing the tool in contact with the solder and seam to be soldered or brazed, and passing an electric current through the tool and material while the tool is maintained in contact with the solder and seam.

460,448. Insulator. Frank A. Ross, Livingston, Mont.

460,457. Printing Telegraph Instrument. John E. Wright, New York, N. Y.

460,464. Automatic Electric Fire Alarm System. William S. Cook, Moses C. Cook and Albert H. Morrow, South Omaha, Neb.

460,488. Trolley Switch. Harry L. Pierce, Leominster, Mass.

460,503. Electric Bell. Walter Hay, Chicago, Ill., assignor of one-half to George E. Horn, same place.

460,504. Apparatus for holding and sewing carpets. Rudolph M. Hunter, Philadelphia, Pa, assignor to The Union Special Sewing Machine company of Illinois.

460,506. Apparatus for Holding and Sewing Fabrics. Rudolph M. Hunter, Philadelphia, Pa., assignors to the Union Special Sewing Machine company, of Illinois.

460,514. Electric Crane. William A. Stadelman, Philadelphia, Pa., assignor to the Equitable Engineering and Construction company, same place.

460,524. Electrical Railway Signaling Apparatus. William F. Z. Desant, New York, N. Y.

460,525. Electric Railway Signal. William F. Z. Desant, New York, N. Y.

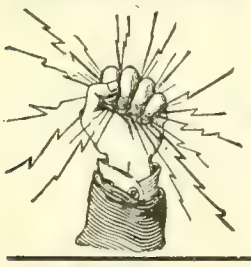
460,538. Thermal Cut out. John O. Phillips, New York, N. Y.

460,541. Electric Elevator. Rudolph C. Smith, Yonkers, N Y., assignor, by mesne assignments, to The National company of Illinois.

This invention consists of the combination, with a circuit over which a constant current is sent, of an electro motor included in the circuit and connected to operate an elevator, a shunt of high resistance around the motor, and a normally open shunt of lower resistance, including a detent magnet controlling the motor.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used. Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the Boston Fire Underwriter's Union, under date of March 29, 1885, he says: "A Thoroughly Reliable and Desirable Wire in Every Respect."

The rubber used in insulating our wires and cables is specially chemically prepared, and is Guaranteed to be waterproof and will not deteriorate, oxidize or crack and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid, an l to a very great extent, fire proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS.

4 LaSalle Avenue, Chicago.

Write us for Prices.

CHICAGO.

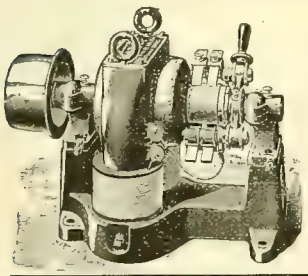
The Electrical Construction Co.

43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

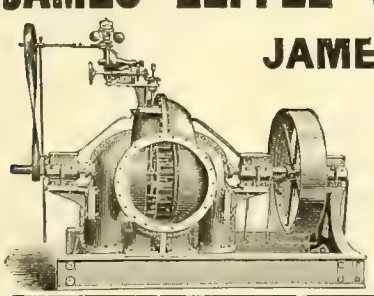
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS



BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., Brooklyn, N. Y.

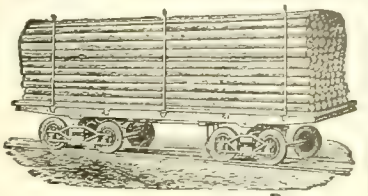
REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light
} CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg., Room 215, 136 Liberty St., NEW YORK

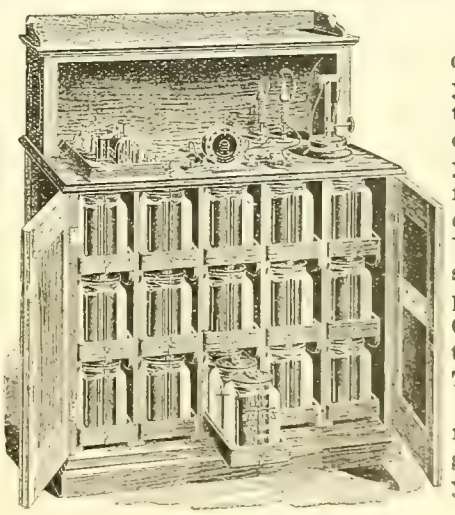
Standard Laboratory Photometer.

For illustrations see WESTERN ELECTRICIAN of September 12th, Page 150.

This outfit is designed to measure accurately the candle power of Incandescent Lamps, and will be found of great value by Manufacturing Companies. Price for the complete set or separate parts furnished upon application. Correspondence solicited.

Send for Illustrated Descriptive Catalogue 1-66.

QUEEN & CO., PHILADELPHIA.



The Law Electro-Therapeutical Office Outfit.

Have you been in doubt as to whether you need an office battery, or are you in doubt as to just what you require, and the first cost, and to the cost of maintenance? Use the Law Outfit and secure pleasure and profit. More than 63,000 cells of Law Battery in use for Electro-Therapeutical work.

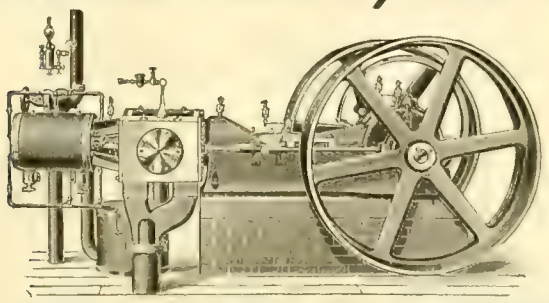
Eleven years on the market. Every cell guaranteed for ten year's service.

SOLE MANUFACTURERS:

LAW TELEPHONE CO., 85 John St., N. Y.

Cable Address: "Barbery." Write us for Catalogue.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION
One	12½x12	80	Edison General Electric Co., Groton, N. Y.
Two	18½x17	400	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rio de Janeiro, Brazil.
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 19x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Hollins & Co., Chicago, Ill.
One	15 and 23x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric [illegible], Tonawanda, N. Y.
One	18½x18	200	T. H. Int. Elec. Co., Leeds, England.
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T.-H. Int. Elec. Co., Hochelaga, France.
One	11 and 19x15	150	Fritz Wiem, Buenos Ayres, Argentine.
One	16x15	150	T. H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 26x17	400	Baltimore Electric Reducing Co., Baltimore, Md.
One	14½ and 23x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, 339 Rookery Bldg., CHICAGO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES, SHADES, Etc., Etc.,

171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.

FITCHBURG, MASS., U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES. ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

Binders

FOR THE Western Electrician **$1.00.**

COMPLETED TO DEADWOOD.

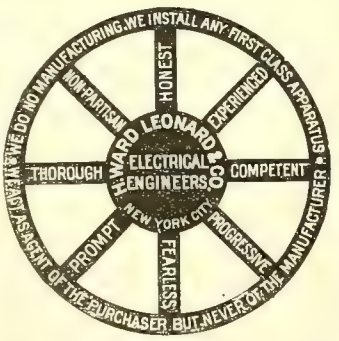
The Burlington Route, C., B. & Q. R. R., from Chicago, Peoria and St. Louis, is now completed and daily passenger trains are running through Lincoln, Neb., and Custer, S. D., to Deadwood. Also to Newcastle, Wyoming. Sleeping cars to Deadwood.

Manufacturers of

OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.



If you wish to use electricity for any purpose whatever, write us for full information.

ROOM 422

Electrical Exchange Building,

NEW YORK CITY.

REMEMBER

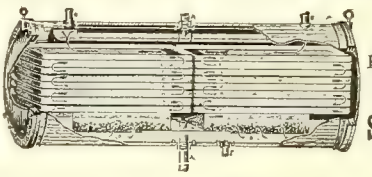
That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

Experimental Work in Anything Electrical.

FREEMAN, COLEMAN & CO.,

53 and 55 South Jefferson Street. - - CHICAGO, ILL.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

EVERYTHING IN

WIRE—FUSE—STRIPS.

MANUFACTURED BY

The Sperry Electric Mining Machine Co.,

39th St. and Stewart Ave., CHICAGO.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

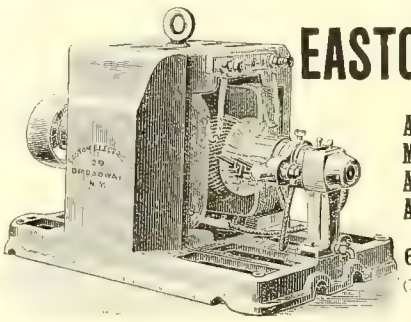
LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingots, Slabs, Sheet Wire and Castings at lowest market rates.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.



THE EASTON ELECTRIC CO.,

MANUFACTURERS OF

Arc and Incandescent Dynamos, Motors, Generators and Separators, And Arc Lamps adapted for use on Arc or Incandescent Circuits.

ADDRESS:

643 Kent Ave., Brooklyn, N. Y.

(Near Roosevelt, Grand and East 23d Street, Ferries from N. Y.),

For Circulars, Prices and Information.

PLATINUM.

JAS. SCHAWEL & CO., 20 JOHN ST., NEW YORK.

Importers and Melters. Wholesale and Retail. Scrap Purchased.

Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

OTIS

ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

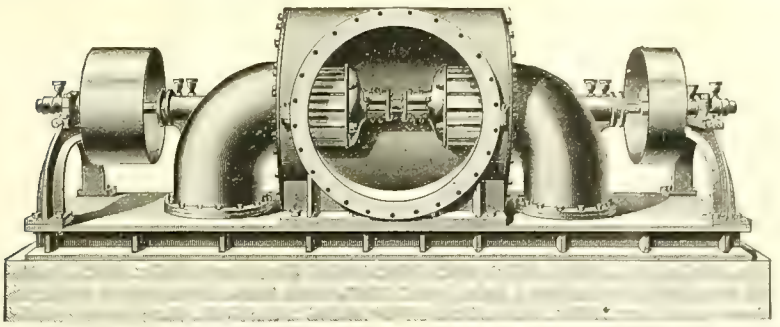
MANUFACTURERS OF

PASSENGER AND FREIGHT

Hydraulic and Electric

ELEVATORS.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC [illegible] CELEBRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high speed and great Efficiency,** and **large Capacity** [illegible] diameter, being **double** the **Power** of [illegible] by a number of the leading electric [illegible] economical use of water it is without [illegible] of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents a pair of [illegible] **VICTOR TURBINES** arranged on a horizontal shaft [illegible] Tubes, End Bearings for Shaft and Driving Pulley [illegible] a substantial cast-iron bed plate. The entire arrangement [illegible] strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts [illegible] admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

BINDERS

FOR THE

Western Electrician,

ONE DOLLAR.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

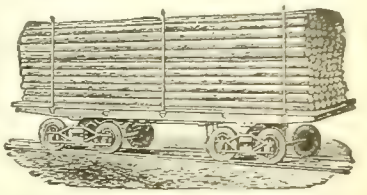
HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

BEST ECONOMY VS. LONG LIFE.

BURLEY HOUSE, Belle Plaine, Iowa.
Principally noted as the place where a Thomson-Houston Incandescent Lamp was permitted to run 4,620 hours without being renewed.

It costs more to produce the same amount of light with a lamp that will burn **4,620** hours than with one that will burn **1,000** hours or less. **Either it was not running at full candle power or it consumed an excessive amount of current.**

SEE WHAT PURCHASERS SAY.

We copy the letter given below from the Thomson-Houston Company's advertisement in the WESTERN ELECTRICIAN.

Extract of Letter from Manitou Electric Co., Manitou Springs, Colo., Dated August 23, 1891.

"We have got T. & H. Lamps burning and giving good light that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston Lamps still burning that have burned 5,000 hours. The lamps were all I could ask. Have tried "Sunbeam",..... and other lamps made in Chicago, and the ....., all of which are no good on earth.

"MANITOU ELECTRIC CO.,
"By C. F. TINGLEY, Manager."

This Company is running 1,600 Lamps.

In the face of these facts, why do you buy lamps that are of short life, low candle power, and that quickly blacken?

Extract of Letter from a large Central Station in the West.
(In which we are not in any way interested.)
Dated August 13, 1891.

"After making a very careful test on the following lamps, using ten of each, we have the following results, the lamps now burning a little over 600 hours: Ten 16 C. P. 50 Volt....., two burned out; a slight blackening; amount of current consumed to operate 10 lamps, 11.65 amperes. Ten 16 C. P. 50 Volt....., two burned out; also a slight blackening; amount of current consumed, 13.45 amperes. Ten 16 C. P. 50 Volt Sunbeam, none burned out; no blackening; amount of current consumed, 10.77 amperes.

"These tests were fairly made and are proof positive to us that your lamp is the superior one. Will forward amount required for monthly shipment next week, as we wish to ascertain definitely how many of the 16 and 25 C. P. we will require monthly.

"Very truly yours, ..."

This Company is running 11,000 Lamps.

For reasons that will probably be obvious to all, we omit both the name of our customer and our competitors. The letter is one taken from a number of similar ones, and came to us in the regular course of business.

The Sunbeam Lamps will burn LONGER than any other Lamps at the same EFFICIENCY.

In the face of real facts, why do you buy lamps that are long lived, bad economy, and that quickly blacken?

THE SUNBEAM INCANDESCENT LAMP CO., 805 Chamber of Commerce Bldg., CHICAGO.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

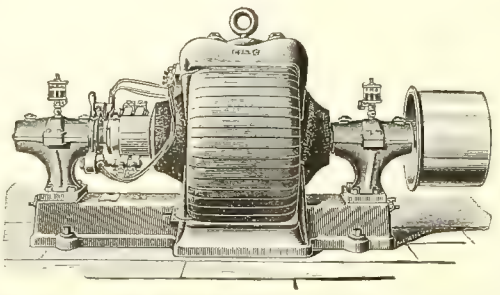
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

MORE WORDS ARE NEEDED

TO DO JUSTICE TO THE

PERRET ELECTRIC MOTOR.

The Elektron Manufacturing Co.—

OFFICE OF CURTIS MANUFACTURING CO., Manufacturers of Carriage Robes,
Fifth Avenue and 16th Street, New York City, September 16, 1891.

GENTLEMEN:—If there were words enough in the English language to express my admiration of the Perret Motor I might do justice to its good qualities; but there are not. We have used it every working day since it was put in, and not one cent has been expended on it except for oil. It drives our six heavy machines as steadily as a clock. I consider it the very best power we could get, and would not part with it unless I could get its equal. I take special pride in showing it to my friends. It's not a plaything, but business every day. If any one wants to know what it can do, just send them up to me. Yours truly, CURTIS MANUFACTURING CO.

THE ELEKTRON MANUFACTURING CO., SPRINGFIELD, MASS.,

New York Office, 89 Liberty Street.

Selling Agents: WASHINGTON, D. C.—J. U. Burkett & Co., 1409 New York Ave. NEW ORLEANS, LA.—George Baquie, 140 Gravier St.
CHICAGO, ILL.—The Electrical Engineering Co., 320 Dearborn St. ST. PAUL, MINN.—F. J. Benz, 95 East Fourth St.
PHILADELPHIA, PA.—Pennsylvania Machine Co., 29 North Seventh St.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

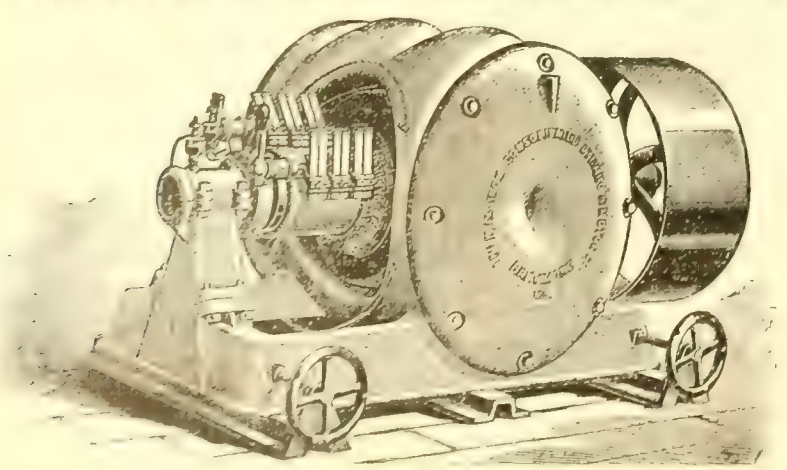
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE WENSTROM CONSOLIDATED DYNAMO & MOTOR CO.,

OF BALTIMORE, MD.,

—MANUFACTURERS OF—



ELECTRICAL APPARATUS.

ELECTRIC MOTORS
For All Work.

DYNAMOS
For Incandescent Lighting.

Special Features: High Efficiency. Slow Speed.

For full information and circulars address

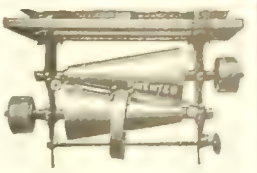
THE WENSTROM CO., Baltimore, Md.

For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

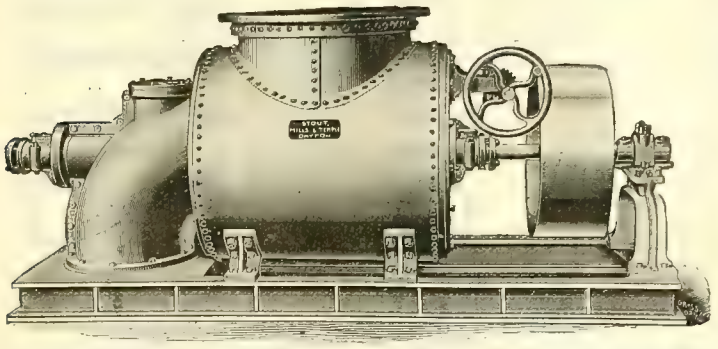
Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

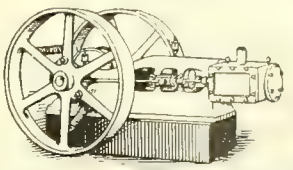
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North Street, BALTIMORE, MD.

A MODEL RAILWAY.

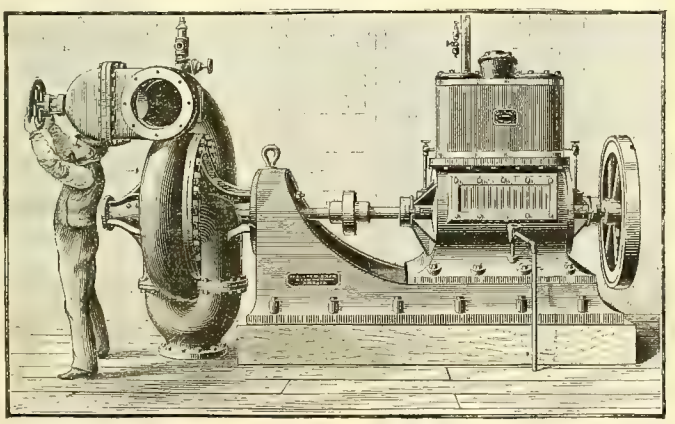
The Burlington Route, C., B. & Q. R. R., operates 7,000 miles of road, with termini in Chicago, St. Louis, St. Paul, Omaha, Kansas City and Denver. For speed, safety, comfort, equipment, track, and efficient service it has no equal. The Burlington gains new patrons, but loses none.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES

A SAMPLE INSTALLATION.

Standard Automatic Engine coupled direct to a Centrifugal Pump. Speed 280 Revolutions.

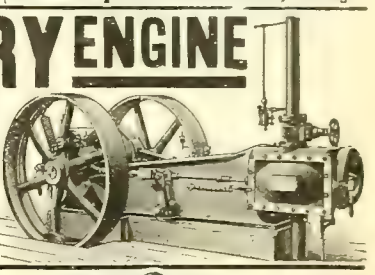


Over 4000 Westinghouse Standard Engines in use.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application. —



STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES | Philadelphia, 942 Drexel Bldg.
San Francisco, 29 & 31 Spear St.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

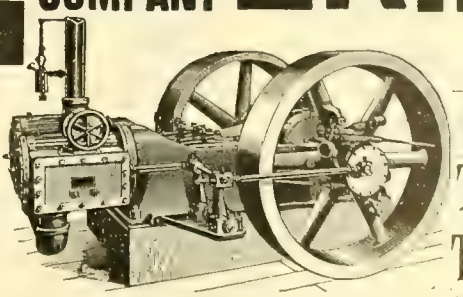
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER & CO., 38 South Fourth Street Philadelphia, Pa; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY Co., Tacoma, Wash.; CROOK, HORNER & CO., Baltimore, Md.; E. G. GILBERT, Atchison, Kan.

BRANCH OFFICE, Room 506 Rookery Building, CHICAGO, ILL. ALBERT FISHER, Manager.

Thomson-Van Depoele

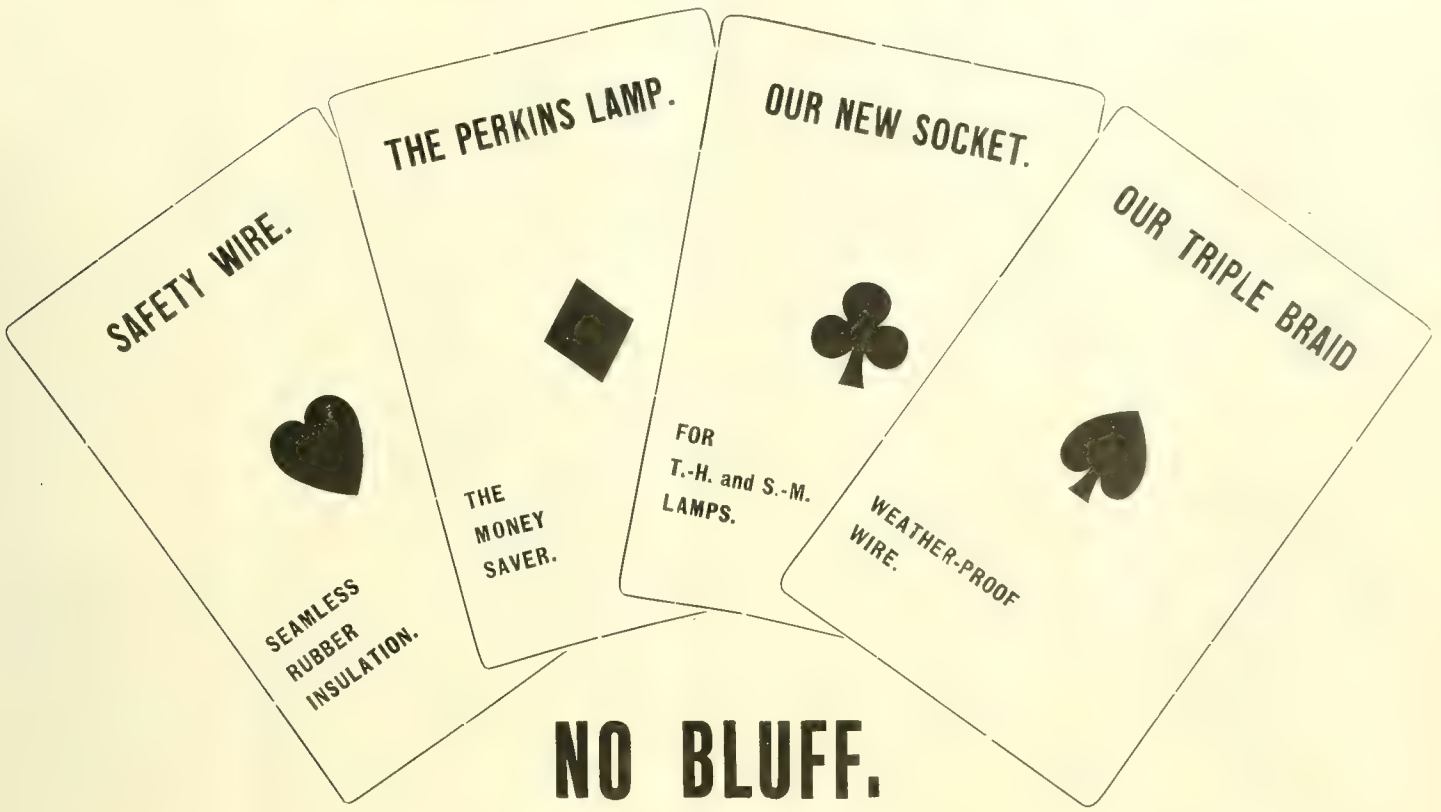
ELECTRIC MINING COMPANY,

148 Michigan Avenue, Chicago.

Inspect Our Exhibit at Chicago Exposition Building, Opposite our Office.

Exposition Closes October 24th.

A SURE WINNER.



NO BLUFF.

MANITOU SPRINGS, COLORADO.

POPULATION 1,000.

The only place where invalids and **POOR INCAN DESCENT LAMPS** can prolong their lives.

TESTIMONIAL

From an electrical expert of national reputation

"We have got T. & H. Lamps burning and giving good light that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston Lamps still burning that have burned 5,000 hours. The lamps were all I could ask. Have tried 'Sunbeam,' 'Edison' and other lamps made in Chicago, and the 'Perkins,' all of which are no good on earth."

MANITOU ELECTRIC COMPANY,
By C. F. TINGLEY, Manager.

Others Furnished on Application.

THE KNAPP ELECTRICAL WORKS,

54 and 56 Franklin St., CHICAGO, ILL.

Chicago, Wednesday, Oct. 7, 1891.

Weather phenomenal, liable to slump any minute, barometer falling.

We can assist you to a considerable extent to withstand the vagaries and vicissitudes of wind and weather.

Shield Brand "Moisture-proof" was made to meet just such emergencies.

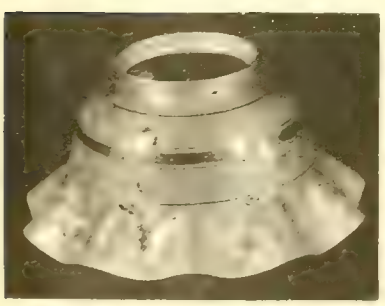
The Real and Imitations.

It is often a difficult matter to distinguish the *real* from the imitation, but if you have ever used Shield Brand *Moisture-proof*, the imitations will hardly find a place in your consideration.

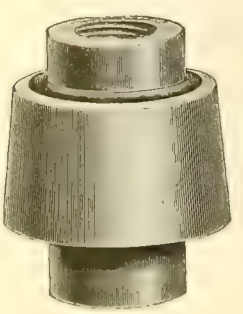
Center Aisle Main Floor.

One of the specialties here is our Shield Brand (that's a good name to remember) Insulating Tape—it's not red tape either—but black, and goes right to the point, and makes the covered joint as secure and "Moisture-proof" as the main wire.

In Tin Shades we can offer exceptional bargains. Our Universal pattern is unexcelled for the factory or workshop. Fits any socket. Other items in this department we tabulate as follows:



Wirt's Flexible Cord Adjuster.
Wirt's Fixture Insulating Joint.
Aluminum Incandescent Shades; we couldn't fully supply our first orders for these dainty shades, but have a new lot ready for *quick shipments.*



If ever we had a meritorious novelty, certainly the Automatic Oiling Device for trolley wheels is one. Don't fail to inquire for them.

The store improvements—we have been adding elevators and stairways and show windows—a big window on the Randolph Street side, and two for the Michigan Avenue front.

THE ELECTRICAL SUPPLY CO.,

Cor. Randolph St. and Michigan Ave.

TAKING THE LEAD.

THOUGH ONLY

ON THE

MARKET

—FOR—

SIX MONTHS,

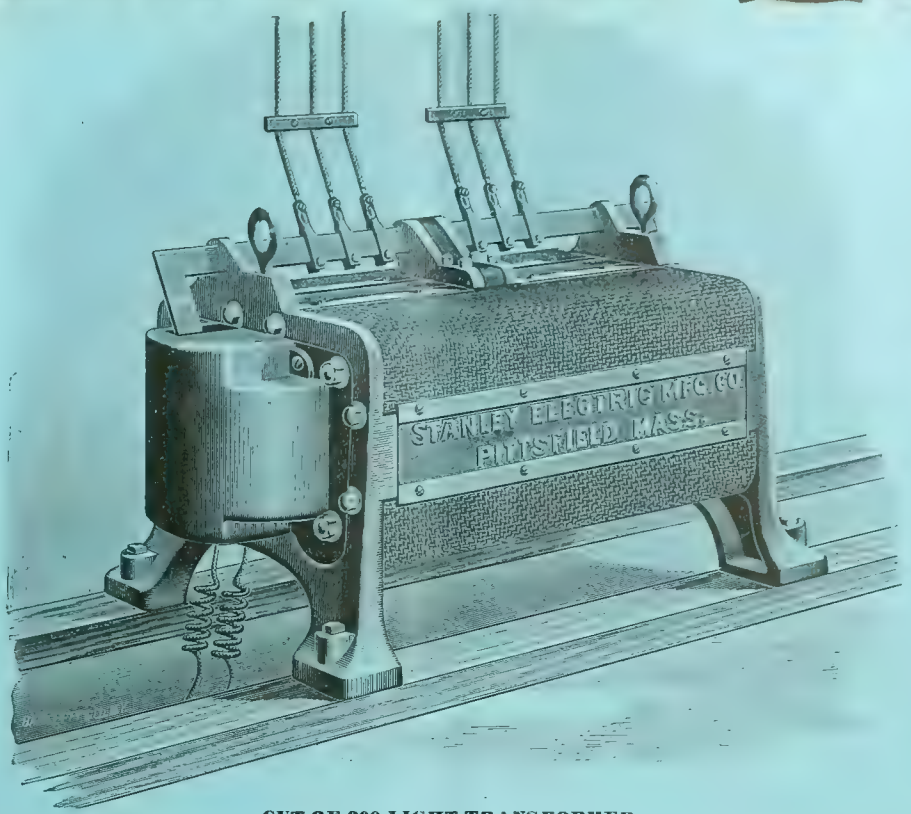
THE

STANLEY

—IS—

NOW KNOWN

—AS—



CUT OF 300 LIGHT TRANSFORMER.

THE

BEST

Transformer.

CORRESPONDENCE

SOLICITED.

STANLEY ELECTRIC MFG. COMPANY, PITTSFIELD, MASS.

WESTERN AGENTS: The Electrical Supply Co., Corner Randolph St. and Michigan Ave, Chicago, Ill.

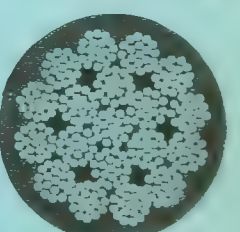
THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.

THE RUBBER USED IN

HABIRSHAW INSULATION

IS PURE PARA.

Underground Core.

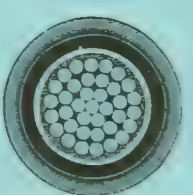


Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.

Feeder Core, Broadway Theater.

Submarine Work, Edison Electric Light Co., Easton, Pa.



Naval Core, United States s. s. "Chicago."

Portable Cable, Broadway Theater.

Marine Core, used on Government Cruisers.

Naval Marine India Rubber Covered Wires.

Naval Land India Rubber Covered Wires.

PROMINENT INSTALLATIONS.

STANDARD INDIA RUBBER COVERED WIRES.

Feeder Conductor, "Dry places," Grand Central Depot.

Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

SOLID AND STRANDED CONDUCTORS, TAPED, BRAIDED, FLAME-PROOF.

The Habirshaw Insulation fulfills all requirements in places demanding the "Best," and in that field finds no successful competitors.

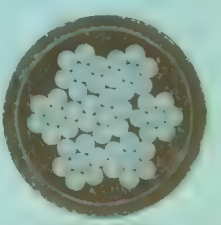
Feeder Core.

FACTORY: GLENWOOD, YONKERS, N. Y.

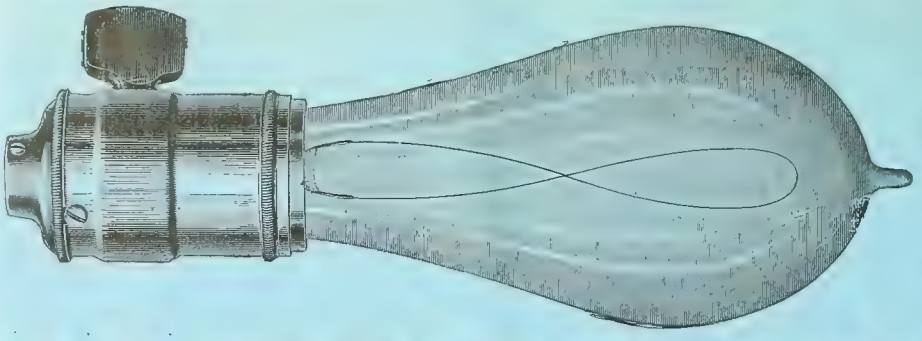
WM. M. HABIRSHAW, F.C.S.,
GENERAL MANAGER.

OFFICE:
315 Madison Ave., Cor. Forty-Second St.,
NEW YORK CITY.

THE ELECTRICAL SUPPLY CO., corner of Randolph St. and Michigan Ave., CHICAGO, ILL.



Feeder Cable, Brooklyn Edison Electric Light Co



LONG LIFE

INCANDESCENT LAMPS.

SEE WHAT PURCHASERS SAY:

BURLEY HOUSE,
Belle Plaine, Iowa,

State of Iowa }
Benton County } ss.

I, B. B. Burley being duly sworn upon oath depose and say, that I am a resident of Belle Plaine Benton County Iowa, and proprietor of the "Burley House" in said City— That Sept. 20th 1887, the Union A. Hunter Electric Company, placed a 32 Candle power — 52 volt incandescent lamp, of the Thomson-Houston System, on the porch at my said Hotel — That said lamp burned continuously for 4620 Hours, burning out July 15th 1891.—

B. B. Burley

Subscribed in my presence and sworn before me August 10th 1891.

John H. Hilliker
Notary Public in
& for Benton Co. Iowa.

B. B. BURLEY,
Prop. BURLEY HOUSE,
Belle Plaine, Iowa.

Extract of letter from Manitou Electric Co., Manitou Springs, Colo.
DATED AUGUST 23, 1891:

"We have got T. & H. Lamps burning and giving good light that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston Lamps still burning that have burned 5,000 hours. The lamps were all I could ask. Have tried 'Sunbeam,' 'Edison' and other lamps made in Chicago, and the 'Perkins,' all of which are no good on earth."

MANITOU ELECTRIC CO.,
By C. F. TINGLEY, Manager.

THE IRON MOUNTAIN ELECTRIC CO., IRON MOUNTAIN, MICHIGAN, state that they have lost but 2 lamps in three months, with one thousand installed.

In the face of these Facts, why do you buy lamps that are of Short Life, Low Candle Power, and that quickly Blacken?

We make our own lamps and can furnish them at once

From 45 to 116 Volts,
From 6 to 150 Candle Power.

Write for Price Lists.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Avenue, BOSTON, MASS.

148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co.. xiii
Alexander, Barney & Chapin.....i
American Electrical Works.... xiii
Andrews & Co., A. H..... ... xxi
Baggot, E xiv
Bain Electric Mfg. Co..... xx
Ball Engine Co.....xxi
Ball & Wood Co., The i
Beggs, J. E. Mfg & Supply.... iv
Belmont & Co., A.....xx
Bernstein Electric Co.....xx
Blatz, L..... xiii
Borden & Selleck Co..... xv
Braun Illustrating Co xxi
Brownlee & Co..... xii
Brookfield, Wm..... ... xii
Brush Electric Co..... ...xvii
Butler Hard Rubber Co x
Buxton, Geo. B ix
C. B. & Q. R. R..... xv
C. & C. Electric Motor Co.....xvi
Card E. Motor & Dynamo Co....xx
Central Electric Co..... ... v
Chicago Electric Mfg. Co..... ix
Chicago Electric Motor Co.....—
Clower, Harris & Co.....i
Chicago Insulated Wire Co... xvii
Colburn Electric Mfg. Co..... xiv
Columbia Electric Co.....xxvi
Coolidge, Fuel & Supply Co..xviii
Consol. Elec. Mfg. Co., The..... i
Cowles Elec. Smelt. Alum. Co..xiv
Crocker-Wheeler Elec. Mo. Co. xiii
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co..xxi
Detroit Electrical Works..... vii
Densmore Typewriter Co.....—
Eastern Electric Cable Co..... xiii
Easton Electric Co..... .....—
Edison General Electric Co..... vi
Edison General Electric Co., Cable and Wire Department..... vi
Eddy Electric Mfg. Co.....viii
Electric Construction & Sup. Co.. xv
Electric Merchandise Co..... x
Electric Secret Service Co.....xiv
Electrician Pub. Co..... ..xviii
Elec. Construction Co., The.... xiii
Electrical Engineering Co.....xii
Elec. Eng. & Supply Co., The..xiii
Electrical Supply Co., The... xxiv
Elektron Mfg. Co.....xvi
Empire China Works..... .xiv
Erie Electrical Supply Co.....xiii
Evans Friction Cone Co..... xviii
For Sale..... iv, xiii, xx
Foster, O. A..... —
Fort Wayne Electric Co..... xxvi
Franklin Electric Co.....—
Freeman, Coleman & Co.....—
Gleason & Bailey Mfg. Co. Ltd. xii
Globe Carbon Co..... xv
Great Western Elec. S. Co..... ix
Greeley & Co., The E. S.....i
Hale Elevator Co..... iv
Heisler Electric Light Co.....xvi
Hill Clutch Works .....—
Hine Elliminator Co.....xii
Holmes, C. H..... xiii
Holmes, Booth & Haydens... .xvii
Hood, Wm..... x
India Rubber & Gutta Percha Insulating Co.....—
Interior Conduit & Insulation Co. x
International Okonite Co..... i
Kartavert Mfg. Co.....xviii
Keller & Degenhardt..... xii
Knapp Electrical Works..... xxiii
La Roche E'ectric Works..... iv
Law Telephone Co..... ..xiii
Leonard & Co., H. Ward..... xiv
Leffel & Co., Jas.....xiii
Loud, H. M. & Sons Lumber Co..xiv
McLaughlin, James xiii
Mason, James H.....xii
Milliken Bros.....iv
Minneapolis Street Railway Co..xxv
Monitor Electric Co..... x
Munsell & Co., Eugene..... xiii
Murphy, T. J..... xv
N. W. T. H. Electric Co .....—
National Carbon Co.....iv
National Electric Mfg. Co.....xix
N. Y. Belting & Packing Co..... xii
New York Insulated Wire Co..xviii
New York & Ohio Co..... i
N. W. Elec. Specialty Co.....xxi
Nuttall Company, R. D..... i
Ostrander & Co., W. R..... ix
Paiste, H. T..... xii
Page Belting Co.....—
Partrick & Carter Co.....—
Payne & Co., Geo. W..... .—
Pearson & Co., W. B.....xxi
Pelton Water Wheel Co xiv
Phoenix Glass Co.....—
Pond Engineering Co xxi
Powell Co., The Wm.....xviii
Queen & Co..... . xiii
Ries Elec. Specialty Co., The... x
Rockford Electric Mfg. Co....—
Roessler & Hasslacher Chemical Co.....i, xii
Royal Electric Co..... xii
Sargent & Lundy..... i
Sawyer-Man Electric Co..... xi
Schawel & Co., Jas..... xii
Schieren & Co. Chas. A.....xii
Schoonmaker, A. O xii
Schuyler Electric Co..... iv
Short Electric Railway Co xii
Schultz Belting Co xviii
Sperry Elec. Mining Mach. Co.. xiv
Standard Underground Cable Co....i
Stanley Electric Mfg. Co..... —
Star Iron Tower Co.....x
Stearns Mfg. Co.....xxi
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co ix
Taussig, S..... iv
Temple, J. C..... xv
Thomson-Houston Elec. Co..ii, xxii
Turner Brass Works..... xiii
Union Electric Mfg. Co., The....ix
Union Electric Works..... —
Union Hardware Co..... ..xii
U. S. Electric Lighting Co.. —
Van Nuis C. S..... —
Vulcanized Fibre Co..... xv
Western Electric Co xvi
Westinghouse Elec and Mfg Co..xi
Westinghouse Machine Co..... xxi
Weston Electrical Instrum't Co.—
Williams Engine Works.... ..xxi
Woodbridge & Turner Eng. Co..xv
Woodhouse & Rawson, Ltd.....xiv
Worthington, Henry R.....—

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelt. & Alum. Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg & Supply Co.
Brush Electric Co.
Columbia Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Franklin Electric Co., The
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Franklin Electric Co., The.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co. The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Cars, Railway.
Minneapolis St. Ry. Co.

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Keller & Degenhardt.
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg & Supply Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Columbia Electric Co.
Detroit Electrical Works.
Easton Electric Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Columbia Electric Co
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co. The.
Turner Brass Works.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E. Mfg & Supply
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co,
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works.

Fibre.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Columbia Electric Co.
Detroit Electrical Works.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co. The.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Roessler & Hasslacher Chemical Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Columbia Electric Co
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Elec. Mo. Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Clower, Harris & Co.
Eddy Electric Mfg. Co.
Edison General Electric Co.
Eddy Electric Mfg. Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Elektron Manufacturing Co.
Erie Electric Motor Co.
Foster, O. A.
La Roche Electric Works
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd

Packing.
Buxton Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Roessler & Hasslacher Chemical Co

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co.
Stanley Electric Mfg. Co
Westinghouse Electric & Mfg. Co

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James
Pelton Water Wheel Co
Stilwell & Bierce Mfg. Co

Type Writers.
Densmore Type Writer Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. **THE NATIONAL CARBON CO.** CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

NOW THEN!! FOR SALE CHEAP!!

Eight 500 light Thomson Houston Dynamos, 110 volts.
One 1300 16-C. P. Alternating Thomson Houston Dynamo
Two extra Armatures for same, new
Two Sperry Arc Machines, 50 lights, 2,000-C. P.
Four American Arc Machines, 25 lights, 2,000-C. P.
Sixty miles No. 10 American Electric Wire, used about one year.
Ninety five American Arc Lights, single carbon.
One thousand Goose Necks, Lamp, Shades, complete.
Two Ball Engines, 80-H. P., A 1, with Base.
One Armington & Sims, 60 H. P., with Base.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

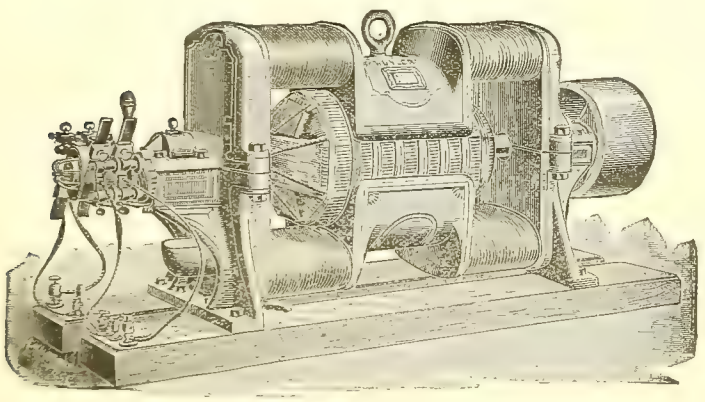
Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

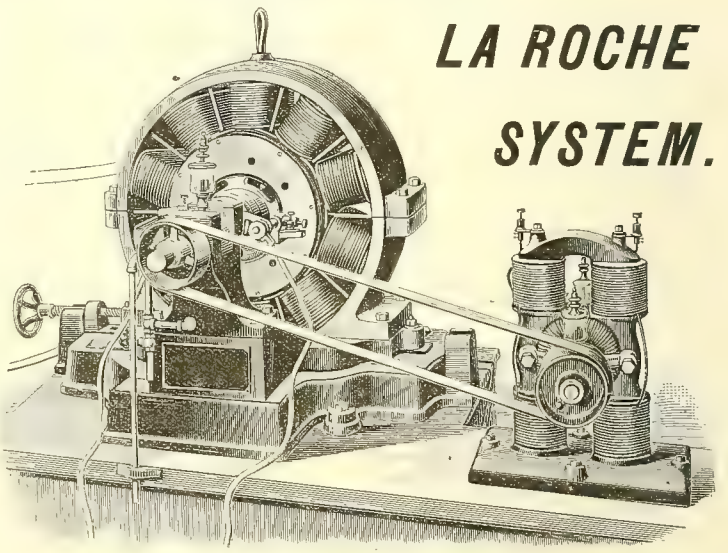
Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,

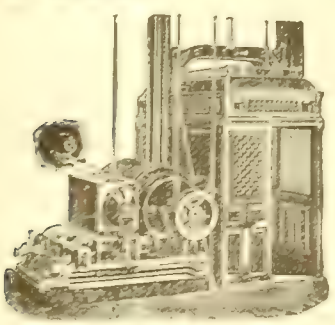
FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

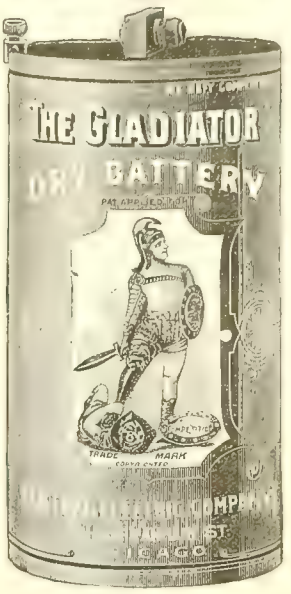
PASSENGER AND FREIGHT

Hydraulic and Electric

ELEVATORS.

DRY BATTERIES.

We have spent a lot of money and time in testing this dry battery, and believe it to be the best in the world. . . . .



$C = \frac{E}{R}$

In the Gladiator the

E = 1.6
R = .4
C = 4.

OUR ST. LOUIS BRANCH.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

OUR KANSAS CITY BRANCH.

OKONITE
TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OUR OMAHA BRANCH.

OKONITE
TRADE MARK.

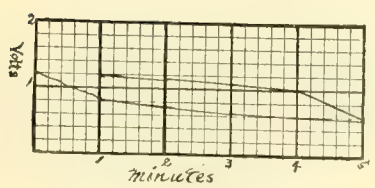
WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

OUR DENVER BRANCH.

OKONITE
TRADE MARK.

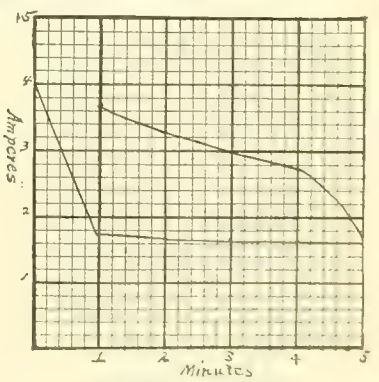
ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., Denver, Colo.

GET ON TO OUR GLADIATOR'S CURVES.



E. M. F. CURVE.

Showing drop of potential and recovery through 2 ohms of external resistance.



CURRENT CURVE.

Showing drop and recovery on short circuit.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

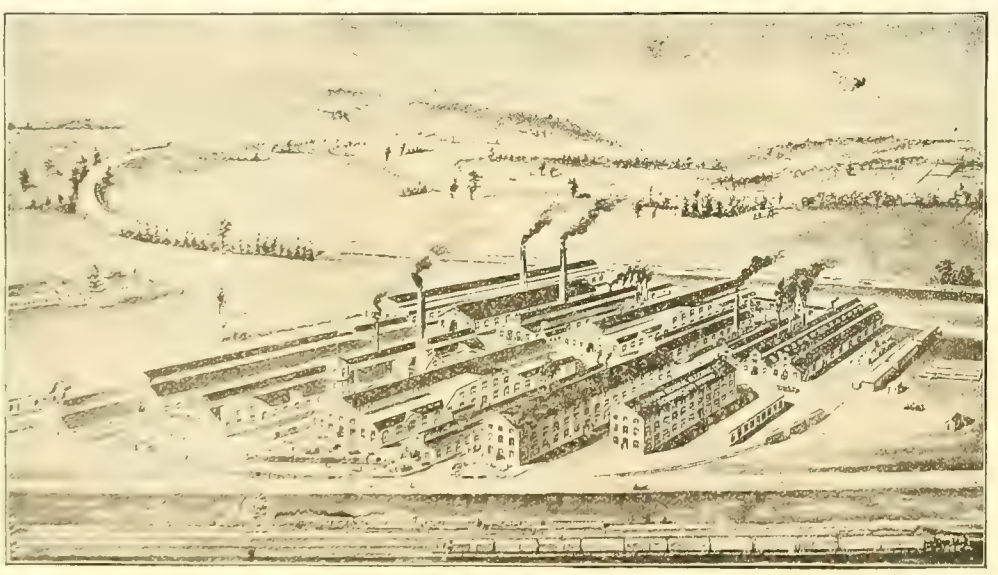
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

FACTS!

STREET RAILWAY MEN SHOULD KNOW ABOUT

The Detroit Electrical Works' STANDARD RAILWAY SYSTEM.

Our *latest type*, "*B*", standard equipments have been ordered by street railway companies at Gloucester, Mass., 10 cars; Salem, Mass., 5 cars; Aurora, Ill., 15 cars; and by J. N. Beckley, President of the Rochester Railway Company, for his railway at Lawrence, Mass., 15 cars, after thorough *trial* and *experience* with the *latest styles* of equipments put on the market by the *other leading electric companies.*

Our equipments will operate with *less current* to do the same work, with less noise and with *less risk* to *burn-outs* of *armatures, fields* and *switches,* than any other equipment on the market, whether double or single reduction.

The advantages over two motors, of having but *one motor* to drive the car, are:

1.—*One-half* the number of electrical parts.

2.—*Uniform wear* on the system throughout.

3.—*Single Absorption* of the *current*, thus eliminating *losses incidental* to *dividing power* into *two* or more units.

4.—*Impossibility* of having one motor working against another, which often happens to the *destruction* of some one or more parts.

5.—*Ability* to *reverse motion* at *speed* in case of *danger*, where prompt action may save personal injury and subsequent damage.

6.—*Accessibility* of *motor parts* to *inspection* from the *car floor*, everything being in the *center*, under *one* trap door.

7.—The *indisputable fact* that *four wheels* of a truck, all *driven simultaneously* from *one source* of *power, give all* the *traction* on the rails due to the weight of the *car* complete, *regardless* of the *distribution* of the load in the car.

This is an *important consideration*, especially in *work* on *grades* where *all* the *traction* of the car is *needed* and where *slipping* of the *wheels* is *objectionable* and *expensive.*

In the *new style*, type "*B*", 30 and 40 H. P. equipments, the details throughout have been redesigned to meet hard service at a *low cost* for *maintenance* and *repairs.*

The *switches,* recently patented, are *strong, durable* and *safe* from *arcing*, or *burning* by breaking heavy currents.

The *rheostats* are made of German silver wire, and arranged in an improved casing, for protection and durability.

These statements are facts, and we will furnish the means for any intending purchaser to verify them, both by inspection of the apparatus at our Works and by inquiry into the results of operation on the roads that we have equipped.

One of our Standard 40 H. P. Equipments will be in operation upon the track of the Duquesne Traction Co., at Pittsburgh, Pa., during the Convention of the American Street Railway Association in that city.

Street railway officials are respectfully requested to thoroughly inspect and investigate the equipment.

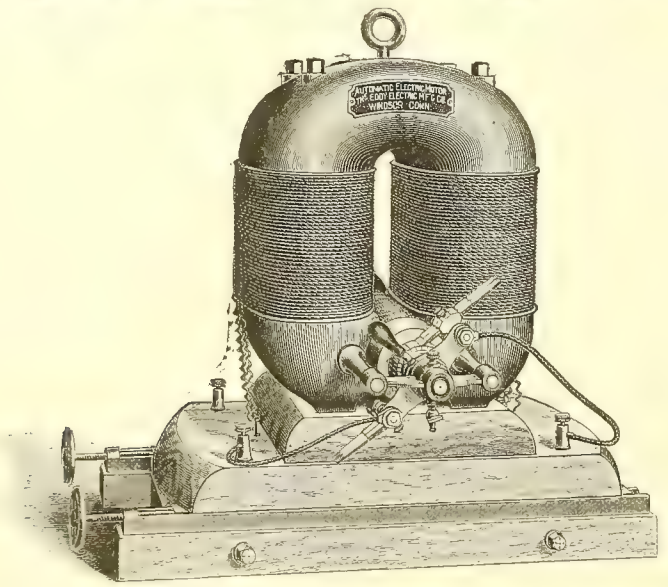
Full information and detail estimates furnished upon application.

DETROIT ELECTRICAL WORKS, - DETROIT, MICH.

THE EDDY ELECTRIC MFG. COMPANY

MAKES A SPECIALTY OF THE COMPLETE EQUIPMENT OF FACTORIES WITH

ELECTRIC POWER.



EDDY POWER GENERATORS,

ANY SIZE UP TO 300 H. P. AND ANY VOLTAGE.

THE EDDY ELECTRIC MOTOR

Is Simple, Efficient, Durable, Economical and Always Reliable.

THE EDDY ELECTRIC MFG. CO.,

WINDSOR, CONN.

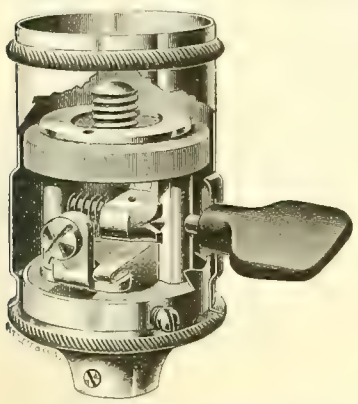
136 Liberty Street, - NEW YORK.
92 Franklin Street, - - BOSTON.
506 Commerce St., PHILADELPHIA.
341 The Rookery, - - CHICAGO.
Rialto Building, - KANSAS CITY.
413 Jackson Street, - ST. PAUL.
409 West Michigan Street, DULUTH.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.



"OF SOME THINGS ONLY THE BEST ARE WORTH HAVING."

WE GUARANTEE ALL GOODS

And will ship to central stations on approval—FREIGHT PREPAID.

The UNION ELECTRIC MFG. CO., Bridgeport, Conn.

NEW YORK: Alexander, Barney & Chapin.

BOSTON: The Eastern Electrical Supply Co.

Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufac urers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,

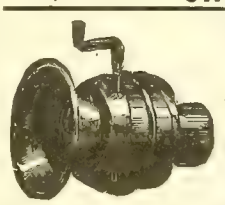
17 VIRGINIA ST., EAST SOMERVILLE, MASS.

73-75 W. Jackson St. RELIABLE

WE ARE FITTED WITH RELIABLE Machinery and Tools, And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

BEST ECONOMY VS. LONG LIFE.

AN INTERESTING GROUP.

B. B. Burley, Proprietor Burley House, Belle Plaine, Iowa.

"If I can only hold out until I reach the Burley House, I may live forever."

Burley House, Belle Plaine, Iowa. The haven for decrepit incandescent lamps.

REMEMBER That the Sunbeam Company can furnish a lamp that will burn for as great a number of hours as any other Lamp made, but an extremely long-lived lamp (4620 hours or more) is, from the standpoint of Best Economy, "no good on earth." We furnish the lamps that we think our customers will like the best, *assuming that they understand the incandescent lighting business.*

QUERY. Why do the Thomson-Houston Company mention in their advertisement the length of life of their lamps as if it were an evidence of Superiority? Is it because they are unable to make "good" lamps of high efficiency; because they are presuming upon the ignorance of their customers; or because the *individual* who wrote the advertisement did not know any better?

THE SUNBEAM INCANDESCENT LAMP CO., 805 Chamber of Commerce Bldg., CHICAGO.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

Something Entirely New. NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED. Simple, Efficient, Economical.

Indorsed by the Electrical Press, and Prominent Electrical Engineers and Electricians. For Particulars and Prices write to

THE RIES ELECTRIC SPECIALTY COMPANY, PATENTEES AND SOLE MANUFACTURERS

Baltimore and Eutaw Sts., BALTIMORE, MD. REGULATING SOCKETS.

BEST MAST ARM IN USE.

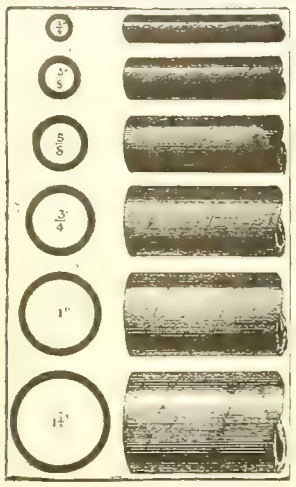
More Lamps Trimmed. No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRON TOWER CO., FORT WAYNE, IND.

SEND FOR New American Electrical Directory, just published; very complete lists. Invaluable for its information of Lighting and Railway Plants.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 226 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

16 C. P. Less than 100 lots, 55 Cents.
" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires, Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and are [illegible] and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

[illegible] remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

WESTINGHOUSE ELECTRIC & MFG. CO.,

PITTSBURG, PA., U. S. A.

Makers of Electric Light and Power Apparatus for all Purposes.

PIONEERS OF THE ALTERNATING SYSTEM.

OUR **CONVERTERS** COMBINE { Absolute Safety, Highest Efficiency, Perfect Regulation, Low Prices.

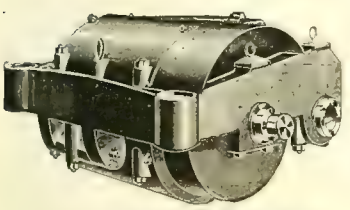
OUR **METERS** ARE { SIMPLE, ACCURATE, RELIABLE, DURABLE.

OVER 700,000 16 C. P. LIGHTS CAPACITY OF METERS IN USE.

The Westinghouse Meter is the only A. C. Meter which has been adopted as standard by the London (England) Board of Trade.

Synchronous System for the Long Distance Transmission of Power in large units claims the attention of every one having available Water Power within twenty-five miles of a market.

RAILWAY DEPARTMENT.



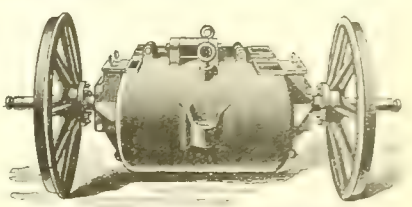
SINGLE REDUCTION MOTOR.

YES, We manufacture and sell GEARLESS and SINGLE REDUCTION

RAILWAY MOTORS,

MULTIPOLAR AND 2-POLE GENERATORS,

And all Station Appliances for Street Railway Work.



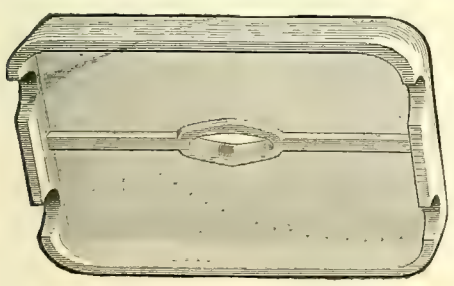
IRON-CLAD GEARLESS MOTOR.

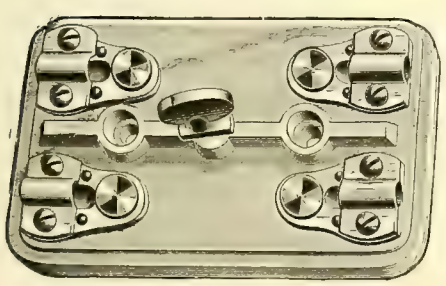
Percentage of increase in roads using our apparatus greater than that of any other company. SEND FOR LATEST CATALOGUE.

Offices in all of the leading cities. **Correspondence Solicited.**

Address.

WESTINGHOUSE ELECTRIC & MFG. CO., PITTSBURG, PA., U. S. A.





CUT-OUTS,

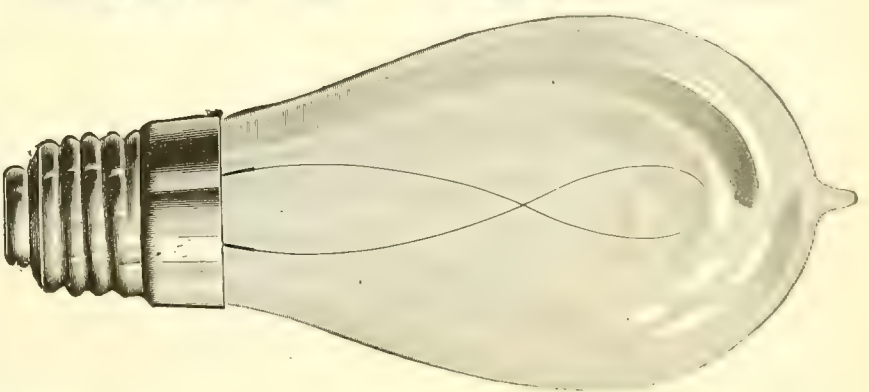
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill 1201 Market St., Philadelphia, Pa.

See our full page advertisement in issue Sept 12 for illustrations, prices, etc

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

KNOW WHAT YOU'RE GETTING!

HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

In a test of the best known "Separators" recently made at Cornell University this ELIMINATOR demonstrated percentages of efficiency over ALL competitors ranging from 11 to 59 per cent. The full report of test with drawings, etc., sent free Address

HINE ELIMINATOR CO.,

106 Liberty Street, NEW YORK.

PLATINUM. JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Wholesale and Retail. Scrap Purchased.

POLES CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

THE ELECTRICAL ENGINEERING CO.,

322 DEARBORN ST., CHICAGO.

Contractors for all kinds of ELECTRICAL WORK.

GENERAL WESTERN AGENTS FOR

The Clark Wire.
The Interior Conduit and Insulation Co. of New York.
The Elektron Manufacturing Co.
Perret Motors.
The Standard Dynamo, Manufactured by the Fairbanks Scale Co.

Gleason & Bailey Mfg. Co.,

(LIMITED.)

GENERAL WESTERN AGENTS FOR THE

STEUBEN INCANDESCENT LAMPS,

The best in the Market,

Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.

Rubber Covered, Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and catalogues.

Royal Electric Co.,

911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURERS OF

Alternating and Continuous Current Dynamos and Motors,

AND ELECTRIC MACHINERY.

THE MOST COMPLETE ALTERNATING SYSTEM NOW ON THE MARKET.

Agents Wanted for Exclusive Territory.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia.

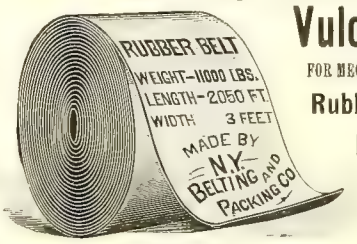
46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

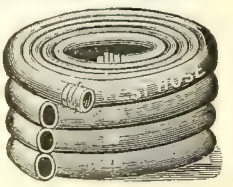
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:
PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 169 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:
SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 16-20 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

FOR INSIDE AND OUTSIDE ELECTRICAL WORK.

Always Pliable! Highest Insulation! Permanently Protecting!

Thoroughly tested and found to be Water, Acid, Alkali and Gas-Proof.

The best and most enduring protection of iron against rust or wood against rot.

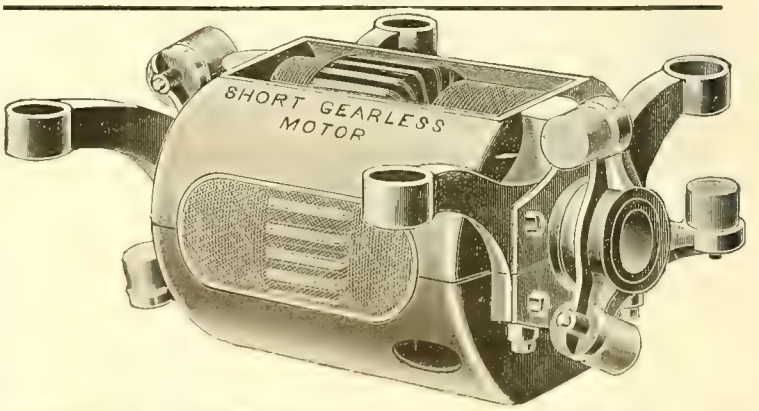
Insulation resistance equal to rubber.

Leaves a black glossy surface.

It dries quickly and covers enormously.

THE ROESSLER & HASSLACHER CHEMICAL CO.,

73 Pine Street, NEW YORK.



—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, OCTOBER 17, 1891. No. 16

Electric Mining Machinery at the Inter-state Industrial Exposition.

Much attention is attracted at the Inter-state Industrial Exposition now open at Chicago by the display of the Thomson-VanDepoele Electric Mining company, which is installed in the northern end of the building. The machinery, which is shown in Fig. 1, is exhibited in operation, and the quantity of work accomplished by the compact appliances invariably excites the wonderment of spectators.

The central piece of apparatus is a large percussion drill operated by a ten horse power generator shown at the left. This drill is mounted over a large block of stone, and, on a recent trial, it bored a hole 1½ inches in diameter through 21 inches of solid granite in exactly 7½ minutes. This statement will seem almost incredible to those who have not seen the machine in operation, but repeated tests have demonstrated that it is no exceptional performance. A machine of this type was illustrated and described in detail in the WESTERN ELECTRICIAN of July 4th. As there indicated, the vibration of the core that moves the drill proper is caused by the attractive and repellant force of three coils or solenoids energized by circuits connected with the revolving brushes of the generator.

The generator is of the latest type of Thomson-Houston manufacture wound for a potential of 220 volts. It is belted to a 12 horse power Duplex high speed engine. This is the rotary type of engine that has recently attracted so much attention. It occupies a remarkably small space and is said to be very efficient. The most interesting feature of the generator is the revolving brush, alluded to above. This device is shown in greater detail in Fig. 2. The manner of its operation was given in Mr. Kirkland's article, already cited.

On the right in the picture is shown a small Gould triplex pump. It is operated by a half horse power Thomson-Houston motor, and it is constantly at work pumping water into a barrel. The capacity of the pump is about ten gallons a minute, and it works evenly and is easily controlled.

In the foreground is shown a solenoid coal cutter, ready for operation, while a three horse power 220 volt motor, with rotating brush attachment, designed for long distance transmission, is also included in the exhibit. A ten horse power portable mining hoist is likewise included in the display, but it was placed in position after the photograph was taken.

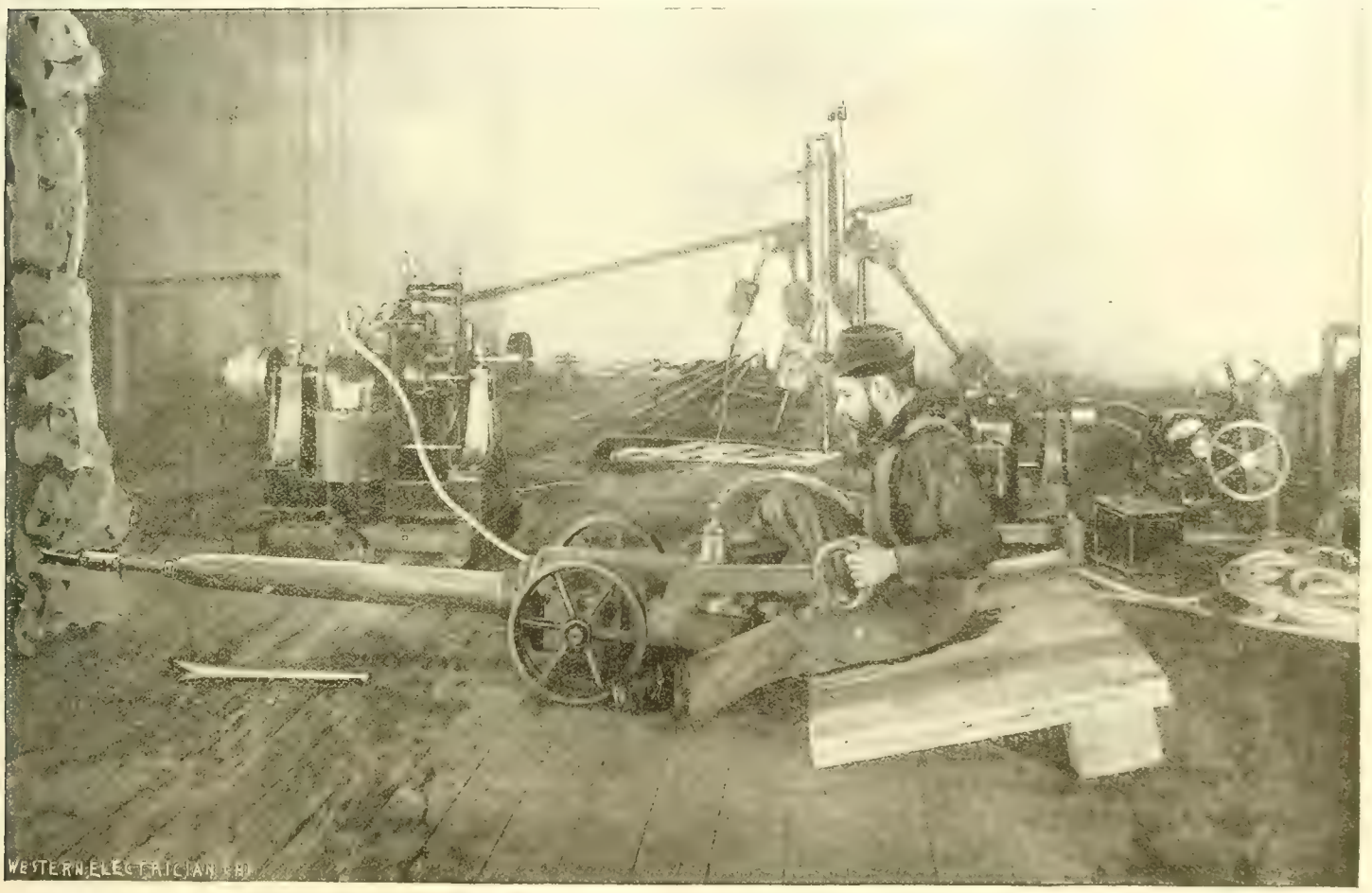


FIG. 1. ELECTRIC MINING MACHINERY AT THE INTER-STATE INDUSTRIAL EXPOSITION.

Beside The Thomson VanDepoele exhibit there is one other display in the exposition in which electricity plays a part. This is in the miniature model of Clarkdale, a Chicago suburban tract which is being boomed by a firm of real estate agents. The model is lighted by about 150 incandescent lamps supplied from a 200-light Thomson Houston dynamo, driven by a Duplex high speed engine of seven horse power. About half of the lights are of 16 candle power capacity, arranged to illuminate the little tract from above. The others are tiny lamps scattered about the miniature grounds representing the street lamps or else dispensing a cheerful glow from the interiors of the pasteboard cottages.

The exposition will remain open until Oct. 24th.

The City Electric Street Railroad company of Little Rock, Ark., is extending its line in the eastern part of the city.

Sawdust as Fuel in an Electric Plant.

A recently organized corporation in Portland, Ore., is the Union Power company, which supplies power by electricity. The plant is in the extreme northern portion of the city, and consists of five Edison generators of a capacity of about 250 horse power each, driven by two engines capable of developing 1,500 horse power. Coal is expensive in Portland, and the company, in looking about for some other fuel as a substitute, decided to adopt a novel arrangement. The great sawmills of the North Pacific Lumber company are adjacent to the plant, and the refuse from the mills will be utilized as fuel for the electric power plant. For this purpose a system of conveyers has been devised. By it the refuse is taken from the saws and conveyed directly to the boilers of the Union Power company without any handling whatever. It is thought that a great saving can be effected by this operation. The company has already arranged to supply power for the operation of two street car lines.

National Electric Light Association.

At the last meeting of the executive committee of the National Electric Light association a very complimentary resolution was unanimously adopted thanking John Carroll, of the Eugene F. Phillips Electrical Works of Montreal, Canada, for his untiring and eminently successful [illegible] in connection with the reception of the association during its convention at Montreal. These resolutions were ordered engrossed and presented to Mr. Carroll. They express the sentiment of all who attended the Montreal meeting.

A telephone company has been established at Walhalla, S. C.

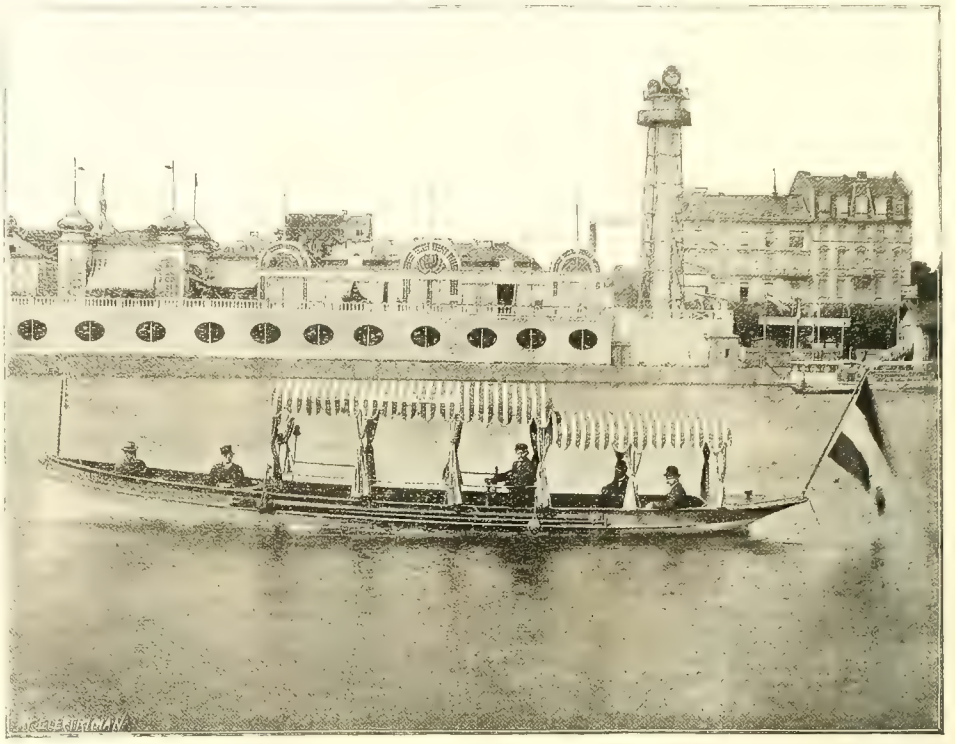
Electric Boat at the Frankfort Exhibition.

Illustrated herewith is an electric boat on the River Main near the Frankfort electrical exhibition, Germany. This little launch was built by Siemens & Halske, Berlin, and is a vertical model of a pleasure boat. The Electra, as the boat is called, is claimed to have a speed of 15 kilometers per hour. It will carry thirty-six persons besides the crew of engineer and pilot. The little vessel is about fourteen feet long and about six and one half feet wide.

The motor is of the Siemens type and will develop eight horse power, making at full speed 800 revolutions per minute. The armature shaft of the motor is coupled directly to the propeller shaft.

Current to drive the boat is obtained from eighty four accumulators. This battery of cells is divided into four sets connected in parallel, with one, two, three or four sets at a time, to vary the speed and power of the motor. The storage cells, as well as the motor, were manufactured by Siemens. The capacity of the battery is such that the boat may be run four to eighteen hours, the time of discharge, of course, being dependent upon the speed demanded. The accumulators are charged from the large machine exhibited by Siemens & Halske in the main machinery hall. The Electra excites general admiration and is usually crowded with passengers.

Another large electric boat, built by Escher, Wyss & Co., and equipped electrically by the Oerlikon company, may also be seen making several trips daily. There is also in service on the Main a small launch built entirely of aluminum.

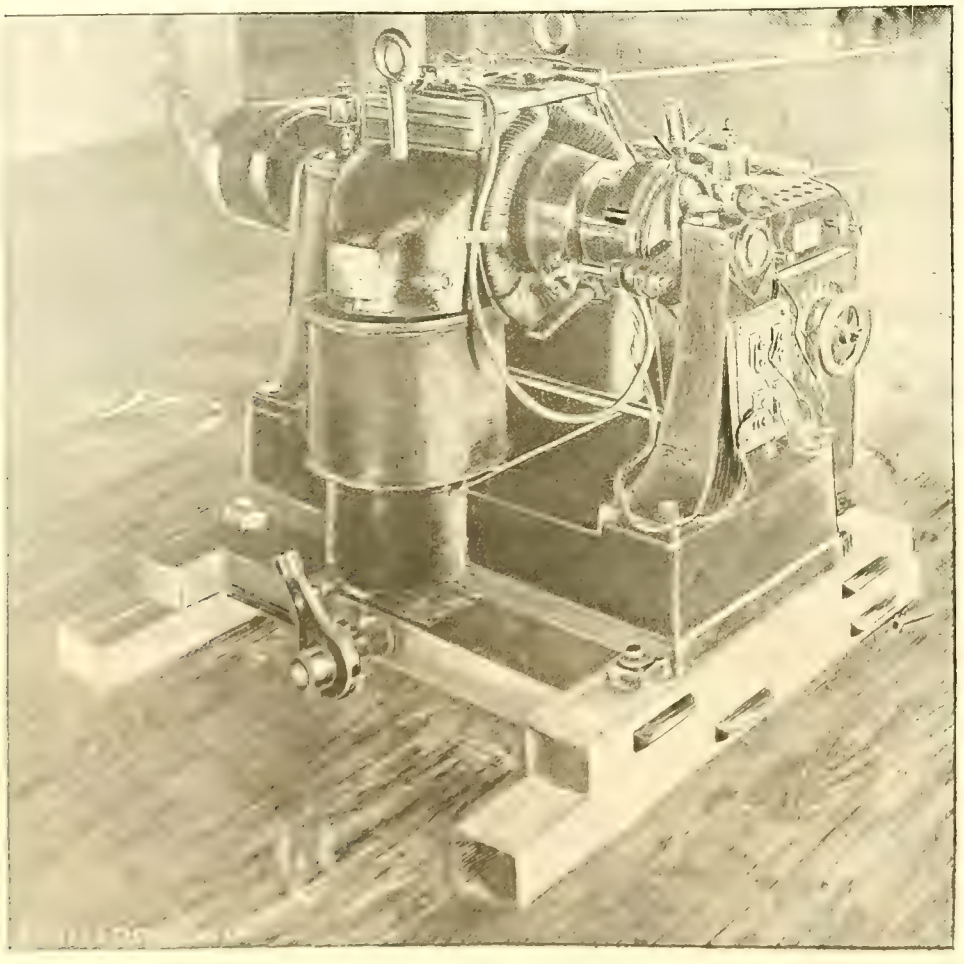


ELECTRIC BOAT AT THE FRANKFORT EXHIBITION.

A Glimpse of an Exhibit by Siemens & Halske at the Frankfort Exhibition.

An interesting feature in the marine department at the Frankfort exhibition is Siemens & Halske's display of torpedoes and the apparatus for locating and discharging them from the shore.

In the foreground of the accompanying view there may be seen one of these torpedoes. The charge of expolsive is inserted by removing the cover at the top. At the bottom is the cable and connections, by means of which the weapon is placed and discharged. On the table are exhibited various other devices employed in electrical torpedo



[illegible] THE INTERNATIONAL ELECTRICAL EXHIBITION.

the position of the torpedoes when in service. It may be mentioned that there is also in this exhibit a dynamo for marine service which has the peculiarity of possessing an iron commutator. This machine has an output of 105 amperes at 100 volts at a speed of 200 revolutions.

The "Minimum Cost" Discussion.

BY IRVING HALE.

The discussion of the minimum cost question by Messrs. Leonard, Sprague, Badt and interested outsiders, has already become somewhat complicated, and the only excuse that the writer can offer for adding to it is the hope that it may be possible to pour oil upon the troubled waters by showing that the differences between the disputants are largely due to their different methods of treating the subject, and that it is not absolutely necessary for either to prove the other entirely wrong in order to establish the correctness of his own position.

The principal points at issue are involved in Mr. Leonard's formulæ and deductions on the one hand, and Mr. Sprague's, as quoted by Mr. Badt in his hand-book, on the other.

To avoid confusion from different notations, both formulæ will be reduced to the following notation:

N = cost (dollars) of plant per kilowatt at motor brushes.
N^1 = " " " " " horse power on motor pulley.
G = " " " generator per kilowatt at its brushes.
G^1 = " " " " " horse power required to drive it.
M = " " " motor per kilowatt at brushes.
M^1 = " " " " " horse power on pulley.
N = number of kilowatts at motor brushes.
N^1 = " " horse power on motor pulley.
r = resistance of one mil-foot of copper (say 10.7 ohms).
w = weight " " " " " (say .000003027 lb.).
k = cost of wire at poles, in cents per lb. of copper.
x = commercial efficiency of motor.
E = " " " generator.
E = electromotive force at generator brushes.
e = " " " motor brushes.
V = volts drop in line.
C = current.

Sprague's discussion deals with minimum cost of total plant including motive power, while Leonard's deals with the electric plant only. To put them on the same basis, we will omit the cost of motive power from Sprague's formulæ, which can be done without affecting the correctness of his results. His formula for cost of plant (changed from cents to dollars) then becomes, with the above notation:

$$N^1 = \frac{E+V}{E \times E} G^1 + \frac{29.84 r D^2 w c}{E\ V\ N} + M^1 + \frac{P}{N^1};$$

or changing from horse power on pulleys to kilowatts at brushes, substituting for r and w their values, and adding 3 per cent. to conductor for "sag, etc.," it becomes

$$N = \frac{E+V}{E} G + \frac{D^2 K}{750 c v} + M + \frac{P}{N} \qquad \text{(Eq. 1)}$$

The first term represents cost of generator per kilowatt at motor brushes, and the second term cost of conductors per kilowatt at motor brushes, and these are identical with Leonard's expressions for the same quantities (changing notation to agree with above), viz.:

$$\frac{G E}{E - V} + \frac{D^2 K}{750\ V (E - V)} \qquad \text{(Eq. 2)},$$

$E - V$ being used instead of its equivalent e, and E instead of its equivalent $E + V$.

From this point they proceed in the same manner to apply the method for determining the minimum value of the functions, regarding V as the variable; but as V enters Sprague's formula only in the first power, while it enters Leonard's both in the first and second powers (owing to use of $E - V$ for e) their differential equations are very different, and the resulting values of V corresponding to the minimum value of the function are differ

ent, and consequently their conclusions drawn from these values do not agree.

As they start from exactly the same premises, and as the mathematical operations are both correct, this seems paradoxical, but it is really not so, for the reason that their methods of treatment cause the function to vary under entirely different laws, and therefore affect the conditions giving minimum value.

Both assume, in any particular case, the power at motor brushes (or pulley) to be constant, and vary the output of the dynamo to offset variation in line loss. But here the similarity ends. Sprague assumes e (at motor) constant; C is therefore constant to maintain the same power at the motor, and hence the resistance of line will vary in the same ratio as V (volts' loss in line), and the size of wire inversely as V, E (at dynamo) varying to correspond with V. Leonard, on the other hand, assumes E constant; therefore as V increases, e will decrease, and in order to keep the motor power constant, C must increase; consequently K of line cannot increase as fast as V, for if it did $\frac{V}{K}=C$ would be constant. If we calculate loss in volts by percentage, the difference in the two cases is still greater, because in Sprague's method the percentage is calculated on an increasing voltage, while in the other case it is on a constant voltage. In both cases the output of the dynamo is the same for the same percentage of loss of energy in the line; but Sprague increases the dynamo output by raising its voltage, while Leonard increases its current.

We, therefore, have the cost of the dynamo increasing alike in the two methods, while the cost of line increases differently; the point of minimum total cost will therefore differ in the two cases. This can perhaps be made clearer by an example.

Assume kilowatts at motor brushes = 100, $e=450$, $E=500$, $V=50=10$ per cent. loss, $C=\frac{100000}{450}=222.2$, C (dynamo output) = 111.1 kilowatts $K=\frac{50}{222.2}=.225$.

Now increase the loss of energy to 20 per cent.

By Sprague's method e is still 450; $E=\frac{450}{.80}=562.5$, $V=112.5$, $C=222.2$ as before, E $C=125$ kilowatts, $K=\frac{112.5}{222.2}=.507$, increased in the same proportion as V, and faster than the percentage of loss. By Leonard's method, if we increase the loss to 20 per cent., E is still 500, $e=400$, $V=100$, $C=250$, E $C=125$ kilowatts, $K=\frac{100}{250}=.4$, or only 1.8 times the previous value, so that the cost of wire is more than half the previous cost, whereas by Sprague's method it is less than half. Forty per cent. loss shows a still more striking difference, the size of wire in Sprague's method being only one-sixth the size for 10 per cent. loss, while with the other method it is more than one-third.

Now taking the equations showing the value of V for minimum cost of plant, we find the value deduced from Sprague's formula, modified to correspond with equation 1, to be $V=D\sqrt{\frac{K'}{750\,G}}$, or making $K'=24$ and $G=50$, $V=.025\,D$ (Eq. 3); or, dealing with percentage of loss in volts $V=100\frac{e}{e+V}\sqrt{\frac{K'}{750\,G}}=100\frac{.025\,D}{e+.025\,D}$ (Eq. 3a). These equations show that the loss in volts corresponding to minimum cost depends only on distance (and the values of constants K' and G), but that the percentage of loss depends also on the electro-motive force used. From Leonard's equations we obtain the condition of minimum cost to be $D^2=\frac{750\,G\,E\,V}{K'\,I-2\,I^2}$ (Eq. 4), from which results a rather complicated value of V, which is evidently a function of both D and E (and the constants), and as E is constant, P must vary directly with V, and hence must also depend on D, E and the constants.

To sum up these results the percentage of loss in volts is in either case a function of both distance and voltage, but the two functions are very different. The loss in volts by Sprague's method is proportional to D, and increases indefinitely with it, while according to Leonard's, V can never equal or exceed $\frac{E}{2}$, for $V=\frac{E}{2}$ makes D infinity, and a larger value of V makes D imaginary. The reason for this latter fact is plain, aside from the mathematics, for after V passes $\frac{E}{2}$, it does not increase as fast as C increases to keep power at the motor brushes constant; consequently K actually decreases, and the size of wire increases at the same time that dynamo capacity increases, so that the total cost of plant continually rises and can never reach a minimum, the minimum point has been already passed.

For example $E=1,000$, $I=500$, $e=800$, C (for 100 kilowatts) $=200$, $K=\frac{500}{200}=2.5$. Increase I to 600, $e=400$, $C=250$, $K=\frac{600}{250}=2.4$, $V=\frac{2.5-2.4}{2.5}=.04$, increased in the same proportion as I, and faster than the percentage of loss. By Leonard's method, if we increase the loss to 20 per cent., E is still 500, $e=400$, $I=600$, $C=250$, E $C=125$ kilowatts, $K=\frac{600}{250}=2.4$, or only .96 times the previous value, so that the cost of wire is more than half the previous cost, whereas by Sprague's method it is less than half. Forty per cent. loss shows a still more striking difference, the size of wire in Sprague's method being only one-sixth the size for 10 per cent. loss, while with the other method it is more than one-third.

Now taking the equations showing the value of V for minimum cost of plant, we find the value deduced from Sprague's formula, modified to correspond with equation 1, to be $V=D\sqrt{\frac{K'}{750\,G}}$, or making $K'=24$ and $G=50$, $V=.025\,D$ (Eq. 3); or, dealing with percentage of loss in volts $V=100\frac{e}{e+V}\sqrt{\frac{K'}{750\,G}}=100\frac{.025\,D}{e+.025\,D}$ (Eq. 3a). These equations show that the loss in volts corresponding to minimum cost depends only on distance (and the values of constants K' and G), but that the percentage of loss depends also on the electro-motive force used. From Leonard's equations we obtain the condition of minimum cost to be $D^2=\frac{750\,G\,E\,V}{K'\,I-2\,I^2}$ (Eq. 4), from which results a rather complicated value of V, which is evidently a function of both D and E (and the constants), and as E is constant, P must vary directly with V, and hence must also depend on D, E and the constants.

To sum up these results the percentage of loss in volts is in either case a function of both distance and voltage, but

GLIMPSE OF SIEMENS & HALSKE'S MARINE EXHIBIT AT THE FRANKFORT EXHIBITION.

larger.

[illegible] a common sense standpoint, and it is undoubtedly correct from a mathematical standpoint. Of course this may give a value of [illegible] will give minimum cost of plant. If, for instance, $E=500$ and $D=$[illegible] will give minimum cost of plant can be readily tested by figuring cost of plant with 1,900 volts and 2,100 volts loss respectively; but a plant could not be operated with any such percentage of loss on account of the enormous variation in voltage at motor under varying load, and for other practical reasons. This is simply one of the cases where minimum cost of plant must be sacrificed for more important considerations.

The following question may, however, present itself: "If, with [illegible] and $D=$[illegible], Leonard's formula requires, for minimum cost, a drop of 414 volts, making $e=586$ volts, should it not be conversely turn that with e assumed as 586 volts, and [illegible], Sprague's formula should require, for minimum cost, the same drop of 414 volts, making $E=1,000$ volts?"

This is plausible, but not correct. Because, with a fixed E, we soon reach a drop in the line beyond which the saving in copper by increased drop does not offset increased cost of generator (owing to the fact, as previously pointed out, that the size of wire decreases more and more slowly as V increases, and finally actually increases with V), it does not follow that if we stop and reverse the process, keeping e constant at the value deduced by first method (586 volts in the assumed case), we can make no further saving in cost by increasing [illegible] (and thereby the initial voltage), for the size of wire now decreases as fast as V increases. Equation 3 shows that [illegible] making $E=1,586$ in the assumed case) gives minimum cost, and this can be verified by actual test.

As equations 3, 3a and 4 show relation between V (or P), D and E corresponding to minimum cost, in might be (and has been) concluded that either two can be assumed and the other deduced, and that we can thus obtain a value of D or of E that will give minimum cost. This is an evident absurdity, for the reason that a smaller distance, or a higher E, other conditions remaining the same, will plainly give a still lower cost. [illegible] by our mathematics. Equations 1 and 2 were differentiated regarding [illegible] as the variable and [illegible] as constants, hence the resulting equations show conditions of minimum cost only when V is the variable and the others assumed. [illegible] should have been differentiated with either of those quantities as the variable. [illegible] process gives with E as the variable, an equation in which these quantities do not appear, showing that no value of E [illegible] corresponds to a minimum, while with D as a variable, we get the condition $D=0$, which is the condition of minimum cost when

ever E (or e) and V may be. These results agree with the conclusions drawn from general reasoning.

What we do get by assuming E or V and deducing P or [illegible] in equations 3, 3 [illegible] and 4, is that particular E (or e) for which the assumed loss in line will give minimum cost at the assumed D. For instance, if we assume in equation 3 [illegible] 10,000 and P=20 we deduce E=1,000. If we reverse the process, assuming that D=10,000 and E=1,000, we deduce P=20 as the line loss that will give minimum cost, while for e=900, P must be 21.7, and for e=1,100, P must be 18.5; in short, there is only one value of e, viz., 1,000, for which the line loss corresponding to minimum cost is just 20 per cent. This value of e has no particular significance, however, for the reason that a higher e will give still smaller cost at the same percentage of loss, although with this new e, a minimum cost would be obtained by using a smaller percentage of loss. (See the examples just given.) If, therefore, we are so arbitrary as to assume that we must have a certain percentage of loss, and no other loss, even though it be smaller, will satisfy us, then it simply remains to use as high a voltage as is practicable under the existing conditions.

Similarly, if the voltage and loss are assumed, there is one particular distance for which the assumed loss will give lower cost than any other loss, but no one, even if he has been deprived of the benefits of an electrical education, would be foolish enough to locate his generating plant at that point if he could get power nearer.

Mr. Badt (example 2) assumes the distance and loss and deduces the voltage, and in example 3 assumes voltage and loss and deduces distance; while Mr. Leonard, in his paper read before the Association of Mining Engineers of Quebec, states, "You will also notice that the formulæ

ling conclusion," with similar statements and examples by Mr. Badt.

b. "With any fixed couple and commercial efficiency, the cost of the wire should bear a definite and fixed ratio to the cost of generating plant."

c. "For minimum initial cost of plant, and assuming certain prices per horse power of motors, generators, and power plants (all erected and ready for operation), and assuming a certain price per lb. of copper (delivered at the poles), the total cost of plant, excluding line construction, is a constant for a certain efficiency of the electric system, no matter what the electromotive force of the motor and the distance may be." (Quoted by Mr. Badt.)

Statement *a*, as we have seen before, is correct when the electromotive force of motor is fixed and the variation made in electromotive force of generator, which is Sprague's method of treating the problem. It must be remembered, however, in this connection, that while loss in volts depends only on distance, percentage of loss will depend also on voltage used. Mr. Leonard evidently misunderstands Mr. Sprague's meaning, as he speaks in his criticism of "same efficiency of apparatus, that is 30 per cent. loss in conductors," whereas Mr. Sprague refers only to efficiencies of motor and dynamo, which enter his equation as constants; he also quotes Sprague later as claiming that "minimum cost of plant is a function of distance alone, and is independent of the electromotive force used at motor," whereas Sprague says that "volts fall to get minimum cost, etc."—a very different statement. As interpreted by Mr. Leonard, Mr. Sprague's statement is certainly absurd, but as actually stated and intended, it is correct.

Statements *b* and *c* are liable to misinterpretation if considered by themselves, and without any explanatory

ELECTRIC HOIST AT THE BLACK DIAMOND MINE.

show that for any given percentage of loss, the electrical pressure to be employed will vary as the distance. Thus for 20 per cent. loss the cost of copper being $11.20 per horse power delivered at motor brushes, the electromotive force necessary for transmission of 16,000 feet will be 1,500 volts; for 32,000 feet we should use 3,000 volts, and at 8,000 feet, 750 volts," and in his paper published in the WESTERN ELECTRICIAN of Sept. 5th, says, "Thus for any initial voltage and percentage of loss we can determine the cost of conductor and the distance of transmission which [illegible] cost of plant."

Still, with the exception of Mr. Leonard's last statement [illegible] that there is a volt [illegible] minimum cost of plant, [illegible] Leonard's statement [illegible] Mr. Badt [illegible] voltage can be [illegible] doubtless [illegible]

conditions, but when taken in connection with the mathematical deductions from which they result, and interpreted as they were evidently intended, they are all right. They are deduced from equations obtained by substituting in the expression for cost of plant, the value of V corresponding to minimum total cost, and making certain additional transformations. The resulting equations are therefore true, only when all conditions for minimum cost are satisfied. Mr. Sprague probably considered a statement of this fact unnecessary, as the conclusion follows directly after his mathematical work, but it might have guarded against a misunderstanding of B and C, especially when standing alone, to have added the provisional clause: "Provided that particular electromotive force of motor is used which, with the volts drop corresponding to minimum cost at the assumed distance, will give the assumed commercial efficiency; which requires, for a given commercial efficiency, the electromotive force of motor to vary directly with the distance." This corresponds perfectly with the well-known fact that if voltage is increased as fast as the distance, the total weight of copper for a given commercial efficiency remains unchanged, and in fact the same thing is shown by Mr. Leonard's chart 1. The two are therefore again in perfect accord.

If equations and mathematical deductions are subject to such widely different interpretations by acknowledged electrical authorities, and if local conditions vary so much as to make any fixed formula valueless for direct application [illegible] modification, the question may arise, "What [illegible] mathematical [illegible] amount to any way [illegible] entirely to experi[illegible] There will doubtless be many [illegible] be as great a

mistake and check to progress to discard theory and mathematics in electrical engineering as in bridge designing, planning of masonry dams, or any other engineering operations, and the chances are that he who relies entirely upon his "common sense" and rule of thumb, will make more serious mistakes than the man who relies too implicitly on theory, although the best results will of course be obtained by an intelligent combination of the two.

The mathematical discussions under consideration are correct, and can lead to nothing but correct results if

FIG. 2. THE LAUFFEN-FRANKFORT TRANSMISSION.

properly understood and interpreted. They contain numerous constants, the values of which will depend on local conditions, such as freights, price of labor, difficulty of the work, cost of developing motor power, etc. The electrical engineer in charge of a transmission of power enterprise, should, after deducing his general equations, substitute in them the local values of the constants and deduce the conditions that will give highest general economy of plant. If the percentage of loss in line required to fulfill this condition theoretically is so high as to give too much variation in voltage at motor brushes under varying load and cause difficulties in the practical operation of the plant, he must cut down the line loss to a practicable amount, even at the expense of minimum cost of plant or theoretical maximum economy of operation. If the size of generator theoretically required happens to be a little larger than the nearest standard size made by the company supplying the machinery, it will be better to decrease the line loss enough to enable this standard size to be used, as the additional cost of copper will probably not be as serious a matter as the expense and delay of getting out a special size of machine. If the amount of water power obtainable is limited, or if additional power can be obtained only at great expense, and if more power can be utilized at the motor than would be obtained with the line loss dictated by theory, he should compute how much additional copper can be put up and have the value of the increased power thus obtained pay proper interest and depreciation on the cost of the added copper. In short, he must consider every detail of the subject in the light of actual local conditions. There can be no doubt that the company whose engineer thus combines theoretical and practical considerations in a consciencious and thorough study of the problem will enjoy larger dividends than the company whose plant is put in by a man who guesses that fifteen or twenty per cent. loss in line is "about right," and who decides all other points connected with the installation by the same "common sense" method.

Electric Hoist at the Black Diamond Mine.

The electrical hoisting equipment shown in the accompanying illustration is installed in the Black Diamond mine in the state of Washington, where it is operating to the entire satisfaction of the owners of the mine, having been in use since April. The dynamo generating the current to

FIG. 1. THE LAUFFEN-FRANKFORT TRANSMISSION.

operate the motor connected with the hoist is located near the mouth of the mine, while the hoisting mechanism itself, shown in the cut, is 3,100 feet away, at the head of a slope in the mine. This slope is now 500 feet deep, and coal is

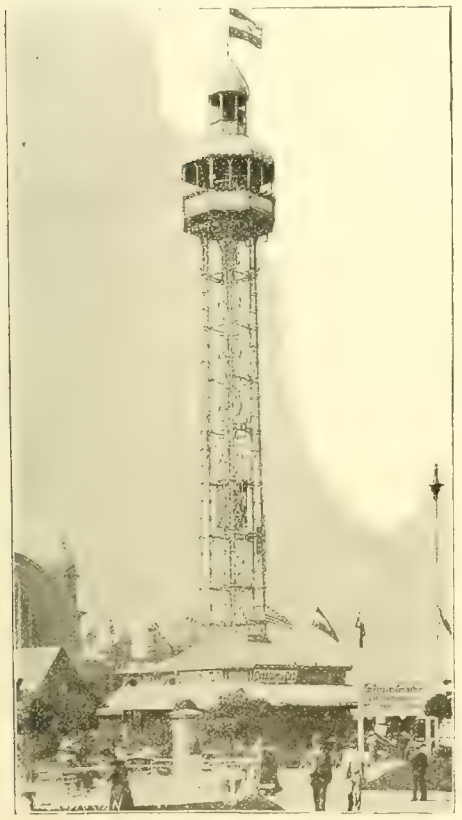
hoisted from the 450-foot station, but sinking is going on to make it 900 feet, where another station will be located.

The stopping, starting and reversing movements of the hoist are effected by the movement of the one vertical lever. But three horse power is needed to operate the entire mechanism. This amount is far less than would be used to transmit the power necessary from the surface to the slope by any other means. The Electrical Engineering company of San Francisco installed the plant.

The Iron Tower at Frankfort.

In the accompanying cut is shown an illustration of the iron tower at the Frankfort electrical exhibition. This structure while not occupying the same importance in the Frankfort exhibition that the Eiffel tower did at Paris is still a very attractive feature, and thousands of visitors are carried every day to the top, which commands a fine view of the city. In the evening when the electric lights are turned on, the tower is a magnificent sight. It is covered with thousands of incandescent lamps, and rises like a pillar of light. In the dome of the tower there is a powerful electric search light and reflector, which is turned on the different parts of the city, making a wonderful effect. There are many attractive features about this tower for the general public, but there are many more from an engineering point of view.

The tower is entirely of wrought iron, and has a height



IRON TOWER AT FRANKFORT.

of 139 feet 9 inches. It consists of four principal columns, which form a square of 5 feet 2 inches. This space is utilized for the elevator car. The structure at the bottom is 13 feet 1 inch square, and at the top 7 feet 10 inches square. Hollow columns serve for the cables which pass from the machine room to the top of the tower and down to the car, where they are attached on the regular Otis system.

The electrical elevator is undoubtedly one of the most interesting features of the exhibition. It is designed to carry eight or ten persons, and is operated at a speed of 240 feet per minute, starting and stopping without jar, and running superior to the ordinary hydraulic elevators in use. The machine was recently inspected by the German authorities, and they approved it, appearing highly pleased with it.

Thomson Scientific Club.

The Thomson Scientific club of Lynn, Mass., has opened its season with a lecture by J. J. Berger, on the "Hoosac Tunnel." A series of six public lectures will be given under the auspices of the club during the season, and a limited number of tickets will be issued. The club is completing arrangements for these lectures, and is now in correspondence with several prominent electrical engineers who will probably appear. The organization is in a prosperous condition, and at present has 150 members.

The Lauffen-Frankfort Transmission.

Details of construction of the Lauffen-Frankfort transmission plant are presented in a recent issue of the London *Electrical Engineer*, from which the accompanying cuts are reproduced. The winding of the armature is illustrated in the accompanying diagrams. There are three distinct windings upon the armature, represented diagrammatically in Fig. 1. The shaded rectangles represent the poles, those, say, at the right-hand side being alternately *S* and *N*. The three circuits are represented by differently formed lines. The method of joining the three wires is shown in Fig. 2, where three ends are joined, while the other ends are open, to be connected with the transformers or with the line. The three circuits are shown as being at 120 degrees from the other.

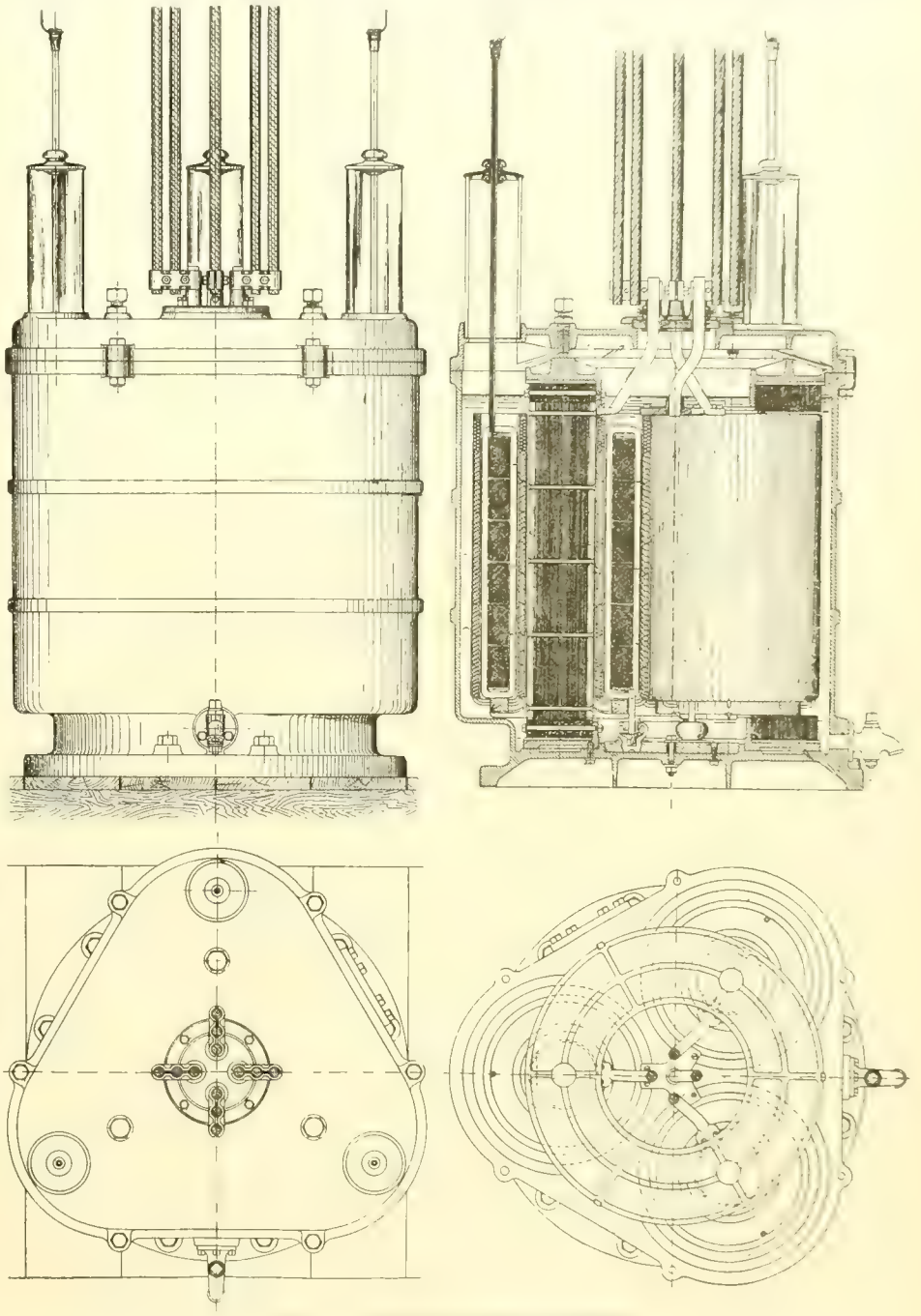


FIG. 3. LAUFFEN FRANKFORT TRANSMISSION.

In Fig. 3 is an illustration of the large high pressure transformers employed in the Lauffen-Frankfort experiments.

The magnetic circuit is composed of three laminated iron columns of circular section, whose ends are connected by two flat laminated rings similar to a Brush armature core. Over each column are slipped the high and low tension coils. As shown in the cut, the high tension coil is boxed between the low tension one. This disposition reduces the inductive drop, and simplifies the way of making the low tension connections.

The transformer was designed to have an output of 200 kilowatts, working with a normal pressure of thirteen to fifteen thousand volts. To insure a very good insulation, the transformer is completely plunged in oil, but without this precaution the insulation is so good that the

Projected Ocean Cables.

These are the days of [illegible] telegraphic communication with the countries on the east coast of South America is the property of a French company, and has entered into active rivalry with the two circuitous lines by which that coast has heretofore been reached. An important submarine cable soon to be laid is that between Pernambuco, in Brazil, and Senegal, in Africa. It is a British company that is the promoter of this project, and recent advices give assurance that, unless there be some unexpected obstruction, the line will be in operation within the next half year. Two cables are projected across the Pacific for telegraphic communication between the American continent and various lands and islands of the Pacific. Last spring a British naval expedition was engaged in the business of making a bed for the cable which, running northward from Australia [illegible] is to have its American terminus at Vancouver, in British Columbia. This project is of importance to the British Government, as it offers a line of communication between London and the British possessions in Asia [illegible] tion with the Canadian wires and the Vancouver [illegible]

The American project [illegible] between San Francisco and Honolulu [illegible] ment at the last session of Congress [illegible] $25,000 was appropriated for the preliminary surveys. The steamer Yorktown was [illegible] It is understood that the British surveying expedition will report the existence of a satisfactory route for the British cable in the Pacific, and there need be no doubt that the [illegible] to Honolulu.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, Editor and Publisher.
J. B. O'HARA, F. L. PERRY, W. E. KEILY, Associate Editors.
J. L. BAKER, Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers. In clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.
Electric Mining Machinery at the Inter-state Industrial Exposition. Illustrated 227, 228
Satisfaction [illegible] an Electric Plant 227
National Electric Light Association 227
An Electric Boat at the Frankfort Exhibition. Illustrated 228
A Glimpse at an Exhibit by Siemens & Halske at the Frankfort Exhibition. Illustrated 228, 229
The "Minimum Cost" Discussion, by Irving Hall 228, 229, 230
Electric Hoist at the Black Diamond Mine. Illustrated 230
The Lauffen-Frankfort Transmission. Illustrated 230, 231
The Iron Tower at Frankfort. Illustrated 231
[illegible] 231
[illegible] Cables 231
[illegible] 232
[illegible] table 232
[illegible] 233
The International Congress of Electricians, by Henry S. Carhart 233
[illegible] 233
[illegible] Illustrated 234
[illegible] the Works 234
Chicago [illegible] the Electrical Congress [illegible] 234
[illegible] Illustrated 234
[illegible] 234
[illegible] Illustrated 234
The [illegible] Electrical Congress 234
[illegible] Illustrated 235
[illegible] 235
An [illegible] 235
[illegible] 235
[illegible] 235
[illegible] by Peter [illegible] 237

DEPARTMENTS.

[illegible]

[illegible] are considering ordi[illegible] the regulation of electric wiring [illegible] high grade of construction [illegible] of all who have the [illegible]

[illegible]

among the directors that such enterprises should not be encouraged. There is enough originality in Americans to devise a sufficient number of attractions without copying the ideas of foreigners. It would hardly be expected, moreover, that that a tower at the Chicago Fair would prove such an attraction as at the Paris and Frankfort expositions. Those who desire to get a view of Chicago and the surrounding country will have plenty of opportunities to do so in '93 from the mammoth sky-scrapers, for which the World's Fair city is becoming noted.

WHILE the city of Vancouver, Wash., is endeavoring to sell its electric plant to private individuals, its namesake across the border, in British Columbia, is reported as contemplating the purchase of an electric railway equipment. The Canadian town authorities will prove themselves wise in their day and generation if they avail themselves of the experience of cities that have tried that sort of thing and let the municipal ownership of electric plants severely alone.

VALUABLE statistics on public lighting in Eastern Europe have been gathered by the French government through its consuls in the principal cities of that section. It appears that these cities have practically no electric lights, and in many instances gas lamps are unknown. Thus, for instance, at Adrianople no gas is manufactured, and an attempt which was lately made to illuminate the city with electric light was a complete failure. The only material used is petroleum, which is imported from the Russian establishments at Batoum. The advantages of good illumination are not appreciated there. Cheapness is said to be the essential feature of the lamps used in Constantinople. Petroleum is used throughout the city, electricity being used only in the palace of Yildiz. In Greece the advancement to the use of gas in Athens and Corfu is noted. There was once a proposal that Syra should be lighted with the electric light, but the poverty of the municipality and political reasons combined to prevent it. The port of Odessa is brilliantly illuminated by electricity, the new installation proving a great boon as steamers can be loaded and unloaded at night.

The information gained by the French government illustrates the condition of the countries referred to. They are equally far behind their western neighbors in other departments.

AN interesting electric railway project is reported from San Francisco, Cal. Electricity is to be substituted for steam on the suburban trains of the Southern Pacific railroad running through Oakland and the near-by suburbs of the Pacific coast metropolis. It does not appear, however, that the company is actuated by the proper motive—better service at a more economical cost of operation—in making the change. There is a curious clause in its charter by which passengers are allowed to ride free within the corporate limits of Oakland, and it is to do away with this, to the company, distastful provision, that the franchise for a steam railroad is to be abandoned and electricity substituted. The new system will be characterized by some unusual features. It will be operated precisely on the plan of a steam suburban railroad, except that the power will be transmitted to the motors by electricity. Trains will be run instead of single cars, and stops will only be made at stations six or ten blocks apart. The speed will be from fifteen to twenty miles an hour, and the train units will be operated, probably, at a headway of five minutes. There will be, beside, "through locals" that will stop only at one or two stations on the line.

The project is one of great interest to all advocates of electric traction, and its development will be eagerly awaited. It is not to be doubted that the venture will be successful, and add another to the long list of triumphs for the modern method of passenger transportation in cities and their suburbs.

PROF. HENRY S. CARHART, in a paper on the "International Congress of Electricians" in this issue, calls attention to the fact that the proposed gathering should be held under the auspices of the exposition, and should be connected officially with the fair. Prof. Carhart takes a lively interest in the plans for the proposed congress, and in view of the erroneous statements circulated has deemed it necessary to place the matter in the right light before the public. It is needless to say that the plan referred to in this article is the one already decided upon by Prof. Gray. The conclusion which Prof. Carhart reaches will be received with approval by every one interested in electrical matters. He says: "[illegible] the movement for an International Congress of Electricians has now been inaugurated by the properly constituted authorities, and under auspices recog[illegible] the World's Fair [illegible], and by the United States government, it is intended that plans shall be rapidly matured, and that nothing practicable shall be left undone to secure co-operation, both at home and abroad. The only electrical congress of great importance thus far held was at Paris in 1881. Its decisions have been universally accepted, and its influence on the progress of the science of electricity has been plainly apparent ever since. If this supreme opportunity, presented by the World's Fair in 1893, can be rightly laid hold of the gathering of electricians in congress at that time may prove no less prolific in results than the one at Paris ten years ago."

MR. HORNSBY writes from Frankfort that the time for closing the international electrical exhibition in that city was postponed two weeks. This will undoubtedly prove fortunate for the interests of the World's Columbian Exposition, as it will enable the secretary of the department of electricity to see nearly, if not all, of the exhibitors at the German exposition before the bustle of removal. No doubt many of these gentlemen can be induced to make displays at Chicago if the matter is presented in the proper light. The representative of the electrical department of the World's Fair now in Europe can be relied upon to leave no stone unturned to secure this desirable result.

IT was demonstrated in Chicago last week that the present street railway facilities are totally inadequate to handle large crowds. The unveiling of the Grant monument at Lincoln park on Wednesday afternoon attracted an immense throng of visitors from out of town, and most of them were obliged to walk to the park. The cable service of the North side showed how thoroughly inefficient it was and the visitors were not favorably impressed with the system.

It is evident that a departure from the present system of operating street cars in Chicago will be required before 1893. The World's Fair officials are aware that a change will be required and they are endeavoring to provide sufficient accommodations for the occasion. Last week President Baker called a meeting of the heads of the railway companies, and suggested that the cable system on the South side be changed and that an extension operated by electricity be made. The managers of the cable system acknowledged that it would be out of the question to put in a costly cable plant to meet the requirements of the World's Fair, as it would prove a dead loss after the exposition.

The introduction of an electric system, however, will solve the problem and insure first-class service. President Baker of the World's Fair earnestly advocated the adoption of the electric system, as he believed it alone could furnish first-class service, under existing conditions.

THE plans for the International Congress of Electricians, in connection with the World's Columbian Exposition, will form the subject of a paper and discussion at the Chicago Electric club next Monday evening. Prof. Elisha Gray will read the paper, and in addition to the members of the club and all who are interested in electrical development there will be several World's Fair officials present to represent the board of directors. An address on the subject is expected from Vice-President Bryan, and it is also believed that Secretary Butterworth, who has recently returned from Frankfort, will offer some suggestions that will prove valuable.

Prof. Gray, who will read the paper of the evening, has accepted the position of chairman of the committee to arrange the preliminaries for the congress. He will be assisted by a committee of twenty one and will have entire supervision of the work. An appropriation of $200,000 has been made to defray the expenses of the congress, which will be held under the auspicee of the Fair. These congresses will be important gatherings, that of the electrical department comprising the most eminent electrical engineers of the world. It is Prof. Gray's ambition to have the most eminent scientists of Europe attend the exposition and participate in the proceedings of the congress. For this purpose a representative will visit each country of Europe with the view of interesting the electrical engineers, and the United States government will extend to each foreign power an invitation to appoint a representative who will be authorized to vote in the congress. There are, of course, many important subjects to be discussed, and the congress will be, it is thought, the most representative gathering of electricians of the age.

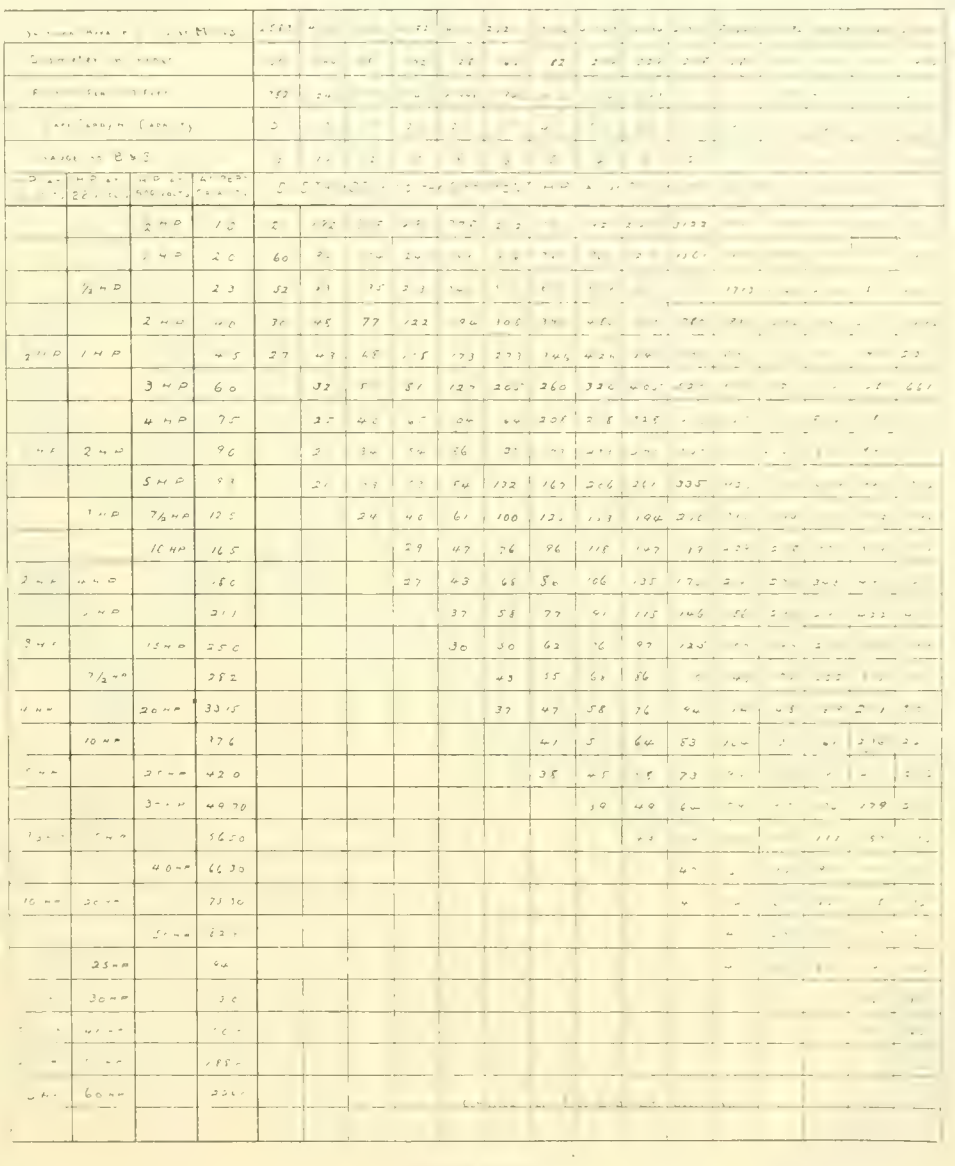
In view of the great interest that will be manifested in this gathering, the Chicago Electric club has arranged for a thorough discussion of the plans of the committee. Prof. Gray's paper will be of general interest to electricians throughout the world.

Motor Wiring.

By Thos. G. Gerr.

In determining the sizes of the wires necessary to transmit a certain amount of horse power, it is necessary to know the pressure at the point of delivery, and the amount of current which will develop the horse power required. Motors of different sizes and designed for different voltages are not of the same efficiency, nor are motors of different types of equal efficiency, even though they may be designed for the same horse power.

In the following table the first three columns show the horse power of the motor to be used; column four gives the ampere capacity required by the motor to develop its rated horse power. The amperes named in this table are a close approximation to actual practice, and so long as the question of efficiency of the motor is a variable one, the most accurate tables must be based upon approximation derived from actual practice. In the other columns of the table is given the distance which the various amounts of power can be transmitted on different sized wires with a loss of one volt. The five lines at the top of the table give information in regard to the wires of different sizes



MOTOR WIRING.

The safe carrying capacity in this table is that which was adopted by the National Electric Light association at Montreal, September 10th. The portions of the vertical columns which are blank indicate that at such a point the size of wire represented in that column is too small to be used, owing to the fact that the amperes required by the motor are beyond the safe carrying capacity of the wire.

To illustrate the use of the table, we will assume certain conditions found in practice in Chicago. The Chicago Edison company allows on its motor service eight volts drop. Let us assume that a motor of 10 horse power is to be placed 320 feet from the service connection. As eight volts can be lost in this total distance, we can lose one volt for each forty feet. By referring to the table it will be seen that a 10 horse power 220 volt motor will lose one volt with No. 5 wire for 41 feet; therefore No. 5 wire will be the size required.

The method used in applying the table is to divide the total distance from the service connection to the motor connection by the number of volts which is to be allowed for loss in the service, and ascertain in what column the figure is found opposite the horse power. The amount nearest that representing this distance will show the size of the wire required. The one great difficulty in motor wiring has been in using wire, the safe carrying capacity of which was less than the power required by the motor. This may easily occur when the distance from the motor to the service connection is short, and the loss consequently small. The loss of 10 volts on the motor service inside of the building should never be exceeded.

Wisconsin Electric Club.

The Wisconsin Electric club celebrated the close of the second year of its existence by a banquet at the Plankinton House, Milwaukee, last week. It was a thoroughly enjoyable affair. A number of guests from out of town were present. W. S. Johnson spoke entertainingly on "Limitations, Electrical and Mechanical;" Don J. Whittemore on the "Electric Branch of Engineering;" Duncan J. Robinson on "The Electrician as an Inventor;" D. C. Jackson, of Madison, on "Underground Electric Conductors for Light and Power Purposes." Remarks were made by F. E. Parker, Dr. J. L. Kaine, E. C. Wall, City Engineer Benzenberg and others. A fine musical program was presented.

Prof. A. J. Rogers, president of the club, made a few remarks in which he referred to the work done by the organization, and complimented the members on the progress they had made. The friends of the club have reason to feel proud of the work it has done.

The International Congress of Electricians.

By Henry S. Carhart.

Several movements have been set on foot with the object of securing the attendance of foreign electricians of note at the International Congress of Electricians to be held in Chicago in 1893. The American Institute of Electrical Engineers extended an invitation to the Paris Congress in 1889, and to the late Frankfort Congress to be present in Chicago a year from next summer; and the National Electric Light Association at its recent meeting in Montreal appointed a committee in the interest of the proposed International Congress of 1893.

The discussion of the subject in the electrical journals discloses the fact that much uncertainty exists relative to the auspices under which this congress is to be held. One report from the Frankfort Congress says that the members in attendance were invited to Chicago in 1893 to take part in a conference to be held under the auspices of the American Institute of Electrical Engineers.

While such auspices would undoubtedly command respect abroad, they would not connect the undertaking officially with the World's Columbian Exposition, nor secure the recognition of the government.

It is well known that the World's Congress Auxiliary is an organization authorized and supported by the exposition corporation. It "has also been recognized and approved by the government of the United States. Its general announcement has been sent to foreign governments by the

This organization will provide places of meeting and other appropriate facilities for various conventions or con-

number of general committees to organize such congresses

of the most distinguished representatives of each department of

or convention. These committees are necessarily resident

co-operation

stitute an advisory council. The advisory councils are invited to aid the local committees by correspondence and by personal conference as opportunity may offer.

The chairmanship of the local commitee on an Electrical Congress

Professor

has signified his acceptance and

Col. Clowry. B. E. Sunny, the chairman of the Montreal committee, is one of the local committee appointed by the World's Congress Auxiliary; so also is the writer.

Since the movement for an International Congress of Electricians has now been inaugurated by the proper, constituted authorities, and under auspices recognized by the World's Fair directory, and by the United States government, it is intended that plans shall be rapidly matured, and that nothing practicable shall be left undone to secure co operation both at home and abroad. The only electrical congress of great importance thus far held was the congress at Paris in 1881. Its decisions have been universally accepted, and its influence on the progress of the science of electricity has been plainly apparent ever since. If this supreme opportunity, presented by the World's Fair in 1893 can be rightly laid hold of, the gathering of electricians in congress at that time may prove no less prolific in results than the one at Paris ten years ago.

Electricity at the World's Fair.

Engineer Keller is preparing a prospectus of the department of electricity, World's Columbian Exposition, which will shortly be issued. The pamphlet will be handsomely illustrated, and contain much information of value to intending exhibitors.

The delay in the work on the electricity building is largely due to the alteration in the plans, in relation to the arch for the roof and the location of the stairways, suggested by Mr. Keller. The changes, however, are not of sufficient magnitude to affect the value of the plans published by the WESTERN ELECTRICIAN on April 25th.

On Monday Prof. Barrett received a letter from Secretary Hornsby, the first communication from that gentleman since he sailed for Europe. The letter was dated at Frankfort on September 28th and was written the evening of the secretary's arrival. Mr. Hornsby said he had

exposition authorities the next day. He added that the time of

weeks. The

the leading electricians at Frankfort.

Facts were

last week

however.

[illegible] Stage Regulators.

[illegible] strated in the accompanying cut. The rate of graduation in this device is not made open; it is continuous from start to finish, there being [illegible] to appreciate the advantage of this feature after experience with one having a discontinuous variation, even when there are numerous [illegible] The [illegible] stage regulator is as compact as consistent with proper temperature allowance, and is fireproof. It is made by the Electrical Supply Company.

[illegible] STAGE REGULATOR

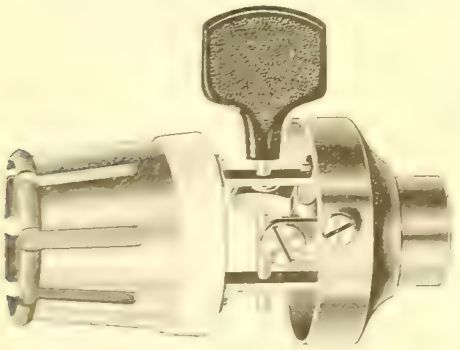
Electricity at the Grant Locomotive Works.

An important contract was signed last week, the Chicago Edison company and the Grant Locomotive Works being the parties to it. When the terms of this document are carried into effect, which will be in a month or so, Chicago will have an electrical plant designed for the needs of a great manufacturing concern which will hardly be inferior to any of its kind in the country.

The Grant Locomotive Works, which recently removed from New Jersey, are establishing a mammoth plant at Twelfth and West Forty-eighth streets, Chicago, and it is intended that electricity shall play an important part in the several shops. Several electrical companies gave estimates on the equipment, but the contract was finally awarded to the Chicago Edison company, which will furnish both the wiring and the generating plant.

There will be two generators, one of 30 horse power capacity and one of 60 horse power. The latter, in addition to its duties in supplying power circuits, will carry 280 incandescent lamps. There will also be one 20 light arc dynamo, and another of 30

The power from the generators will be mainly utilized in operating the great electric cranes that will shift the heavy castings and pieces of machinery, up to complete locomotives, about the shops. There will be a 40 ton crane in the erecting shop, one of ten tons' capacity in the machine shop, a third of 20 tons in the boiler shop, and another of the same size in the foundry. These cranes are



Chicago Electric Club and the Electrical Congress in '93.

The Chicago Electric club will open its season's work next Monday evening, Oct. 19th, when a special meeting will be held to consider the question of preparing for the Electrical Congress to be held in 1893 in connection with the World's Columbian Exposition. It will be remembered that the directors of the World's Fair have appropriated $200,000 to defray the expenses of the scientific and educational congresses to be held under the auspices of the exposition management. The electrical people are particularly interested in this feature of the fair, and already the work of organizing for the event is under way. Prof. Elisha Gray of Highland Park has been appointed chairman of the preliminary committee on arrangements, and he will direct the preparation, and in fact assume the management of the affair. He will appoint a local committee upon which will devolve the greater part of the work of perfecting the local arrangements for the congress and devising plans for the entertainment of visitors.

An advisory committee composed of the most eminent American electricians, will also be named, and the work of interesting electricians at home and abroad, will at once be begun.

At a meeting of the board of managers of the Chicago Electric club Saturday, Oct. 10th, the position which the club should assume in the matter was discussed, and it was decided to invite Prof. Gray to read a paper before the club outlining his views on the subject. The meeting for next Monday evening was consequently arranged. It will essentially be a World's Fair meeting, and the officers of the exposition will no doubt be present. Among those expected to attend will be President Baker, Vice-President Bryan, Secretary Butterworth and Director General Davis. Other officials will also doubtless be present.

The club will take occasion at the meeting to give an informal reception to Col. Clowry, B. E. Sunny, Henry B. Stone, Chief Barrett and Prof. Gray, who are representing the electrical interests of the World's Fair.

At the meeting of the club at which Prof. Gray's paper will be read, there will be a discussion in which the members may avail themselves of the privilege of presenting their views on the subject of the World's Fair, and the Electrical Congress. The representatives of the exposition will be called upon for a statement of the position of the fair officials in relation to the electrical department and the congress. As they have displayed a deep interest in all that has related to the electrical department they will no doubt have many suggestions of interest to offer. The meeting promises to be one of the most interesting in the history of the club, and will no doubt be largely attended. At Saturday's meeting of the board of managers the following committee was appointed to make arrangements for the meeting: Alex. Kempt, chairman; W. B. Pearson, F. W. Cushing, C. H. Wilmerding, F. W. Parker.

New Incandescent Lamp Socket.

In the accompanying cut is shown a new incandescent lamp socket exploited by the Knapp Electrical Works of Chicago. This socket is simple in design, yet it is complete in construction. It has a quick positive make and break, is easily wired, and has a good broad contact. The distance between the terminals of the cord is nearly an inch, thus eliminating all danger of a short circuit.

The insulation material is made of hard vitrified porcelain. The sockets are made to receive either Sawyer-Mann, Thomson Houston or Edison lamps.

Regulations for Electric Wires.

The progress that has been made in electric lighting, power and railway work on the Pacific coast has been so great that many of the more important cities have adopted regulations providing for the wiring of buildings. The general provisions of the local ordinances are similar and are in accordance with the best practice in electric construction. It is provided that concealed wires, carrying less than 250 volts, and intended for lighting or power shall be thoroughly insulated, and the wires of opposite polarity separated at least ten inches. Special provision is made where an interior conduit system is used.

Every detail of electric wiring is provided for, and precautions are taken to guard against accidents from poor outdoor construction. All uninsulated trolley wires, feed [illegible] of electric railways, having ground or earth connections, shall be protected by not less than two well in [illegible] and [illegible] grounded wires, to prevent [illegible] from coming [illegible]

[illegible] This ordinance empowers the city electrician to enforce the [illegible] provisions. [illegible]

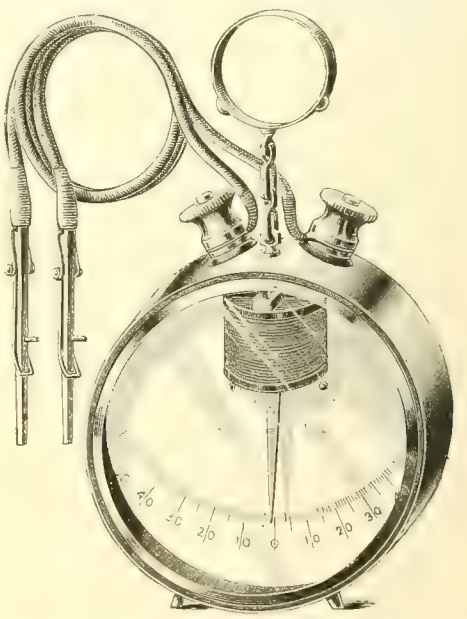
are generally approved by first-class electric construction companies.

Pocket Galvanometer Battery Gauge.

In the accompanying cut is shown a pocket galvanometer constructed and calibrated so as to furnish a reliable standard for practical measurement of current strengths in testing from one to five cells of ordinary batteries, such as the various forms of sal-ammoniac, sulphate of copper and acid batteries. The galvanometer gauge is arranged for use either standing upright on an instrument table or desk or, as when used for miscellaneous testing in battery room, etc., it is held suspended by the chain and ring, in which position the needle hangs at zero the same as it would if the galvanometer were standing on a table.

The galvanometer gauges are especially intended for use as permanent circuit indicators for fire alarms, burglar alarms, district telegraphs, etc., on account of their presenting the face of the instrument in upright position. It is practically a dead beat instrument, a feature usually found only in the most expensive galvanometers.

Two silk covered conducting cords are attached to each gauge, and these cords are provided with a very convenient form of improved tip, which is so made that it can enter any ordinary binding post and be held by the binding screws in the usual way, or, being a square end tip, is suitable for English binding posts, and also having a spring clamp it can be hooked firmly on to bare wire at any exposed point. This form of tip is extremely handy in all experimental temporary work, and by its use with the gauge the condition of any one to five cells in the middle



POCKET GALVANOMETER BATTERY GAUGE

of the series can be instantly ascertained without making breaks and reconnecting. This gauge is manufactured by J. H. Bunnell & Co. of New York.

The Frankfort Electrical Congress.

Silvanus P. Thomson contributes an interesting article to the London *Electrician* on the work of the electrical congress at Frankfort, concluding with the following remarks: "If the congress of 1891 had had no other result than to bring together so many electricians and engineers to discuss, day by day, the progress of their common science, and to learn to esteem and value one another, it would have done a useful service. But it did more than this; it showed how an important scientific experiment can be carried out on a large scale by the co operation of public authorities with private industrial bodies. The Lauffen Frankfort transmission would have been simply impossible but for the enlightened and spirited way in which the German Postal Telegraph Department lent its powerful aid to forward a scheme requiring the assent not only of various local bodies, each exercising local government in the territories traversed by the line, but also of the railway companies and other corporations. The success of this enterprise is a lesson in many ways, not only to the electricians, but to the telegraph departments of other countries."

On the occasion of the visit of the French fleet at Cronstadt a new form of telephone for use under water, invented by Dr. Wrede, a Russian navel surgeon, was exhibited to the visitors. A diver, fitted with the apparatus, descended into the water and held a conversation with the captain of the French frigate Surcouf. Admiral Gervais also held a short conversation with the diver from one of the cabins of the vessel. The admiral heard with great distinctness the words of the diver and also a Russian song which he whistled. He expressed his admiration for the apparatus and followed with great attention the explanation furnished by the inventor.

Data Relating to Water Power.[1]

By [illegible] B. [illegible].

There are numerous natural water powers in the United States running to waste. These water powers may be improved, utilized for electric power transmission, and be made to pay handsomely on the capital invested.

As the improvement of a water power is attended with considerable expense, the amount of power at various seasons should be exactly determined to prevent later disappointments.

The determination of the amount of power is best left to a reliable hydraulic engineer. Any manufacturer of water wheels, however, will send on application complete catalogues giving practical rules and tables for determining the horse power of water powers.

As one cubic foot of water weighs 62.5 lbs., this figure multiplied by the number of cubic feet per minute multiplied by the head in feet, gives the foot pounds; this divided by 33,000 gives the horse power; or expressed in a formula:

$$\text{Horse power} = \frac{62.5 \times \text{cubic feet} \times \text{head}}{33{,}000}.$$

Very often the quantity of water flowing per minute is not expressed in cubic feet but in "miners' inches." A "miner's inch" of water is approximately equal to a supply of 1.5 cubic feet per minute.

Dr. T. O'C. Sloane writes in the *Scientific American*: "For the ampere a peculiarly close analogy is found in a very well-known water measurement unit, namely, the miner's inch. The miner's inch is defined as the quantity of water which will flow through an aperture an inch square in a board two inches thick, under a head of water six inches. Here, as in the case of the ampere, we have no reference to any abstract quantity, such as gallons or

FIG. 2. DATA RELATING TO WATER POWER.

pounds. There is no reference to time. It is simply and purely a rate of flow, exactly what the ampere is conceived to be in electricity.

"In the illustration, Fig. 1, a representation of a tank whence water is flowing through a hole one inch square extending through a two inch plank, and under a head of water six inches, is shown. The perforated plank is shown as horizontal, simplifying the pressure question. Referring to these conditions, we may consider the head of water of six inches as the representative of electrical pressure; in this case representing one volt. The aperture restricting the flow of water may be assumed to represent the resistance of one ohm; the flow through a resistance of one ohm under the pressure of one volt is, of course, one ampere; the flow through the resistance of a one inch hole two inches long, under the pressure of six inches to the upper edge of the opening, is one miner's inch.

"The expression, one miner's inch per second would be just as meaningless, or at least redundant, as the expression, one ampere per second. On the other hand, the miner's inch-second is the correct analogue to the ampere-second, the one denotes a specific quantity of water, 0.194 gallon; the other a specific quantity of electricity, a coulomb; 0.194 gallon per second of flow represents a miner's inch; one coulomb per second of flow represents one ampere; 1.94 gallons per second is supplied by ten miners' inches; ten coulombs per second is supplied by ten amperes.

"If we attempt to apply ohm's law to the miner's inch we naturally fail because the laws of hydraulics differ from those of electricity, but, none the less, it is a very excellent analogy."

The quantity of water per minute in a small stream is best measured by means of a weir or dam placed across the stream. The weir tables contained in most of the water wheel catalogues give at once the quantity of water in cubic feet per minute passing over the weir. For larger streams it is necessary to first find the area of cross section in square feet, and then the mean velocity.

The cross sectional area is found in the following manner: Divide the width of the stream from *A* to *B* as in Fig. 2, in any number of equal parts. Find the depth of the stream at each point of division, add all the depths together and divide the result by the number of divisions; this will give the "mean depth;" this multiplied by the width *A B* gives the cross sectional area in square feet.

Supposing the measurements are as follows:

Depth at point	1	= 2	feet
" " "	2	= 4	"
" " "	3	= 5	"
" " "	4	= 5	"
" " "	5	= 6	"
" " "	6	= 7	"
" " "	7	= 7	"
" " "	8	= 6	"
" " "	9	= 4	"
Total		46	feet

Divide 46 by 10, the number of divisions, and 4.6 feet is the mean depth.

Supposing the width *A B* to be 80 feet, 4.6 × 80 = 368 square feet, the areal cross section of the stream.

The velocity of the stream is best estimated by throwing floating bodies on the surface. These "floats" should be of almost the same specific gravity as the water, be weighted on one end and sink well into the water. They should be started near the middle of the stream where the water has the greatest velocity, and the time should then be accurately measured during which the float will pass a given distance marked by stakes.

Two observers are necessary.

Observers *O* and *P* in Fig. 3, have aligned themselves over stakes *a*, *b*, and *c*, *d*, respectively.

Observer [illegible] is provided with a stop watch [illegible] horse races), which he starts when the float passes line *a*, *b*; then he turns his face toward *P*, who gives an optic signal when the float passes over line *c*, *d*. *O*, of course, immediately stops the watch. The distances *a*, *c* and *b*, *d*, must be alike.

Supposing this distance is 400 feet, and the time which elapsed while the float passed between *a*, *b*, and *c*, *d*, is 2 minutes [illegible] seconds, speed per minute = $\frac{400 \times 60}{151}$ = 1[illegible] feet.

This, of course, is the velocity near the center and surface of the stream; the velocity near the sides and the bottom, however, is lower. From experiments it has been found that the "mean velocity" is 83 per cent. of the maximum surface velocity.

We must therefore multiply 159×.83=132 feet, which is the mean velocity per minute.

If we now multiply this value with 368 representing the cross section in square feet, we get the number of cubic feet per minute; 368×132=48576 cubic feet.

The "head" should be ascertained at high and low water.

It is well to remember that the number of horse power thus ascertained is the *theoretical* energy expended by the water, but only a part of this can be utilized to drive the electric generators. The commercial efficiency of the best water wheel is hardly over 80 per cent., besides there is a loss by friction (water in pipes, shafts in bearings, etc.), so that at best not more than 75 per cent. of the energy of the water falls can be utilized for driving the electric generators.

1. From the "Electric Transmission Hand-Book," Electrician Publishing company, Chicago.

Electric Light in Holland.[1]

In a country where so curious a mixture of imperturbability and enterprise, of thrift and luxury, is to be found, it seems to be a mere chance whether electric light will spread rapidly or struggle ineffectually. It happens that what little electrical work there is has been put down by Germans, and though it is spreading on its own merits, it is not likely to be taken up so well as if some Dutch engineers could be found to turn their attention from canal cutting and dyke building. Numerous factories are provided with their own electric light plants here, as all over the world; but, as far as we are aware, there are only two public supply stations, the one at the busy capital, Amsterdam, and the other at the fashionable residence of the Court at the Hague.

On a recent occasion we took the opportunity of visiting these two stations, tracking them down in each case by the chimney shafts and their exhalations; for the Dutchman is justly proud of the picturesqueness of his streets, and allows no overhead wires. With praiseworthy impartiality Holland has adopted alternate currents in one station and low pressure with batteries at the other, and as far as the light is concerned, both glow lamps and arcs are thoroughly first class, the former being well up to color, the latter steady and silent, both giving general satisfaction, and not known to fail.

At The Hague we found the central station a substantial building, consisting of a commodious engine room and "kettle house," surrounded and overlooked by a glazed

FIG. 1. DATA RELATING TO WATER POWER.

corridor communicating with the various offices of the supply company. The whole of the plant, from the dynamo to the lamps themselves, including the mains, is supplied by, and is the design of Messrs. Siemens and Halske, who are represented by the chief engineer, N. J. Singels. A pair of horizontal engines had been at work, but are now dismantled, and are being moved to allow for extension of the plant, on account of the increasing demand for light. The three-wire low-pressure system with batteries is employed, and the load last month was equivalent to rather more than 3,000 16 candle lamps. The engines are of an inverted marine type, and drive two dynamos, one at either end of the shaft, the driving of course being direct. There are two of these sets, and there is plenty of room for two or three more. They are of the inside pole, outside commutator pattern. The stationary magnets are like those of the Jablochkoff dynamo; and the armature, wound Gramme fashion, with bar conductors, is overhung. The outer surface of the armature acts as a commutator; and although the machine appears to be very expensive to build it must be admitted that the trouble of attaching the sections of a separate commutator is thus avoided. It was [illegible] manship that cannot fail to please the eye of an English engineer, their German allies should deliberately build such strange machines. There is no reason why the efficiency should not be excellent, and the only points about which we are inclined to be skeptical are the cost and the durability.

Only a small battery capacity is provided at the Hague station, and it is employed in much the same way as at Kensington and Knightsbridge. An all day supply is provided, all the private houses and smaller customers being charged by meter, while the hotels and large establishments are charged by contract. A large switch-board, placed in a gallery [illegible] the various feeders and mains, voltmeters with pilot wires from the ends of the feeders and ammeters being provided while an attendant controls the pressure by means of resistances. In the *ketel-huis* large locomotive boilers are used, and, the remaining space being limited, a water tube boiler is being put down. The economy of this station appears to be remarkable, but the figures which we saw cannot be compared directly with those of our London stations, though we hope that the chamber of commerce scheme of gathering statistics will enable a just comparison, in such a case as this, to be made. Load diagrams are taken every day, and among the various analyses which are made is one which gives the "ampere hours per kilogramme" of coal. This appears to vary from 2.8 to 3. There being, say, 110 volts, this gives 308 to 330 watts for 2.2 lbs. or 5.33 to [illegible] lbs. per electrical horse power. Siemens armored [illegible]

FIG. 3. DATA RELATING TO WATER POWER.

cable is used, many of the feeders being concentric conductors.

At Amsterdam a beginning was made in the center of a large block of houses in the busiest part of the city, and overhead wires were run to various shops and hotels. The light being appreciated, more plant was put down, and permission was granted for running underground conductors. Alternating currents are used, one dynamo running direct on the mains, and the other on alternators. The high pressure service is at 2,000 volts, and is transformed to 72 volts for the glow lamps and to 36 volts for the arcs. The dynamos are of Ganz's make, and resemble the Siemens continuous current dynamos at The Hague, in having overhung ring armatures with fixed internal magnets, and are direct driven by horizontal engines. The space in the engine room is very limited, and the supply company hopes to remove shortly to larger premises. The underground conductors are made by Felten and Guilleaume, the larger ones being concentric; they are lead covered, and are laid in wooden troughs, filled in with asphalt and covered with stone flags. The supply is not maintained all day, but the whole of it is charged by meter, considerable abatement being made to large consumers. Frager and Aron meters are used, and a meter of Ganz & Co., made by the Helios company. The transformers, arc lamps, and many of the accessories are of Ganz's design, but manufactured by the Helios company.

The price charged at Amsterdam is 8d. per 1,000 watt hours; and lamps are to be bought, having a life of 1,000 hours, and an efficiency of [illegible] watts per candle for 1s. 8d. to 2s. The price of current compares well with that which is charged in London, when it is remembered that while the gulden is worth 1s. 8d., it only goes as far as a shilling in most purchases; and the price of 8d. may, for practical comparison, be reduced to less than 5d. It is a pleasure to find such good results, and that the work is well and carefully carried out, with no unsightly temporary makeshifts.

1. From the London *Electrician*.

An English Opinion of the N. E. L. Association Convention.

The London *Electrician* makes the following editorial comment on the Montreal convention: "The convention of the National Electric Light association, which was held during this month at Montreal, appears to have been of a thoroughly commercial and practical character. Discussions on C. G. S. units and theories of magnetism are not to be found at this gathering, but manufacturers and managers of supply stations were well to the fore, and the papers which we have glanced over are full of practical suggestions and records of experience."

The common council of Lockport, N. Y., has granted a charter to the Lockport and Olcott Beach Electric railroad company for an electric road to the village of Olcott. The principal [illegible] commenced within three months from the date of acceptance of the grant, and that it shall be completed [illegible] of next year. The company is [illegible] with [illegible] November [illegible] to comply with the conditions named. [illegible] backers of the company reside in Rochester, N. Y.

Notes on Electrical Work in Mines.

[illegible]

Perhaps no branch of engineering has received more attention of late than the application of electricity to the ordinary purposes of mining. At home, on the Continent, and in America, electrical energy has been applied to this [illegible] the majority of instances with success.

In February, 1890, the question of "The Electrical Distribution of Energy over Extended Areas in Mines" was discussed before the Federated Institute of Mining Engineers, and I then proposed the use of over compounded dynamos for this purpose. When the matter was also discussed at the Newcastle meeting in 1891, I was able to state that several installations designed on these lines had been working successfully for some time. One of these was the Newbridge Rhondda Colliery pumping plant, and by the courtesy of Mr. Abraham, the manager, I am able to bring the following details before you. This plant is typical of the system; it is successful here, and there is no reason to prevent its being equally successful under similar conditions in other pits. The problem was to drive two pumps off the same set of mains. The pumps were 700 yards apart, and it was required to make each independent, so as to be stopped or started without affecting the speed of the other. It was also imperative that the electric light should be used at the pumping stations, at the pit bank and pit bottom; and further, there was to be only one dynamo. These conditions assumed that the pressure would be practically constant throughout the circuit. In practice, it is impossible to secure an absolutely constant pressure all over the system, owing to the resistance of the mains themselves; but by over-compounding the dynamo, so as to give a constant pressure at a point near the center of the system, it is possible to approximate very closely to the required conditions. How well the case has been met is apparent when I mention that both the pumps can be switched off without appreciably raising the voltage of the lamps. The dynamo is one of our Sh. D. C. 12-16 type, and running at 800 revolutions per minute gives a pressure of 300 volts and 60 amperes. Each of the motors gives 7-brake horse power, and runs at 800 revolutions per minute. The lamps are coupled in series of three. The pumps are three-throw rams, 4 inches in diameter by 9 inches stroke. Mr. Abraham tells me the plant has been perfectly successful from the first, and he hopes to extend the use of electricity at an early date.

Another interesting application of electricity which is likely to be of use in certain cases is a new system of haulage patented by G. B. Walker of Wharncliffe Silkstone and Immisch of the G. E. P. and T. company. In this system the locomotive does not depend for grip on its own weight, but gets a direct pull on a cable lying between the rails, parallel to the road, and fixed at either end. This cable passes over a sprocket wheel on the locomotive or trolley, and is driven through suitable gearing by an electric motor. The motor is supplied with energy from a bare copper wire arranged on the roof or the side of the road. It is needless to say that such a trolley is only applicable to roads free from gas. The chief advantage of the system lies in the light weight of the trolley in proportion to the heavy tractive effort it can exert. It will be principally used as an auxiliary power on short steep lengths of otherwise fairly level roads, where horses are generally used, and will be found in many cases to be a great saving in horseflesh. A locomotive or trolley of this type has been running at Wharncliffe Silkstone collieries for nearly twelve months on a brow 500 yards long, with a grade averaging one in nine. It raises loads of about five tons at a speed of three miles per hour. Formerly, twelve horses were required for the work, and even with this number it was so severe that it was not deemed advisable to keep the same animals at it for more than six months at a time. Mr. Allison, my assistant, who erected the line, gives me the following figures, roughly measured, which will be interesting from the electrical [illegible]

[illegible]	[illegible]	...4 tons
[illegible] speed	[illegible] miles per hour	
[illegible]	[illegible]	
[illegible]	Amperes, [illegible]	Volts, 150.
[illegible]	Amperes, [illegible]	Volts, 1[illegible]0
[illegible]	Amperes, [illegible]	Volts, 1[illegible]
[illegible]	Amperes, [illegible]	Volts, 200.
[illegible]	Amperes, [illegible]	Volts, 2[illegible]

[illegible] larger dynamo [illegible] now do more [illegible]

[illegible] heavy for the [illegible] for [illegible] materia[illegible] [illegible] design in [illegible] horse power [illegible] figures [illegible] I am able to give the [illegible] dynamo three [illegible] The pumps are [illegible] the one [illegible] motor the [illegible] power. The [illegible]

wire rope is used for the return, and no difficulty has been experienced from this; but if the pressure were higher, or the work larger, I should advise an insulated return.

In Bohemia, my company erected last year two plants of some importance in the history of mining in that district, being the first application of electricity to mining work there. The first is at the Standard Tin company's St. Mauritius mine. The dynamo is placed below ground and is driven by a turbine, the water being led down a shaft by suitable pipes. The motor is arranged to work a pair of lift pumps with spears forty metres long, and also to wind ore through the same vertical distance. When the installation was first made the lower levels were drowned out and the electric plant had to pump them dry before work could be resumed. This was successfully accomplished in a shorter time than the engineers expected, and ore is now being regularly raised by the plant. The power of the motor is about 20 horse. The second instance is at Eger, at one of the brown coal mines. Here the main ventilation is produced by a fan driven by electricity, and it is, I believe, the only mine where this is the case. The dynamo is driven by a turbine about half a mile away from the fan house, and the current is carried by bare wires mounted on poles with fluid insulators. The power of the motor is approximately 25 horse. The fan has now been running for about twelve months, and the manager reports that it is working perfectly satisfactorily.

We are now building a very interesting plant which illustrates the conversion of water power into electrical energy and its utilization for light and power. One thousand yards from the Greenside lead mines, near Ullswater, there is a waterfall of upward of 100 horse power. A turbine running at 1,000 revolutions per minute is coupled by a belt to one of our 100 electric horse power four-pole transmission dynamos, wound in compound to give 625 volts and about 900 amperes. The energy is transmitted by a bare cable (19-15 S. W. G.) carried on poles to the mine mouth, and there lead covered cables are used to convey the electricity to the various motors. These will at once run a winding plant of 10 brake horse power, a pumping plant of 10 brake horse power and another winding plant of 20 brake horse power is under consideration. Electric light will be used at different points of the line, and other motors will soon be installed for various purposes. Other examples might be given, but the preceding cases are fairly representative of the work now being done.

Every system of transmitting energy must necessarily entail certain risks peculiar to itself; therefore it is not surprising that we find such difficulties in connection with the use of electricity in mines. There is no doubt that the limits of these difficulties are very imperfectly understood by many mining engineers, and a few remarks on the subject may not be uninteresting. There are two distinct difficulties to contend with which may or may not be dangerous. The first is the risk from shocks. These may be received from any part of the circuit, if the installation be faulty, and under any circumstances from the brushes, commutator and terminals of the dynamo and motors. The dangers to be apprehended from electricity on this account depend primarily on the pressure of the circuit. Opinions are very much divided as to the number of volts necessary to cause death; but as, owing to difficulties of installation, the pressure in mines is usually limited to 500 volts or thereabouts, there is no fear of a fatal accident under any ordinary conditions. I have installed many plants of about this pressure, and have never heard of a single injury occurring to either the attendants or the miners, although shocks have necessarily been frequent. At St. John's colliery, Normanton, we have been working for rather more than three years with a maximum pressure of 700 volts without a single accident happening from this cause; and further, no casualty from electrical shock in any other mine in England has to my knowledge been heard of; consequently I venture to think that this danger is practically negligible. The second difficulty which confronts us is the risk from fire, which may occur in two ways: By sparking at the commutator gas may be fired; or through a faulty connection or a bad leak, some part of the circuit may become heated and may set fire to timber. These dangers have frequently been discussed, but as a matter of fact no serious accident has occurred from the use of electricity, and should ordinary precautions be taken, and the plant be supplied and erected by a responsible firm, the chance of trouble on this score is extremely slight. Let us first look at the risks that belong to the cables themselves. It has been rightly surmised that in the event of a heavy fall of the roof breaking them, there may be a spark if ordinary single cables are used, but this danger may be minimized by using concentric cables; for if such a cable be broken by a fall, the mains will be short-circuited and the cut-out on the surface will fuse, thus cutting off the supply of electricity. In most cases, however, the cable is torn from its supports and simply buried beneath the stones, the strength of the conductor being greater than that of the supports. I have known several cases of this sort and the cables continued in use until the fall was removed, after which, being little the worse, they were re-erected. Even assuming that the cable should break, it by no means follows that the spark, if any, would be intense enough to fire gas, or that gas would be there in sufficient quantities to be dangerous. I take it that risks of this kind are about on a par with the [illegible] of a safety lamp exploding gas through a fracture of the glass which is liable to happen at any time [illegible] on the whole, I should think this danger is far greater than that from electric cables. But we are accustomed to the breakage of safety lamps, and [illegible] than the chief point of [illegible]

[illegible] commutator introduces [illegible] together. Although in theory a well designed motor with commutator and [illegible] so far as not [illegible] wear and tear and [illegible] motor may at times spark badly

Then arises the question, Will those sparks ignite gas? In 1888, when speaking on this subject before the Midland Mining Institute, I gave it as my opinion that the sparks at the brushes of a motor would not readily fire gas on account of their low temperature. This low temperature is due to the large mass of metal in contact with them. To make this point clear I made the following experiment: In a wooden box about 6 feet long with an internal cross section of a square foot, I put a small motor and a gas gauge; a glass window was arranged in the center of the box so that the gauge could be read and the sparking noted. One end of the box was closed and the other fitted with a hinged door. Ordinary coal gas was then admitted at the closed end, and the motor started. The mixture of air and gas in the box was varied through the most explosive ranges and the motor ran for half an hour without firing the gas, although the brushes were sparking more than normally. These were then shifted so as to cause excessive sparking, thus heating both brushes and commutator, the heat at the points of the former being so great that oxide of copper was formed and deposited on them in a white film. At this point the gas exploded. Marsh gas and air explode at about 1,000 degrees C. (1,832 degrees F.) according to the mixture. It would appear to follow that although under normal conditions there would be little danger of a motor igniting gas, yet if by any means the brushes and commutator became heated beyond a certain intermediate point, this danger would arise; and if motors are to be used in fiery mines it will be necessary to protect them.

Two ways of doing this suggest themselves. The one is to inclose the entire armature and commutator in a dust-tight metal box sufficiently strong to resist the force of the explosion of possible gas within it; and the other is to box in the commutator and brushes only. The former method has the advantage of also guarding against sparks caused by a possible short circuit on the armature. The second method does not protect the armature winding at all, but it reduces to a minimum the volume of gas which may be exploded by sparks. Both methods are good in their way, and, by proper attention to details, I believe that with either the risks will be comparatively slight. Of course, the best protection is ample ventilation, for if the faces are swept with plenty of fresh air, and the roof properly packed and looked after, there can be no danger from the cause in question. The protection of the motor should only be expected to act as a safeguard against "blowers," because under ordinary mining regulations men would not be allowed to work in a fiery atmosphere. If the motor be fixed at a pump or hauling engine, the difficulties are materially lessened, for the air would not be foul in such places, and if the "blower" worked against the main air-way there would be ample time for the men to switch off the motor before withdrawing, or it could be stopped from the surface.

Electric Locomotive for Mill Use.[1]

The present tendency to the general use of electricity as a motive power has much to commend it, but there is one line of work to which as yet, at least to our knowledge it has not been applied, though we believe it might be so with profit to all concerned. We refer to its adaptation to light locomotives suitable for rolling mills, steel works, and heavy machine shops.

The ordinary steam locomotive for use about yards in the open air, used regularly up to something like its full capacity, answers its purpose well enough, and perhaps in the matter of economy it could not be excelled by any other form of motor, but in inclosed spaces, such as mills and other large manufacturing plants where locomotives must be used, some improvement is needed, and here we believe an electric locomotive of proper design would find a wide application. Its principal point of superiority would lie in its freedom from smoke, and also in that it consumes no power except at the moment of use. The smoke from the steam locomotive can perhaps be avoided by the use of coke as fuel, but this at the expense of filling the air with fine dust, which, in machine shops at least, is neither conducive to good work nor to the comfort of workmen. And in any case, steam must be constantly kept up at the expense of fuel. The great problem, were electric locomotives to be introduced for this use, would be the transmission of the current to the motor. It is obvious that the overhead wire system would not answer under the conditions obtaining in most works, and it would appear that on account of the advantage of making the locomotive independent of external conditions, especially of the track, that the secondary battery is the most feasible. Most works of any magnitude have their own electric light plant, which could be used during the day for the purpose of charging the batteries, two alternating with each other for each locomotive, without crippling the efficiency of either equipment.

That electric power can be used safely and economically is now well settled. One firm, to our knowledge, one of the largest manufacturers of overhead traveling cranes in this country, recommends the use of this power in preference to any other in machinery of that class, and it does not appear that the difficulties in the way of adapting it to locomotives for mill use are any greater than that for overhead traveling cranes. And with the freedom from smoke and dirt which an electric locomotive would give, other things being equal, it would possess a decided advantage over the steam motor. We should be pleased to see the problem taken up by some of the electric companies, for we believe its successful solution would inure to their benefit, and to that of large manufacturers and to their employes.

The Gray Electric company of Chicago, Ill., has been incorporated, with a capital stock of $100,000, to manufacture electrical apparatus. The incorporators are [illegible] Gray, [illegible] W. Cushing and Leon O. McPherson.

---

[1] [illegible]

Electricity as a Motive Power in Dentistry.[1]

By Peter Brown, L. D. S.

The question of providing some motive power for the dental engine has led many inventors to investigate the merits of the electro motor in its application to the dental engine. Electricity is coming rapidly to the front as a motive power, and the rapid strides made in its various applications have not been lost sight of by those interested in applying this wonderful agent to various uses in dentistry.

The electro motor has many advantages, strongly indicating it as the only perfect machine for applying power to the dental engine.

Prominent among these is the small space required, comparing it with other motors. As an illustration, it may be mentioned that a one horse power motor requires a floor space of only 20 inches square. It can be placed out of sight of the patient; it is noiseless, clean, and requires very little attention.

To dentists living in cities or towns where a supply of electric power cannot be obtained from a central power station, the use of batteries must be resorted to, but it must not be looked upon as a very great objection. Many improvements have been made in the construction and durability of galvanic cells, rendering them much more cleanly and free from unpleasant odors, and less troublesome to keep in proper order, than the form of cell heretofore in use. Batteries can be obtained to-day that will supply for a month or more, without any further attention than the addition of a little water occasionally, all the power required in operating a dental engine.

Where a supply of electricity can be taken from a power station, it may be put to endless uses in the dental laboratory.

With an electric motor properly adjusted to the engine, one may work through the most fatiguing operation with ease. With the foot-power it is necessary, as we know, to stand on one foot while using the engine, which is a very tiresome position in itself, but when the other foot is obliged to work the treadle of the engine, it is doubly tiresome. While with the motor you may take any position the nature of the operation will allow you, and at the end of a long day's work, you will look upon the electro motor as one of the greatest boons that modern invention and science have given us.

Another advantage of the electro motor is the perfect steadiness it gives the cutting instrument. There is no swaying of the body as there is when moving a treadle, and it can be run slowly without that decidedly unpleasant jar the instrument receives every time the crank of the driving-wheel passes over the center.

It is maintained by good authorities that one of the best methods of excavating sensitive dentine with a mininum of pain, is by the use of a very sharp burr run at a high speed. Now, in order to get a high speed with the ordinary engine we have to exert quite a little force, and in doing so the body is moved about, and the steadiness required is much disturbed; while with the motor a speed of from 2,000 to 5,000 revolutions per minute can be easily obtained by the simple operation of closing a switch, leaving the operator perfectly steady and at rest.

Many will object to introducing the electro motor so near to the chair, saying that it looks too much like machinery; but were there not objections on the same ground made to the dental engine itself on its first introduction, and how many dentists are there to-day without that valuable instrument? When the advantages of the electro motor become better known among the dental profession, there will be few who will be without it.

Then there is the objection of introducing the electric current from a power station into our houses, on the grounds that it is dangerous to life and property. The dangers from this source have been very much exaggerated; the low tension current is not at all dangerous when properly insulated. We have a deadly agent in our houses now in the form of illuminating gas, and serious consequences may result from a leaky joint or improperly closed tap. Yet we do not go about with fear and trembling when we use this agent in our houses. When electric wires are covered with proper insulating material, the fluid they carry is as safely confined as gas or water in their respective pipes. The amount of knowledge required for the successful operation of electrical appliances in dentistry is not neccessarily very great. Certainly, a fair amount of information will help one wonderfully out of a difficulty, and will prove valuable in successfully using electricity in practice.

This force is coming into such general favor and use, that every one should have a little general knowledge of it, which may be easily obtained from one of the numerous text-books on the subject. The time is not far distant when we shall have our houses heated, lighted and ventilated by electricity; the obnoxious gas jet will give way to the clear and steady light of the incandescent lamp, which gives us light with a minimum of heat, and does not vitiate the atmosphere of our rooms, and fill our lungs with carbon. This lamp is to be strongly recommended in making examination of the teeth, or in operating on dark or cloudy days when the light is unsteady. With proper fixtures the lamp may be made to concentrate its light on the mouth, and also shaded from the eyes of the operator. The incandescent current may also be used to run the electric mallet, the electro cautery; and, applied to a fine platinum point, is the best means of drying out root canals before filling.

The United States Corporation Bureau of Chicago reports 1,089 new corporations in the United States during the month of September; total capitalization, $374,973,325. Of these 74 were light, heat, power and transportation companies with a capital of $27,298,000.

1. Read before the Odontological society, Montreal.

CORRESPONDENCE.

New York Notes.

New York, Oct. 10.—Electrical news during the past week has been exceedingly scarce. The week has been one of expectation, especially as far as the rapid transit problem is concerned, but the proposed modifications have not yet been completed and presented, and consequently the commission seems to be far from a final solution.

It is said that the officials of the Naugatuck road have hit upon quite a novel method of heating the cars on the early morning trains. These trains stop near the electric light station at Waterbury, and the station men force a great quantity of steam into the pipes of the cars.

The Cowles Electric Smelting and Aluminum company of Lockport, N. Y., and the Pittsburg Reduction company of Pittsburg are at present engaged in a gigantic patent litigation, and, on that account, neither company will be able at present to accept the order, recently placed by the German government in the hands of its United States agents, for eighty-five tons of pure aluminum. This large amount of that valuable metal is to be used for army purposes, to be turned into buttons, buckles, wire for telegraph and telephone service, and cartridge shells.

Staten Island is again having trouble with its electric lights owing to accidents to the temporary works at St. George, and the residents have consequently suffered much inconvenience. During the storm on Tuesday night the streets in the villages of Stapleton and Clifton were left in total darkness. At the next meeting of the trustees of the village of Edgewater, it is said that a number of prominent tax-payers will appear to request that the electric light company forfeit its contract and that the streets be again lighted by gas.

Owing to a broken trolley wire an accident occurred near the Brooklyn terminus of the Brooklyn and Jamaica Electric railroad, resulting in the killing of two horses attached to a farmer's wagon and one attached to a Cypress Hill horse car. The farmer values his horses at a high figure and will sue the company for the loss.

After the regular meeting of the police commissioners yesterday an executive session was held. They passed upon the estimates for the department for the next year, and decided to ask the board of estimate and apportionment for $100,000 for an electric signaling system, and $75,000 for an improved telegraph system.

The Oliver & Roberts Wire company of Pittsburg, Pa., one of the largest business corporations of its kind in the country, has petitioned its creditors for an extension. It announces that it expects to pay dollar for dollar with interest.

The cases of the alleged telegraph wire tappers, who tried to fleece the pool rooms at New Haven, Conn., have been continued. One of the culprits turned state's evidence under a promise of immunity and said that he had hired an accomplice to do the wire tapping.

Stanley & Hall of Frankfort street, New York, have gone into the hands of a receiver.

The monthly meeting of the American Institute of Electrical Engineers has been postponed until Octobe 27th, to avoid conflicting with the street railway convention at Pittsburg.

At a meeting of the Board of Electrical Control, Chief Engineer Kearney reported completed subways in Exchange Place, Bowling Green, University Place, Park Row, Warren, Thirty-ninth, Walker, White, Grand and State streets. Permission was given for the building of subsidiary subways through forty-five streets in other parts of the city. There was a protracted contention between W. H. Kelly for the East River company and Edward Lauterbach for the Consolidated Telegraph and Electrical Subway company on the subject of the payment of rent in advance. Judge Kelly said that the subway company was overcharging for rent and inspection, and he did not think his company ought to be compelled to pay a year's rent in advance and thus be forced to lose interest on the money. It was decided that the East River company should pay one-fourth of its rent, and that the board would hold a special meeting within a few days to consider the question of modifying the rule to pay a year's rent in advance. The alleged overcharging for rent will be considered at the same meeting. A map was exhibited showing that the telegraph poles, except those of the fire department, have been taken down between Eighth and Fifty-ninth streets and Third and Eighth avenues.

There seems to be much talk and speculation everywhere at the present time in regard to the storage battery prospect. All electrical men are interested in its welfare and advancement, and it is rumored that at a very early date a large company with an enormous capital and backing is to begin manufacturing in that line, establishing branch

[redacted]

the present gas engine in the matter of economy and general

Cincinnati, O.

Cincinnati, Oct. [redacted] at the Hunt street generating station of the Cincinnati [redacted] Street Railway [redacted] greas damage to the building and machinery. The twenty-ton [redacted] engine flew to pieces, completely wrecking the engine. The flying fragments knocked out one side of the building, totally demolished the switch-board and five 80 horse power generators and severed a 14 inch main steam pipe. The damage is estimated at $15,000. The primary cause of the trouble was a very heavy short circuit somewhere on the line. It is supposed that when this occurred and while the engine was crowded and the generators working up to their full capacity, the arresters cut out the entire lines, thereby relieving the engine of its load and allowing it to gain such a momentum as to cause the ponderous wheel to burst. Fortunately no lives were lost by the accident.

F. M. La Boiteaux, electrician for the Varwig Motor & Manufacturing company, has returned home from the East, where he had been for several weeks looking after the interests of his concern.

The F. B. Morgan Electric Light & Power company has been refused a permit to string its wires for light and power service. It will very likely carry the matter into the courts.

John Evans, electrician at the Hunt street generating station, while engaged in making some changes on the switch-board in the station, received a severe shock which completely prostrated him and for several hours his life was despaired of. He is getting along nicely now, however, and hopes to be out again in a few days.

The Cincinnati & Suburban Telegraph (Telephone) company has secured a franchise for putting down an underground system. It has a large force of men at work and hopes to get the greater part of the system completed before winter.

San Francisco, Cal.

San Francisco, Oct. 9.—If the information published in the local papers is correct, the Southern Pacific company is to substitute electricity for steam on the Seventh street "local" lines in Oakland, and the change, if effected, will be watched with interest, as the electric trains will handle the traffic now carried by standard trains of eight or ten coaches running every half hour. For the benefit of those who are unfamiliar with the topography of the Golden Gate cities it may be mentioned that Oakland is the Brooklyn of San Francisco. Large and commodious ferries cross the bay every fifteen minutes, the boats of the South Pacific coast route alternating with those of the Southern Pacific line. The distance across the bay to the Southern Pacific or Oakland Pier is six miles, and at the pier passengers take the Oakland local and ride to different stations along the route or out to Fruitvale, twenty miles from San Francisco. One remarkable feature of this road, as it has been operated for the last twenty years, is the fact that no fare is collected for riding within the limits of Oakland, its franchise containing a clause to that effect. This dead-head travel has long been a thorn in the side of the Southern Pacific company, and in order to do away with it the company proposes to abandon the steam franchise with its obnoxious dead-head clause, and to apply for a new franchise for an electric road over the old route. The proposed electric road, though running through the most populous district of a city of [redacted] people, will [redacted] electric street railway system in hardly any sense. Single cars will not be run, neither will stops be made anywhere, as on other electric lines. Instead, electric trains of three coaches each will be made up and will stop only at stations from six to ten blocks apart. The speed will be from 15 to 20 miles an hour, and each train will [redacted] minutes or ten minutes' headway, probably the former. [redacted] be called "through trains" will leave the pier [redacted] and, [redacted]

[illegible] stations. Mr. Clement, of the com[illegible] ps, is now in the East studying electric roads, and it is believed that when he returns and his plans are ratified the road will be built.

[illegible] Electric Power company of Portland, Ore., is about to finish its generating station. The initial plant consists of five 250 horse power 500 volt Edison dynamos, [illegible] engines having a combined capacity of 1,500 horse power.

Alameda, Cal., finds itself sat upon by a white elephant, masquerading as a municipal electric lighting plant. Whether the city will sell the outfit and obtain light by contract, or whether it will put more money into the station in the hope of increasing its effieiency, is the problem Alamedans are endeavoring to solve.

Los Angeles boasts of an electric tower clock, similar to one in Rome, and to two in Paris. It is in the turret of the new courthouse, and controls every clock in the building.

The projectors of the proposed electric road between Haywards and San Jose have applied for a franchise from San Jose to Los Gatos. If completed, as proposed, the road will be nearly seventy miles in length.

For some time the telegraph operators of the Southern Pacific company have entertained grievances against their employers, and Grand Chief Telegrapher Thurston of the Order of Railway Telegraphers is now gathering evidence in Oakland preparatory to a conference with the railway officials.

Stephen E. Barton, president of the Electric Mutual Insurance company, is visiting the Pacific coast for the first time, and is making friends wherever he goes. His wife and daughter accompany him. S.

Cleveland, O.

CLEVELAND, Oct. 10.—The Niles council recently inspected the electric light plants at Millersburg, Mt. Vernon and Pittsburg, with a view to adopting the most economical system.

J. H. Mead, superintendent of the Edison company at Cincinnati, will resign October 1st.

Plans are being drawn for the construction of an electric railway from Cleveland to Richfield, with a probable extension to Akron. The road would traverse Independence and Brecksville and five postoffice points. The government pays now about $3,000 a year for the carrying of the mails between the points on the proposed line, and this contract could be secured. Freight cars of a capacity of about five tons are included in the equipment. Chas. [illegible] is in the deal.

The equipment of the Mt. Adams, Eden Park & Norwood Electric Railway at Cincinnati comprises thirty-four new cars, of which fourteen are Pullman and twenty Laclede make.

There is no likelihood that the electric railway from Conneaut to the harbor will be built before the P. S. & L. [illegible] the harbor.

S. M. Hamill, secretary of the Brush Electric company of New York, was in Cleveland last week.

[illegible] the local branch of the Central Thomson-Houston company, attended the Knight Templars [illegible] Cincinnati.

The Ford-Washburn Storage Battery company has equipped a car to make experimental runs on the Woodland [illegible]

[illegible] Jerome B. Fenn, superintendent and [illegible] Washington C. H. Electric & Gas com[illegible] last week.

[illegible] council of Ashtabula have been enjoined from selling $25,000 worth of bonds issued for [illegible] of an electric light plant by [illegible] lighting now. B.

Toledo, O.

[illegible] Electric Street Railway [illegible] of its line for the [illegible] for the winter service. [illegible] will be increased. [illegible] Hoag street to [illegible] avenue. A [illegible] the line [illegible] gone into [illegible] [illegible] C. D.

Denver, Colo.

DENVER, Colo., Oct. 10.—The city council recently passed a resolution providing for the erection of 194 arc lights in the different wards. The additional lights would cost the city $30,000, less the cost of the incandescents which would have been taken out. Mayor Rogers refused to sign the resolution, objecting to the additional expenditure.

The question, however, has been settled by the board of supervisors passing a resolution providing for 203 arc lights, and the discontinuance of 219 incandescents.

Another street railway company has been organized. Articles of incorporation of the Denver Traction company have been filed in the office of the Secretary of state. The incorporators are Fine P. Ernest, James B. Grant, James S. Wolfe, Charles S. Thomas, Harry C. James and Ralph Voorhees. The capital stock is placed at $300,000. The line will cover the northwest section of the city, where heretofore there has only been a horse car line. As soon as a franchise is secured, work will be begun. The cars will be operated by electricity.

The La Junta Electric Light & Power company has been organized. The incorporators are Benjamin F. Hasking, Theodore F. Doty, James Ives, Victor Alberd, James B. Sherman, Frank Finney and Moses L. Stein.

Pueblo has another electric company. On September 23d articles of incorporation were filed for the Citizens' Electric Light & Power company. The incorporators are John F. Vail, J. A. Black and John W. Finlan. The authorized capital is $100,000 in 1,000 shares. The directors for the first year are C. R. Frost, J. A. Black, John W. Finlan, John F. Vail and F. H. Devine. The company's object is to furnish electricity for illuminating purposes and for power, handling electric supplies, etc.

Lake City is to be lighted by electricity within a few weeks. Work has already begun on the new plant. G. W. Crowe is making arrangements for the necessary appliances. E. C. D.

Columbus, O.

COLUMBUS, Oct. 10.—In a short time, if all goes well, horse cars will have become a thing of the past in this city. The Consolidated company is now operating nearly all of its electrical lines, and soon the familiar street car horse will be only a reminiscence in Columbus. The company uses the Thomson-Houston system.

The Edison company has increased the capacity of its plant nearly 2,000 lamps by adding two more dynamos and another engine.

Within two weeks the electric lighting equipment of the Ohio state-house will be completed. The wiring, which is now in progress, is for 1,200 lamps. Eight arc lights will illuminate the grounds. At present current will be obtained from the Edison central station, but the building is wired with the idea of installing an isolated plant at any time. The work is being done by the Western Electric company of Chicago, under the supervision of Frank L. Elliott. C.

PERSONAL.

J. W. Godfrey, general manager of the New York Insulated Wire company, was in Chicago this week.

Walter F. Smith, general manager of the Heisler Electric Light company of Philadelphia, was in Chicago this week.

C. C. Sibley, general manager of the Universal Arc Lamp company, New York, is suffering from an attack of typhoid fever.

B. E. Sunny, manager of the western department of the Thomson Houston Electric Company, returned to Chicago last week, after a pleasant trip to the Pacific coast. Mr. Sunny had been absent about two weeks.

Charles E. Bibber, general manager of the Consolidated Electric Manufacturing company of Boston, and C. A. White of the same city, spent several days in Chicago last week. Mr. Bibber and Mr. White will make a tour of the western and southern cities, which will take them several weeks.

Lieut. B. A. Fiske, who goes as second watch officer on the United States steamer Yorktown, recently ordered to Chili, is well known in connection with his electrical inventions, chief among which are the range finder, telescopic sight, and steam and helm electrical devices. Lieut. Fiske has just finished three years on shore, and now takes his turn with his brother officers in duty afloat.

D. B. Dean, the energetic and popular representative of the Electric Merchandise company, Chicago, is receiving the hearty congratulations of a host of friends on the occasion of his marriage to Miss Mary [illegible] of [illegible] avenue, Chicago. The wedding took place on [illegible] at the residence of the bride's parents, the ceremony being performed by Rev. [illegible] Henson, D.D. [illegible] The occasion was as merry [illegible] and the young people [illegible] on their journey followed by a shower of good wishes and other palpable manifestations of their newly [illegible] After a wedding trip in the East Mr. and Mrs. Dean [illegible] to Chicago, where they will reside on Forty-fifth street.

NEW INCORPORATIONS.

Attica Electric Light & Power company, Attica, N. Y.; capital stock, $20,000; to manufacture and use electricity for light, heat and power.

Omaha Consolidated Electrical company, Omaha, Neb.; capital stock, $10,000; manufacturing, selling, leasing and testing electrical machinery.

Leslie Electric Light & Power company, Leslie, Mich.; capital stock, $10,000; supplying village with light, power and heat; J. A. Hanelly, Leslie, Mich.

People's Electric Light & Power company, Creston, Ia.; capital stock, $12,000; to furnish electric light and steam heat, erect an electric plant in Creston, Ia.; A. H. Spurr, Creston, Ia.

Nunsie-Coles Electric Railway Equipment company, Jersey City, N. J.; capital stock, $500,000; to construct and run electric circuits above or under ground for railways and other purposes.

Athens Electric Light, Heat & Power company, Athens, Pa.; capital stock, $5,000; supplying light, heat and power by means of electricity to the public at Athens; Rodney A. Mercur, Towanda, Pa.

Nickel Plate Street Railway company, of Scottdale, Mt. Pleasant, Pa.; capital stock, $12,000; operating an electric road from a point near the S. W. P. railroad track to a point at or near the Catholic cemetery.

Citizens' Street Railway company, Scottdale, Pa.; capital stock, $50,000; operating an electric road from Fifth avenue and Jacobs Creek to Scottdale station of B. & O. road in Scottdale, Pa.; Geo. H. Sewell, Scottdale, Pa.

Hero Electric company, Union Hill, Hudson county, N. J.; capital stock, $50,000; to manufacture and sell electric batteries and other electrical appliances and apparatus; Cowen, Dickenson, Nichel & Brown, New York, N. Y.

Columbus & Clintonville Electric Street Railway company, Columbus, O.; capital stock, $10,000; building and operating an electric street railroad from Columbus to Clintonville, Franklin county, O., James N. Loren, Columbus, O.

North End Passenger Railway company, Allegheny, Pa.; capital stock, $200,000; operating a cable or electric road from Fremont street and Washington avenue to Woods Run avenue in the city of Allegheny, Pa.; Stone & Potter, Pittsburg, Pa.

Hanson Battery Light & Power company (incorporated in West Virginia), Washington, D. C.; capital stock, $1,500,000; producing and furnishing electricity for light and power, and for all the various forms that are necessary for the public welfare.

International Electric Manufacturing company, Chicago, Ill.; capital stock, $100,000; to manufacture, purchase and sell mechanical and electrical apparatus and appliances, and purchase and deal in patented inventions; E. T. Brainerd, 17-19 River street, Chicago, Ill.

Scottdale, Everson & Broadford Street Railway, Scottdale, Pa.; capital stock, $30,000; operating an electric road from a point on the township road at Broadford over several streets and roads to Loucks avenue in Scottdale, Pa.; Geo. H. Sewell, Scottdale, Pa.

ELECTRIC LIGHT.

It is reported that the Volusia county bank will operate the DeLand, Fla., electric light plant.

The Waynesboro, Va., Street Railway, Light & Water company has been granted a franchise to erect an electric light plant.

Mayor H. O. Clagett will receive sealed proposals for lighting the streets of Leesburg, Va., either by gasoline or by electricity.

The Enterprise Manufacturing & Development company will put in an electric light plant to light the village of Enterprise, Miss.

It is proposed that the Gas & Electric company and the Electric Light, Heat & Power company of Grafton, W. Va., consolidate.

By a vote of 225 to 10 the town of Peabody, Mass., at a recent meeting, appropriated $47,000 to establish a plant for 120 arc lights.

An electric light plant will be erected in Moberly, Mo., to cost $50,000. It is expected to have the plant in operation by January 1, 1892.

An electric light plant will be put into the oil mill at Greenwood, S. C., and it may be enlarged to a capacity sufficient to light the village.

The Utica Electric Light company, of Utica, N. Y., will increase the capacity of its plant by the addition of a Hamilton-Corliss engine of 1,000 horse power.

It is reported that a company of Chattanooga capitalists will submit a proposition to the citizens of Monroe, Tenn., to establish an electric light plant to cost $25,000.

It has been proposed to develop the water power at Horseshoe Bend, on the Catawba river, near Charlotte, N. C., for supplying the city with electric lights and power for all purposes.

At a special town meeting in Andover, Mass., it was voted to enter into a contract with the electric light company for street lighting, at a cost of $4,500 per annum, for a period of three years.

The Western Maryland Railroad Land & Improvement company has been incorporated by Baltimore men for the

purpose of developing land along the Western Maryland railroad. Electric light plants will be erected.

Electric buttonhole lamps are being tried as part of the outfits of conductors of London omnibuses, which it would appear, are not particularly well lighted. Since the great strike tickets are compulsory on all omnibuses, and an army of inspectors examines them. At night this is difficult, and several electric omnibus inspectors now possess a small electric buttonhole lamp, which is worked by a pocket battery. On asking for the passenger's tickets the inspector has only to touch the battery, and a vivid light reveals the number and particulars of the printed slip. The idea is still in the experimental stage.

ELECTRIC RAILWAYS.

An electric street railway will probably be built at Sumter, S. C.

The Knoxville, Tenn., Electric Railway company will, it is stated, extend its system to Arlington.

A company has, it is reported, been incorporated to build an electric street railroad at Portsmouth, Ky.

G. M. Webb, Jr, & Co. have secured a franchise to build a dummy or electric railroad at Shelby, N. C.

The Anderson, S. C., Electric Light & Power company contemplates establishing an electric street railroad.

The electric cars of the Rochester, N. Y, Railway company have supplanted horse cars on Central avenue in that city.

The first electric road in Brazil will be at Bahia, where a narrow road one and a half miles in length is under construction.

The Cherokee Land company of Knoxville, Tenn., states that it will construct an electric street railroad about January 1st.

It is reported that the Atlanta, Ga., Consolidated Street Railway company will install additional machinery in its power station.

The Rock Hill, S. C., Land & Town Site company is considering the advisability of changing its dummy line to the electric system.

J. G White of 20 Broadway, New York, has received the contract for the engineering work for the new electric road at Pawtucket, R. I.

The Moundsville, W. Va., Mining & Manufacturing company has applied to the city council for a franchise to operate an electric railroad.

The Sherman, Tex., City Railway company has been granted the right by the city council to change its motive power to the electric system.

The North Avenue Electric Railway company of Baltimore has, it is stated, awarded contract for building its road to E. B Smith & Co of Philadelphia.

The Greensboro, N C., Street Railway company has been organized. The company contemplates building an electric railroad with perhaps horse car connections.

The Mabry street car line of Knoxville, Tenn., will, it is stated, be changed so as to be operated by electric power and extended through East Knoxville to Craig.

It is reported that the Thomson-Houston Electric company is perfecting a new slow speed motor for street railway work, which will shortly be placed upon the market.

It is stated that financial arrangements have been completed for the construction of the South Baltimore Electric Railroad company's electric road to Curtis Bay. W. S. Rayner, 8 East Lexington street, Baltimore, is the treasurer of the company.

Eugene T. Lynch, Jr., of Memphis has secured the contract for the complete equipment for the electric railroad to be built by the Raleigh Springs Railway company; also for the electric line of the North Highlands company of Columbus, Ga.

The city of Vancouver, B. C., is considering a proposition to purchase the entire plant of the electric street railway in that city for $300,000. Should this sale be consummated, it will be, it is said, the only instance in America of an electric road owned by a municipality.

A Boynton bicycle electric railroad is proposed to connect Seattle and Tacoma, in Washington. The distance is 36 miles, and it is estimated that the trip could be made in 40 minutes. Trains on the Northern Pacific now take an hour and forty five minutes to cover the distance between the two cities.

Negotiations are pending for the purchase by a syndicate of the Wilmington, N. C., street railway. It is said that if these negotiations are closed, and certain privileges granted by the city, it will insure the changing of the road's motive power to electricity. E. L. Hawks is in charge of the scheme.

The second electric railway in England to be operated by overhead conductors will soon be built to connect the towns of Walsall, Wednesbury and Darlaston in Staffordshire. This line will also be the longest electric road in the United Kingdom. British electricians are looking forward to the operation of this line and the one at Leeds with much interest.

At Baltimore electric railway interests are active. The North Baltimore Passenger Railway company and the Central Railway company have applied to the city council for permission to use the electric system. The Baltimore Union Passenger Railway company, lessee of the Baltimore & Hampden railway, has applied to the county commissioners for authority to extend the road along Loland avenue and operate it by electricity.

It is said that the electric railway in Guernsey is the first in Great Britain to be operated by means of overhead conductors. The generating station is situated at a point near the middle of the line, and includes a steam engine of 35 horse power and a dynamo giving 100 amperes at 500 volts. The conductors, which are supported on iron posts, are at a height of about 23 feet above the ground. The line, which is a single one, has a total length of about 1,510 yards, or almost a mile.

All the employes of the San Antonio, Tex., Electric Street Railway company recently went on a strike to enforce a new ordinance of the city council to the effect that no motor man or conductor should be required to work more than twelve hours a day. The cars were left in the streets, with the trolleys tied down and the power discontinued. There was no disorder and at four o'clock the company yielded. The men will work twelve hours a day and receive extra pay for overtime.

An important consolidation of street railway interests has been effected at Atlanta, Ga. The Atlanta Consolidated Street Railway company has been formally organized with Joel Hurt as president, thus uniting under one management the Gate City Street Railway company, the Atlanta Street Railway company, the West End & Atlanta Street Railway company, the Atlanta & Edgewood Street Railroad company, the Fulton County Street Railroad company and the Metropolitan Street Railroad company. These companies have all recently petitioned the city council for authority to extend their lines, and the new company proposes to change the motive power to electricity.

H. B. Williams of Rochester, N. Y., has invented a radial truck designed to facilitate the running of electric cars around sharp curves. The invention consists of a balanced frame which carries friction rollers that project in front of the main driving wheels of the car, resting on the rails and taking the side friction, which is now borne by the driving wheels. The friction or leading wheels are about six inches in diameter and the arms on which they are carried extend two feet in front of the main wheels giving the leaders two feet of leverage to move the driving wheels at a curve. The frame which carries the leading wheels rests on a rocker-shaft and is contrived so as to provide for holding a set of leaders on the track which ever way the car runs.

TELEPHONE.

A company has been incorporated to connect the towns of Gormania and Medley, W. Va., by telephone.

R. A. Burroughs of Rowan county, N. C., contemplates the construction of a telephone line from Wilkesboro to Jefferson.

J. B. Goodpaster, J. J. Nesbitt, J. M. Richart and others have incorporated the Owingsville, Ky., & Preston Telephone company.

Representatives of the Bell Telephone company in Washington say that the trunk line of 50 wires now being constructed between New York and Chicago will be completed within four months.

During the recent French army manœuvers the headquarters of four army corps in the vicinity of Bar-Sur-Aube were connected by telephone for the purpose of testing the value of the instrument in time of war.

Arthur Coleman of New York has sued John F. Griffith to recover $220.20, which he says he expended for the defendant between April 14th and April 20th of this year. Both are bookmakers at the race tracks. Coleman had a telephone to transmit messages to and from the track, and he alleges that Griffith used the instrument, and agreed to share the expense. Griffith denies this, and says that the suit is an effort to make him pay the other man's bills.

ELECTRIC MINING.

"The question of supplying mines, mills and other machinery in Red Mountain, Poughkeepsie Gulch and tributary camps with electric power," says the Ouray, Colo., *Muldoon*, "has been agitating the minds of capitalists and others in this section for the past season, but not until last month were active steps taken. The first power site secured was by ex Senator Wallace of Pennsylvania and his associates. He was followed by Judge Sherman and others, who have the land and power at the confluence of Red Mountain creek and Uncompahgre river, as well as the falls near River Side. The minimum power secured is 5,000 horse power, ample enough for all the demands of the south end of the county, and being but three miles from Ouray, may prove a dangerous rival for the electric folks in this village. Electricity is the power of the future, and when Nature provides the water power the expense is nominal."

MISCELLANEOUS.

It is reported that an electrical exhibition is to held at Sherborne, in Dorset, England.

An international exhibition is announced as to be held under the auspices of the Russian Government at Odessa in 1894.

John Waters, J. S. Boyd and others of Baltimore have incorporated the Southern Electric company with a capital stock of $50,000.

The Olympia Light and Power company, of Olympia, Ore., has gained complete control of the water power of the Des Chutes, valued at $350,000.

A quantity of electrical apparatus imported by the Calkin Electric Light company, of St. John, N. B., was recently seized by the customs authorities on the ground of undervaluation.

A report [illegible] ment engineers, on the electrical exhibits in the Paris exhibition, of [illegible] shows the progress in electrical science up to the year [illegible].

The Danish [illegible] prize of a gold [illegible] position of the [illegible] resting bodies in general, with a special application to simple forms [illegible] ing the mathematical problem which they offer.

A fully equipped electrical department has been opened at Wesleyan University, Middletown, Conn. A building for this purpose has been erected on the west campus. It is said that no iron entered into its construction. The department will be in charge of E. B. Rosa, Ph. D., late of Johns Hopkins University.

It is said that the latest venture in the exhibition line is the proposed Greater Glasgow Electrical Engineering Exhibition. The matter has been under discussion for some time, and a prospectus of the proposed show has just been issued. The object of the exhibition is to illustrate the best appliances suitable for the utilization of electricity in Glasgow. The site is that of the late East End Exhibition.

Judging by the following circular just received the Chicago public is to be treated to something novel: "What is electricity? Lecture at Central Music Hall, Chicago, Saturday eve, Oct. 24th, by C. S. Page. Acknowledging the right of the public to know what they are to expect for their patronage, I make the following outline: A new answer to the above question. First announcement of some important discoveries. So explain necessary electrical terms that by this answer any intelligent man or woman can understand the operation of storage battery, electric light, dynamo, motor, lightning, etc. Show the relations between electricity and heat, light and gravitation. Explain my own paradox, namely, that not one of the sixty-four elements, singly or in combination, possesses weight. You ask no more? Yet a surprise for every intelligent mind—the scientific world."

The Franklin Institute has just issued a neat little pamphlet containing the programme of lectures for the approaching season. It also contains much information pertaining to the scope and purposes of the institution, and the advantages of membership. An important feature of the institute is the library, which at the present time contains over 35,000 volumes, some 20,000 pamphlets, 1,800 maps and charts, and over 1,000 photographs, classified and catalogued. It is exclusively scientific and technical in character; it embraces, in addition to the standard and current works on mechanics, physics and chemistry, pure and applied, the publications of the principal scientific and technical societies of the world, files of over 300 home and foreign scientific and technical serials. These are accessible to all members in good standing, and complete sets of the British (and Colonial), French, German, Austro-Hungarian, Russian and American patent records are open for inspection by members at all hours, and by the public from 8 a. m. to 6 p. m. The extent and very complete condition of its serials make the library particularly valuable for reference. The library is open daily, Sundays excepted, from 9 a. m. to 10 p. m. A librarian, with several assistants, is in charge of the library, under the general direction of the secretary and the committee on library.

A Boston lad recently had a thrilling experience on Pike's Peak in a thunder storm. He gives the following graphic description of his adventure: "I was a few rods ahead, when suddenly I heard Jackson cry. Turning I saw a sight that fairly made my blood run cold. Less than half a mile distant was that terrible cloud, one blaze of lightning, rushing toward us with terrific speed, and on a level with us. We had little time to be frightened before the cloud was upon us. I was fifty feet ahead of Jackson when the storm struck us. Simultaneously came a downpour of sleet and snow, and a terrible flash. Will and I were thrown to the ground, completely stunned by the shock. When we recovered consciousness we found that a large rock lying directly in our path had been shattered by the lightning. To retreat was as bad as to advance, so on we went. All at once we discovered that the electric fluid was running over us. Sparks flew from our fingers, from our noses, our ears, and from our mustaches. We sat down on the rocks, but this would not do, as we were wet to the skin, our clothes frozen stiff, and we were in danger of freezing to death. On we pushed, the lightning striking all around us, the sparks streaming from our bodies, and the air full of a sulphurous smell. We expected that every moment would be our last. Three separate times during that terrible walk we were knocked down [illegible] ric shocks."

TRADE NEWS.

In referring to the appointment of [illegible] manager of the Chicago [illegible] pany last week, it was erroneously stated that he had recently been connected with the [illegible] Company.

The John T. Beggs Manufacturing Company, New York city, is handling second hand electrical apparatus of all kinds. Mr Beggs has been in the machinery trade of New York for four years and has built up a large business.

The Interior Conduit [illegible] New York will be represented at the street railway [illegible]

at Pittsburg by F. L. Johnson, president, and E. T. Greenfield, electrician. The company will show its improved method of burying the feeder wires of electric railway systems, also a new junction box.

The Crocker-Wheeler Motor company has recently added Thomas J. Fay to its already large electrical staff. This gentleman brings with him an extensive experience gained by previous connection with the Edison, Thomson-Houston and other prominent electrical companies, which will be of value in his present work. Mr. Fay will have charge of the testing department, which the company has lately increased in size.

The World's Columbian Exposition has installed a Ball engine at Jackson park, and J. C. Slocum, mechanical engineer, in a communication to the Ball Engine company, Erie, Pa., says: "I have to congratulate you upon the start made, which I have no hesitancy in saying was the prettiest I have known in my experience. We started the engine under full load at six o'clock and it ran until 6 o'clock this morning without the slightest trouble from heating or any other cause. I consider it a very valuable record."

The W. S. Hill Electric company has purchased from W. S. Hill all of his electrical inventions for motors, dynamos, lamps, switches, etc., and will at once enter into the manufacture of these goods. The new men coming into the company are Geo. A. Denham of the Merchant Bank of Sioux Falls; Geo. H. Poor, formerly general superintendent of the American Brake company at St. Louis, and lately of the Boyer Railway Speed Recorder company at Chicago; Geo. F. Gould, counsellor at law and judge of the Municipal Court of Portland, Me., and Louis F. Busiel, retired hosiery manufacturer of Laconia, N. H. The office of the company will for the present be located 54 Devonshire street, Boston. Mr. Hill's present factory at 133 Oliver street will be enlarged.

The R. & H. Chemical company of New York, has taken the American agency for the "Isolatine Paint," which has become recognized as a standard article in European markets. The energy which has characterized this company's undertakings will no doubt soon bring "Isolatine Paint" prominently before the public. There has just been completed an exhaustive series of tests which indicates clearly, it is claimed, that "Isolatine Paint" is waterproof; that it resists solutions of most acids, alkalies and salts, and that its insulating qualities are of the highest character. It has been found serviceable in all branches of the electrical trade, being in use for railways, light and power, underground and submarine work.

"Facts are stubborn things, and the hard figures of arithmetic cannot be satisfactorily answered by airy figures of speech. The truth remains." This quotation, credited to James G. Blaine, adorns the front page of the circular just issued by the Detroit Electrical Works, which will be circulated at the Pittsburg convention of the American Street Railway association. The circular sets forth in an attractive way the merits of the standard street railway system of the Detroit Electrical Works, which comprises one motor mounted upon a rigid frame entirely independent of the car truck, and car body, and which is so geared for work as to drive both axles absolutely simultaneously. The advantages claimed for one motor over two motors are: One-half the number of electrical parts to maintain and renew; uniform wear on wheels, journals, etc.; no racing of one pair of wheels, the full capacity of the motor being utilized on one axle without overloading it; there being no division of the current, one motor uses what current it needs with less loss than two motors, as exactly uniform results cannot be produced; all parts can be instantly examined and adjusted.

BUSINESS.

The Western Electric company, Chicago, has issued a pocket edition "photo facsimile" of its illustrated general catalogue. It is a handsome work typographically, and contains much valuable information.

Among the recent catalogues is one issued by the Buckeye Engine company, Salem, O., showing the Buckeye [illegible] engine. The merits of this well known engine are attractively set forth. N. W. Rob- [illegible] street, is the agent for Chicago.

[illegible] Maiden Lane, New York, is now [illegible] for electrical gas [illegible]. These [illegible] are as light as paper [illegible] to be very durable. They are [illegible] in this direction.

[illegible] company, Providence, is [illegible] the Narragansett Electric [illegible] system. [illegible] company of New York has the con- [illegible] has been [illegible] and the [illegible] power of its own [illegible]

[illegible]

business.

[illegible]

Manufacturing company, Macon, Ga.; Bradley-Hubbard Manufacturing company, Md.; Mason-Perkins company, Bristol, N. H.; Spalding & Moss, Boston; Hudson County Railroad company, Hoboken, N. J.; Pettis Dry Goods company, Indianapolis, Ind.; also two large contracts with the U. S. government at Washington, for the postoffice and the engraving and printing departments.

The Detroit Dynamo company, manufacturer of the "King" dynamo for electro-plating, reports a very satisfactory season's business, the demand for this class of apparatus being very much in excess of any previous year. This company also manufactures a dynamo for both arc and incandescent lighting, which is having a large sale. The Matchless Metal Polish company, Chicago, has the general western agency for this apparatus.

The Detroit Electrical Works have had an unusually busy season, having built and equipped a large number of street railway lines with the Rae system. Among the recent contracts are the following: One 80 kilowatt generator and equipment for an extension of the Calumet and South Chicago line, one 40 horse power equipment for Wooster, Mass., and also a large plant for the Queen City electric railway of Marion, Ind. An extensive new factory is being built, which will be ready for next season's business, when more attention will be paid to general electrical work.

Huyett & Smith of Detroit, manufacturers of fans especially adapted to electric motors and other electric appliances, have recently removed their Chicago headquarters from 26 and 28 W. Randolph street to 31 South Canal, st., where a very commodious roomhas been provided. C. A. Lathrop who had been in charge of the Milwaukee office was transferred to Chicago last month, and the entire western territory placed under his charge. The capacity of the factory at Detroit has been doubled recently, and with the increased facilities in the sales department the output will undoubtedly increase rapidly.

E. G. Gilbert, Atchison, Kan., is erecting a 40 horse power steam plant, consisting of 40 horse power engine, boiler, heater, pump, etc., for the Norfolk Street Railway Construction company, Norfolk, Neb. He also installed a 35 horse power engine for the Norfolk Beet Sugar company, Norfolk, Neb. Both engines are of the Ball type. The Wesleyan University, Middletown, Conn., is installing a 25 horse power Ball engine, and the Johnson company, Johnstown, Pa., has recently ordered a 60 horse power engine, making the twenty-second engine built by the Ball company for the Johnson company, aggregating over 3,000 horse power.

The Palace Hotel, San Francisco, Cal., has ordered a 200 horse power cross compound engine from the Ball Engine company, Erie, Pa., for the electric light plant. The Palace Hotel is now using a 100 horse power tandem compound engine, manufactured by the Ball Engine company. The Patent Brick company, San Francisco, Cal., has ordered a 150 horse power tandem compound condensing engine, one 200 horse power Stewart purifier and heater and one 200 horse power Wheeler independent pump and Admiralty surface condenser; and H. Bloomfield, San Francisco, Cal., has ordered a 150 horse power compound condensing engine from the same company.

An interesting catalogue has been issued by H. Ward Leonard & Co. of New York, entitled "The value of the Services of a Consulting Electrical Engineer to Persons Investing in Electrical Plants." Among the topics discussed are the following: "Why such Service has not until Recently been in Demand; Instances from our own Experience Showing Value of such Services; Street Railway Plants; Foreign and Distant Plants; Our Method of Acting for Distant Purchasers; Acting to Assist Architects; Municipal Plants; Acting in Consultation with other Engineers; Value of Services to Owners in Making Alterations and Extensions; Value of Service to Parties Wishing to Apply Electricity to New Use; Services upon Inventions using Electricity; Services upon Electrical Patents; Expert Testimony in Legal Cases; Services as Contracting, as well as Consulting Engineers; Services for Parties Intending to Invest in Electrical Securities."

ELECTRICAL PATENTS.

Issued Oct. 6, 1891.

460,5[illegible]. Safety Plug. Henry P. Ball, Brooklyn, N. Y.

460,751. Turn-out or Switch for Trolley Wires. Daniel W. Edwards, Saginaw, Mich.

460,572. Printing Telegraph. Moses G. Farmer, Eliot, Me.

460,587. Electric Arc Lamp. Hosea W. Libby, Boston, Mass.

[illegible] to that class of arc lamp in which a [illegible] carbon is employed for the positive electrode and a pencil [illegible] for the negative electrode and the invention consists in the [illegible] manner of operating the electrodes and in the mechanism therefor.

[illegible]. Arc Lamp Pencil. Isaiah L. Roberts, Brooklyn, [illegible]

[illegible]

[illegible]. Electrode for Arc Lamps. Isaiah L. Roberts, Brooklyn, [illegible]

[illegible]. Electrode for Arc Lamps. Isaiah L. Roberts, Brooklyn, [illegible]

[illegible]. [illegible] for Secondary Batteries. Wm. A. [illegible], Jersey City, N. J.

[illegible]. Electric Conductor. William Vogler, Somer[illegible] Mass.

[illegible]. [illegible] for Electric Wires. William Vogler, [illegible]

460,614. Regulating the Speed of Electric Motors. Merle J. Wightman, Scranton, Pa.

460,615. Rail Connection for Electric Railways. Merle J. Wightman, Scranton, Pa.

460,618. Electric Switch. Charles Wirt, Chicago, Ill.

Of the three claims the second is given:

"In a circuit breaker the combination of a central rotating portion with extended spring arms, contacts having faces concentric with such rotating part, and similar contacts having faces eccentric with reference to the center of such rotating part and having faces exposed to such arms, the contacts having concentric faces being connected with the electrical circuit to be controlled."

460,619. Steno Telegraphic Apparatus. Alexander Wood, Philadelphia, Pa.

460,634. Trolley Wire Support. Thomas Fricker, Ashtabula, O.

460,650. Millampere Meter. Lyman D. McIntosh, Chicago.

Of the six claims the first is given:

"The combination, in a millampere meter, of a face-plate having on one side a short scale and on the opposite side a long scale, both scales arranged on the arc of a circle and both indicating milliamperes of measurement, and a deflecting needle, one end coacting with the short scale and the other end with the long scale."

460,652. Globe Protector for Electric Arc Lamps. Edward J. Openlander, St. Louis, Mo.

This guard is of conical shape, and is preferably made of perforated sheet metal, although it can be formed of other material. It is preferably made detachable from the lamp and shade, although it might be more or less a fixture thereupon.

460,676. Message Recording Instrument. Albert Storer, Boston, Mass.

460,680. Arc Lamp Electrode. Hosea W. Libby, Boston, Mass.

This invention is a carbon electrode for arc lamps, consisting of a hollow cylindrical carbon, the upper end of which is at right angles to its side, and its lower end of spiral form.

460,688. Musical Instrument. William M. Jewell, Chicago, Ill.

460,695. Electrically Controlled Cutting Device. Le Roy S. White, Waterbury, Conn.

This invention consists of the combination, with the cutter and a motor for operating the cutter, of a stop for arresting the motor, an electro magnet for withdrawing the stop, and an electric circuit in which said magnet is placed, the opening and closing of said circuit being under the control of the material to be cut.

460,701. Automatic Safety Cut-out. William B. Cleveland, Cleveland, O.

This invention consists of the combination, with a slotted contact, of a pivoted arm and a switch tongue engaging the contact and pivotally connected to said pivoted arm at a point a distance from the axial line of the fulcrum of the latter.

460,725. Insulation for Electric Wires. John R. Markle, Detroit, Mich.

460,735. Trolley Wire Support. Nelson Weeks, Jr., Long Island City, N. Y.

460,765. Composition for Insulating Material. Elihu Thomson, Lynn, Mass.

This invention consists of a composition for an electrical insulating material, consisting of asbestos, rubber, soapstone or their insulating equivalents.

460,767. Central Station Apparatus for Call Boxes. Edmund R. Wilder, Kansas City, Mo.

460,771. Telegraph Box System of Railway Traffic Control. David C. Coombes, Lewisham, near Sydney, and William Rowe, Marrickville, near Sydney, New South Wales.

460,779. System for Electrical Signaling for Railroads. Simon de Jager and Albertus Zoutman, Denver, Colo.

460,780. Underground Railway Conduit. Emil E. Keller, Chicago, Ill.

The last claim is given:

"The combination of an underground conduit with a bearing or guide surface on one side, a series of heavy laterally moving conductors on the opposite side, and a trolley adapted to engage such movable conductors and provided with guide rollers to engage the guide surface."

460,781. Electric Railway Trolley. Emil E. Keller, Chicago, Ill.

The first claim follows:

"In a trolley, the combination of a conductor body connected with the part to which the current is to be led and a series of rollers in contact with such body and disposed so that two or more of them will engage the conductor which delivers the current simultaneously."

460,864. Automatic Electric Switch Indicator. Everest W. Hadley, Corvallis, Ore.

460,887. Electric Railroad. Ira Robbins, Sheffield, Ala.

460,895. Electrical Alarm. Homer P. Smith, Neenah, Wis.

Of the two claims the first is presented:

"In the lubricator, the combination, with the oil receptacle, of the depending tube open upon its sides, the movable buoyant contact guided upon the said tube, the spring actuated valve within the said tube, the fixed contact within the receptacle, the lower metallic portion having screw threaded upward extending portion to which the lower end of said tube is connected, and electrical connection."

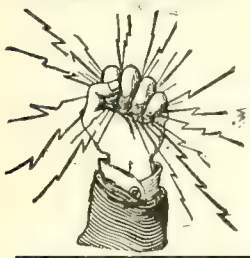
460,926. Core for Electric Solenoids. John T. Williams, Mount Vernon, Va.

The first claim reads:

"The combination, with a coil, of a magnetic core movable axially through the coil and composed of a series of tubular members of different length and varying in diameter, which are fitted one within the other in metallic contact, and having their middle zone arranged in the same plane."

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street.

P. C. ACKERMAN, Agent.

THE "CLARK" WIRE.

Insulation Guaranteed Wherever Used. Aerial, Underground or Submarine.

In a letter from the INSPECTOR of the Boston Fire Underwriter's Union, under date of March 29, 1883, he says: "A Thoroughly Reliable and Desirable Wire in Every Respect."

The rubber used in insulating our wires and cables is specially chemically prepared, and is Guaranteed to be waterproof and will not deteriorate, oxidize or crack and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid, an 1 to a very great extent, fire proof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

EASTERN ELECTRIC CABLE COMPANY,

61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

CHICAGO AGENTS: THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

BRASS CASTINGS.

THE TURNER BRASS WORKS,

4 LaSalle Avenue, Chicago.

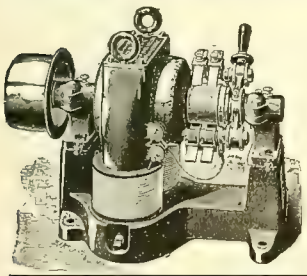
Write us for Prices.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

JAMES LEFFEL WATER WHEELS

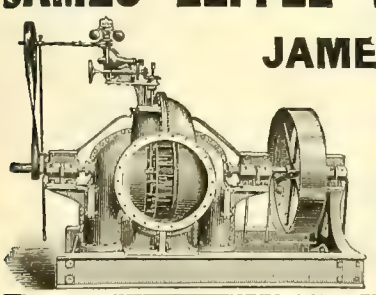
BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.



Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

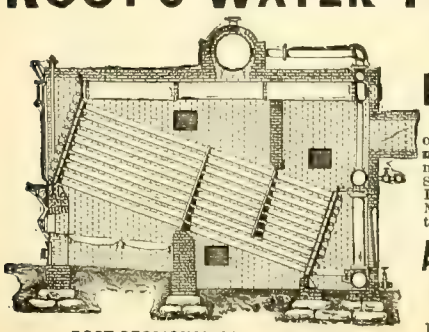
SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ROOT'S WATER-TUBE BOILER.

SAFE, ECONOMICAL. DURABLE

AN EXCELLENT

Electric Plant Boiler.



ROOT SECTIONAL SAFETY BOILER.

Adop'ed by the Electric Light Companies of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass. and the Thomson-Houston Electric Co., Lynn, Mass.

Abendroth & Root Mfg. Co.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N. Y.**

BRASS FOUNDRY.

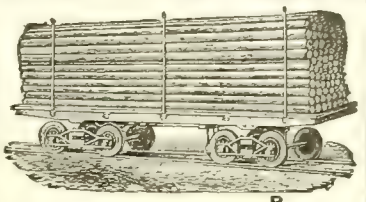
Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES

A SPECIALTY

L. BLATZ, 103-107 West Monroe St., CHICAGO.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

FOR SALE,

One 3 Horse Power Electric Motor.

One 6 Horse Power Electric Motor.

Both in excellent condition, having been used but little.

ERIE ELECTRICAL SUPPLY CO.,

ERIE PA.

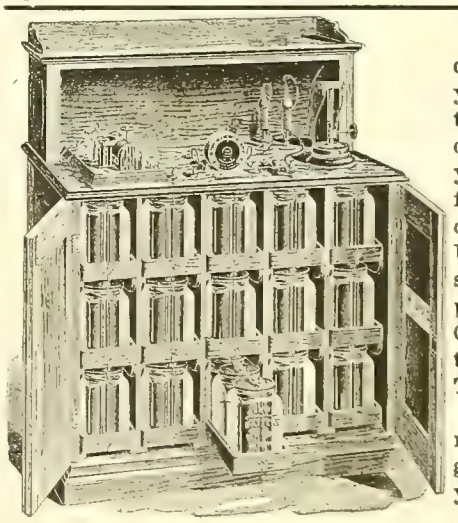
Standard Laboratory Photometer.

For Illustrations see WESTERN ELECTRICIAN of September 12th, Page 150.

This outfit is designed to measure accurately the candle power of Incandescent Lamps, and will be found of great value by Manufacturing Companies. Price for the complete set or separate parts furnished upon application. Correspondence solicited.

Send for Illustrated Descriptive Catalogue 1--66.

QUEEN & CO., PHILADELPHIA.



The Law Electro-Therapeutical Office Outfit.

Have you been in doubt as to whether you need an office battery, or are you in doubt as to just what you require, and the first cost, and to the cost of maintenance? Use the Law Outfit and secure pleasure and profit. More than 63,000 cells of Law Battery in use for Electro-Therapeutical work.

Eleven years on the market. Every cell guaranteed for ten year's service.

SOLE MANUFACTURERS:

LAW TELEPHONE CO., 85 John St., N. Y.

Cable Address: "Barbery." Write us for Catalogue.

AN EXPENSIVE DELAY

Will Not Occur If You Order Supplies from Us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers; Packard High Grade Lamps; Eddy Motors; "Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

931 Rookery, CHICAGO. 134 E. 6th St., opp Hotel Ryan, ST. PAUL. 409 W. Michigan St., DULUTH

SEND FOR CATALOGUE AND DISCOUNT SHEETS.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES, SHADES, Etc., Etc.,

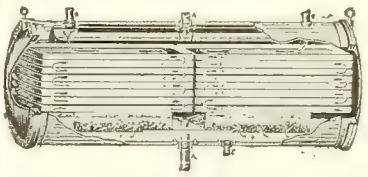
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

H. WARD LEONARD & CO.,

Contracting and Consulting Electrical Engineers.

Write for descriptive pamphlet if you wish to use electricity for any purpose whatever.

Electrical Exchange Building.
NEW YORK CITY.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingots, Slabs, Sheet Wire and Castings at lowest market rates.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.

TO AMERICAN INVENTORS.

Woodhouse & Rawson,

UNITED, LD.,

88 Queen Victoria Street,

LONDON, ENG.,

NEW YORK OFFICE, 36 WALL STREET.

Are Prepared to Negotiate and Introduce Inventions of Merit into Great Britain and all Parts of the World.

CORRESPONDENCE INVITED.

EVERYTHING IN

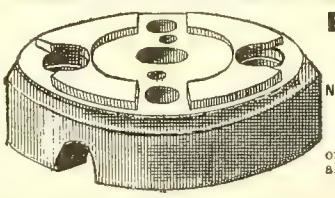
WIRE—FUSE— STRIPS.

MANUFACTURED BY

The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

OLBURN ELECTRIC MFG. CO.

№ 180 MAIN St.
FITCHBURG, MASS, U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

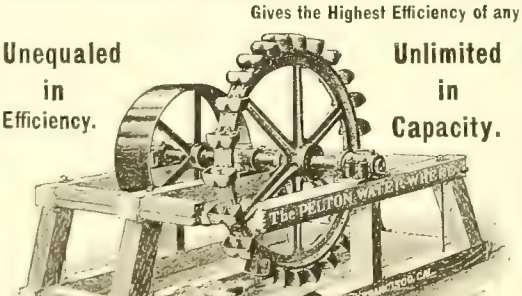
TRUE HARD PORCELAIN.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 50 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,
121-123 Main St., San Francisco, Cal., U. S. A.
143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

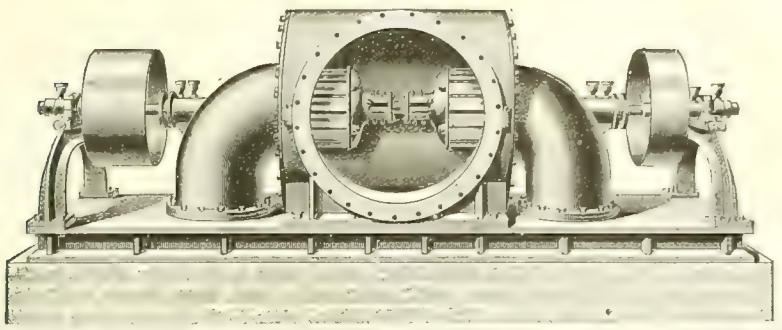
45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This system Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES [illegible] to the **CELEBRATED WATER WHEEL** [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** [illegible] **diameter,** being **double** the **Power** of most wheels of same diameter. It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended, as no gears are required and it can be belted directly to dynamo.

The accompanying engraving represents a pair of [illegible] **VICTOR TURBINES** arranged on a horizontal shaft with [illegible] Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

COMPLETED TO DEADWOOD.

The Burlington Route, C., B. & Q. R. R., from Chicago, Peoria and St. Louis, is now completed and daily passenger trains are running through Lincoln, Neb., and Custer, S. D., to Deadwood. Also to Newcastle, Wyoming. Sleeping cars to Deadwood.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215 **136 Liberty St.,** NEW YORK

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

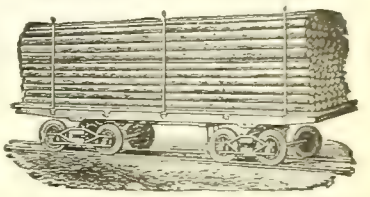
HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

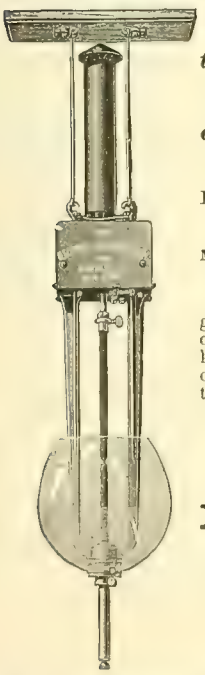
ESTABLISHED 1873.
SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building, **CHICAGO, ILL.**

Established 1881.

Telephone Building, **NEW YORK CITY.**

C. & C. ELECTRIC MOTORS AND DYNAMOS.

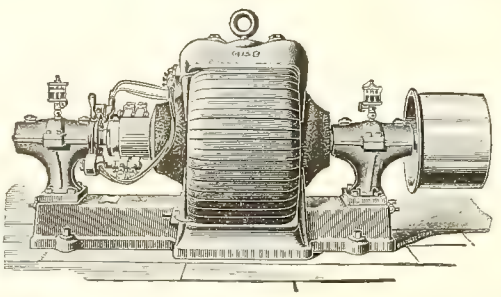
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS., NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.

MORE WORDS ARE NEEDED

TO DO JUSTICE TO THE

PERRET ELECTRIC MOTOR.

OFFICE OF CURTIS MANUFACTURING CO., Manufacturers of Carriage Robes,
Fifth Avenue and 16th Street, New York City, September 16, 1891.

The Elektron Manufacturing Co.—

GENTLEMEN:—If there were words enough in the English language to express my admiration of the Perret Motor I might do justice to its good qualities; but there are not. We have used it every working day since it was put in, and not one cent has been expended on it except for oil. It drives our six heavy machines as steadily as a clock. I consider it the very best power we could get, and would not part with it unless I could get its equal. I take special pride in showing it to my friends. It's not a plaything, but business every day. If any one wants to know what it can do, just send them up to me. Yours truly, CURTIS MANUFACTURING CO.

THE ELEKTRON MANUFACTURING CO., SPRINGFIELD, MASS.,

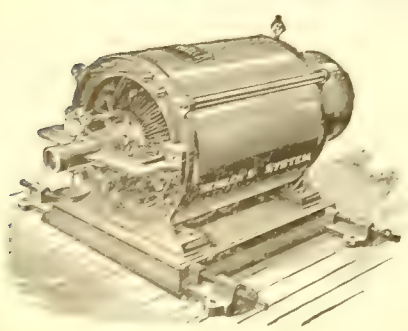
New York Office, 89 Liberty Street.

Selling Agents: WASHINGTON, D. C.—J. U. Burkett & Co., 1409 New York Ave. NEW ORLEANS, LA.—George Baquie, 140 Gravier St.
CHICAGO, ILL.—The Electrical Engineering Co., 320 Dearborn St. ST. PAUL, MINN.—F. J. Benz, 95 East Fourth St.
PHILADELPHIA, PA.—Pennsylvania Machine Co., 29 North Seventh St.

The Heisler System Long Distance Incandescent Lighting.

A practical subdivision of the electric light. Cheap to install and perfectly automatic regulation.

Specially adapted for the lighting of Public Halls, Railroad Depots, Pleasure Resorts, Streets, Stores and General Illumination.



Noted for the Brilliancy of the Light and Greatest Production of Candle Power per H. P.

NO TRANSFORMERS USED UPON THE CIRCUITS.

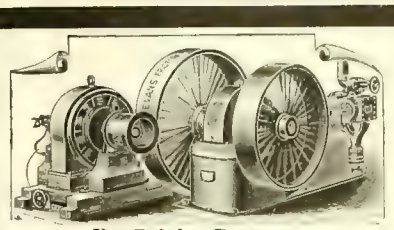
We manufacture and carry in stock, dynamos of the following capacity, in 32 C. P. lights: 160,-200,-250, 300,-350,-400,-450, which will operate their rated capacity in 16,-20,-32-45,-60,-100 and 150 C. P. Lamps. The output of any of the above sized dynamos can be distributed from a circuit composed of No. 8 B. & S. wire; and there will be no drop in candle power of the lights at any point upon the circuit.

Full guarantee given with our apparatus, and special fixtures for indoor and outdoor lighting.

Series Lamps and Sockets for any current or candle power. Send for descriptive matter and price lists.

HEISLER ELECTRIC LIGHT CO., DREXEL BUILDING, PHILADELPHIA.

AGENCIES:—Inter-State Complete Electric Construction Co., St. Louis, Mo.; Belton Electric Co., Belton, Texas.; Howe Construction Co., Norwalk, O.



For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.

Evans' Cones.
For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | **CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.**

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus, Electric Motors and Generators,
Alternating Current Apparatus, Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

COOLIDGE FUEL & SUPPLY CO.,

RAILROAD CROSS TIES AND PILING.

CEDAR AND OCTAGONAL PINE POLES.

CROSS ARMS, PINS AND BRACKETS.

—MANUFACTURED BY—

J. R. CLARK CO., Minneapolis, Minn.

This cut represents our Class A

STAR SIGHT "UP-FEED" LUBRICATOR.

There are no joints about it. Arms and body cast in **One Piece**, so you won't be annoyed by leaking and it will work to your entire satisfaction. Will let you try it before you buy it.

For sale by Jobbers, or apply to

THE WM. POWELL CO., - CINCINNATI, O.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

BRANCHES: 164 Summer St., Boston, Mass; 225 Pearl St., New York City. 120 N. Third St., Philadelphia, Pa; 60 W. Monroe St. Chicago. | St. Louis, Mo.

THREE GOOD BOOKS.

DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO, ILL.

ONE DOLLAR EACH.

CUT-OUTS,
JOINTS,
DISTRIBUTING
BOXES,
ELBOWS
ETC., ETC.

CORRESPONDENCE SOLICITED.

THE NEW SAFE-DUCT AND COMPLETE METHOD OF WIRING FOR ALL ELECTRIC LIGHTING SYSTEMS.

"VULCA"

AND CHICAGO.

ELECTRICAL WIRE DUCTS.

THE NATION'S CHOICE.

Grimshaw White Core Wire.

B. D. WIRE, TAPES AND COMPOUNDS.

ALL SUPPLY STORES KEEP THEM.

NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street, CHICAGO,

MAIN OFFICE: 649-651 Broadway, New York. GEO. H. MEEKER, Western Manager.

THE NATIONAL TRANSFORMER SYSTEM

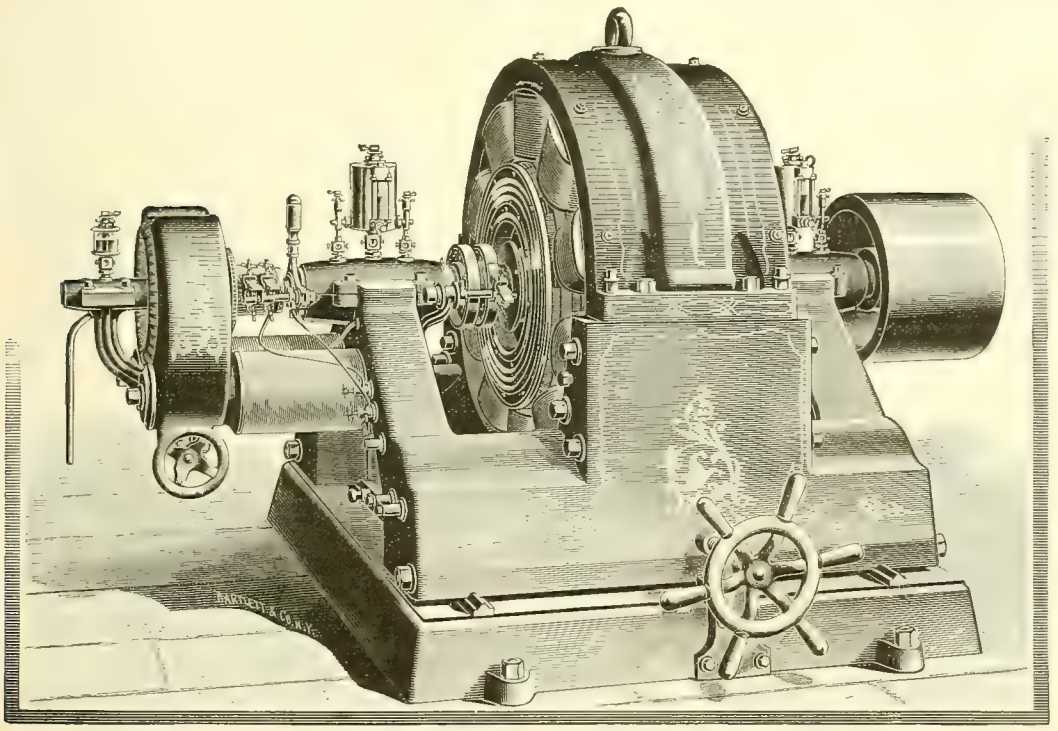
OF INCANDESCENT LIGHTING.

Florence, S. C., August 19, 1891.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.:

GENTLEMEN:—I write this to tell you of the wonderful performance of our Alternating Dynamo, which is a 750 lighter of your manufacture. Last night, while at supper, a cross got on our mains by their sagging on to a telegraph wire, and my engineer, who is a new man, ran the dynamo with the ampere meter needle clear on the end of the scale, which is about 80 amperes, or equivalent to approximately 1,600 lamps. It ran that way until it chocked down a 100 H. P. engine with 110 pounds steam, and then he sent for me. Strange to relate, the machine was not damaged a particle. The excessive current had melted all of the 4 fuses on the board, but the engineer had put in new ones and heavier ones, and had started up again. I consider that we have the only dynamo on earth that would stand such a strain and not be injured. I shall of course see to it, that a thing of this kind does not happen again.

[Signed] A. A. FORMAN, Supt. Florence Impvt. & Mfg. Co.



Self-Contained Alternator. Capacity 1,000 16 C. P. Lamps.

THIS IS THE MACHINE THAT WE BUILD.

SEND FOR CIRCULARS AND PRICES.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

AGENTS

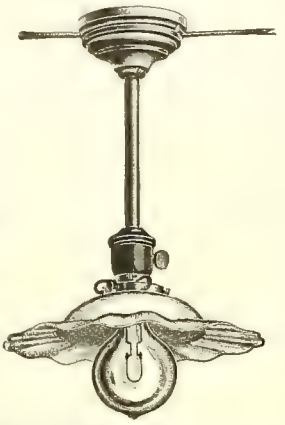
NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.
SEATTLE, WASH.,	Chas. H. Baker & Co.
ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
DETROIT, MICH.,	Commercial Electric Co.
DENVER, COLO.,	The Mountain Electric Co.
WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
SAN FRANCISCO, CAL.,	National Electric Development Co
KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
DULUTH, MINN.,	The Electrical Eng. & Supply Co.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS
—FOR—
ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

The Card Electric Motor and Dynamo Co.,

—CINCINNATI, OHIO.—

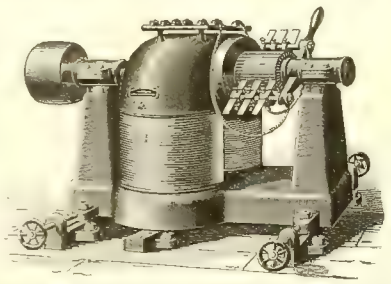
MANUFACTURERS OF

ELECTRIC MOTORS AND DYNAMOS.

Incandescent **Dynamos** from 20 to 350 Lights.

Arc or Incandescent **Motors** from ⅛ to 30 Horse Power.

Motors for the Arc Circuit a Specialty.



These Motors have the Highest Efficiency, Low Speed and Self-Oiling Bearings.

AUTOMATIC, SIMPLE, DURABLE AND CLEAN.

Correspondence Solicited.

AGENTS.—Boston: The Eastern Electrical Supply and Construction Co., 65 Oliver Street. Chicago: The Thos. L. Johnson Co., 312 Dearborn Street. Milwaukee: Henry Ramien, 641 Third Street. Washington, D. C.: J. Geo Gardner, 1005 H. Street. St. Louis: Stagl Electrical Engineering Co., 1106 Pine Street. Montgomery, Ala.: W. F. Murphy. Detroit, Mich.: The Michigan Electric Co., 212 and 214 Griswold Street. Minneapolis, Minn.: J. M. Lennon, 22 Loan and Trust Building.

FOR SALE:

(IN GOOD ORDER.)

One Edison 150 Light Dynamo, good as new . . $275 00

One U. S., New Style, 110 Volt, 200 Light Incandescent Dynamo. Rheostat, Ammeter and 200 Key Sockets, has not been used three months, good as new 375 00

One Manchester 50 Volt, 200 Light Compound Dynamo 180 00

One Manchester 50 Volt, 150 Light Dynamo . . 150 00

One Daft 110 Volt Shunt, 200 Light Dynamo, New Armature 250 00

One C. & C. 15 H. P., 110 Volt Motor 260 00

One T.-H. 500 Volt Compound Dynamo, 50 H. P., New 1,260 00

One T.-H., 15 H. P., 500 Volt Motor, New 400 00

One Sperry Arc Dynamo and ten Arc Lamps . . 350 00

One 600 Volt, 25 Ampere, U. S. Shunt Dynamo 400 00

FOREE BAIN,

47 and 49 South Jefferson Street,

CHICAGO.

AUGUST BELMONT & CO., New York.
LEE, HIGGINSON & CO., Boston.

Subscription for

$3,000,000

7 per cent. Cumulative Preferred Stock.

SHARES, $50 EACH.

WESTINGHOUSE
Electric & Manufacturing Co.,

NO. 120 BROADWAY, NEW YORK.

DIRECTORS:

CHARLES FRANCIS ADAMS . . . Boston, Mass
LEMUEL BANNISTER . . . . . Pittsburg, Penn.
AUGUST BELMONT . . . . . New York, N. Y
A. M. BYERS . . . . . Pittsburg, Penn.
CHARLES FAIRCHILD . . . . . Boston, Mass.
MARCELLUS HARTLEY . . . . . New York, N. Y.
GEORGE W. HEBARD . . . . . New York, N. Y
HENRY B. HYDE, ... New York, N. Y.
BRAYTON IVES . . . . . New York, N. Y
GEORGE WESTINGHOUSE, Jr. . . . . Pittsburg, Penn.

REGISTRAR OF TRANSFERS:

MERCANTILE TRUST CO., - 120 Broadway, N. Y.

WE ARE AUTHORIZED TO OFER FOR SUBSCRIPTION THE ABOVE ISSUE OF Seven Per Cent. Cumulative Preferred Stock AT PAR.

The Preferred Stock is entitled to a cumulative preferred dividend of 7 per cent, payable semi-annually on Jan. 1 and July 1, and, in addition, to a proportionate share of all dividends declared in any year, after 7 per cent has been paid on the other stocks outstanding. The Preferred Stock has also a preference in the assets of the company in case of liquidation over all other stocks.

The authorized capital stock of the Company is $10,000,000, of which $4,000,000 is Preferred Stock. Shares, $50 each.

The portion offered for subscription will be full paid and non-assessable when taken and paid for hereunder.

Application will be made to list the stocks on the New York and Boston Stock Exchanges.

The proceedings taken by the Company to create this issue of Preferred Stock have been submitted to counsel, and they advise us that the reorganization and this issue of Preferred Stock are valid in law.

The business of the Westinghouse Electric and Manufacturing Company has grown to its present large proportions in about five years. Its growth has been not only rapid, but continuous, and has fully kept pace with the remarkable development of the electrical industry. Sales are as follows:

9 months, from 1st April to 31st December, 1886, $141,816.71
12 months, to 31st December, 1887 . . . . . 874,657.87
12 months, to 31st December, 1888 . . . . . 1,288,569.41
12 months, to 31st December, 1889 . . . . . 3,618,379.81
12 months, to 31st December, 1890 . . . . . 4,289,086.81

The Company manufactures its apparatus at three fully equipped factories, located, respectively, at Pittsburg, Penn., Newark, N. J., and New York City, which furnish exceptionally complete facilities for the manufacture of all kinds of electric light and power apparatus.

The company relies chiefly for success upon the quality and mechanical perfection of its work, although it has more than one thousand patents affording valuable protection against competition.

The Company will continue to have the benefit of the mechanical and engineering ability of its founder, Mr. Westinghouse.

We have made an estimate of the assets of the combined Companies, and our examination has led us to believe that, after making liberal deductions for all foreseen contingencies, the assets of the reorganized company will furnish ample security for the total issue of Preferred Stock, without taking into consideration the value of the patents at all, and that the working capital will be fully sufficient to conduct the business on an economical basis, the saving in the interest account alone being sufficient to pay full dividends on this issue.

Subject to certain reservations detailed in the prospectus, the examination of the accountants shows an average profit of $443,140.52 per annum for the periods considered.

We invite subscriptions to the above mentioned Preferred Stock AT PAR, payable as follows.

10 PER CENT. ON APPLICATION.
30 PER CENT. ON ALLOTMENT.
30 PER CENT. ON 2D NOVEMBER.
30 PER CENT. ON 23D NOVEMBER.

Subscribers have the option of paying in full for the stock allotted to them, and interest on the anticipated payment will be allowed at the rate of 4 per cent per annum.

The right is reserved to reject or reduce any subscriptions and to make allotments of less than the amounts applied for. In allotment preference will be given, so far as practicable, to those stockholders assenting to the recent plan of reorganization and to employes and dealers in the Company's manufactures.

The failure on the part of the subscriber to pay any instalment when due shall operate as a forfeiture of all previous payments.

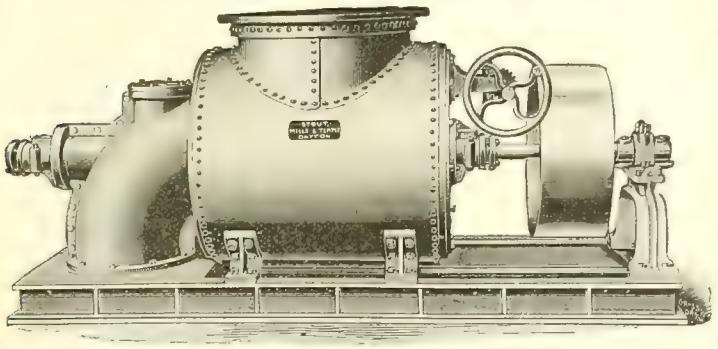
The subscription list will open simultaneously at 10 o'clock A. M. on Wednesday, the 14th day of October, 1891, and close at 3 o'clock P. M. on Friday, the 16th day of October, 1891, at our offices.

AUGUST BELMONT & CO.,
23 Nassau St., New York.
LEE, HIGGINSON & CO.,
44 State St., Boston.

Copies of the Plan of Reorganization, the Prospectus, with full details and forms of application, can be obtained at the offices above mentioned.

The subscription for the entire amount of the Preferred Stock above offered has been guaranteed by underwriters in this country.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

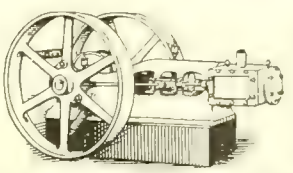
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 447 North Street, BALTIMORE, MD.

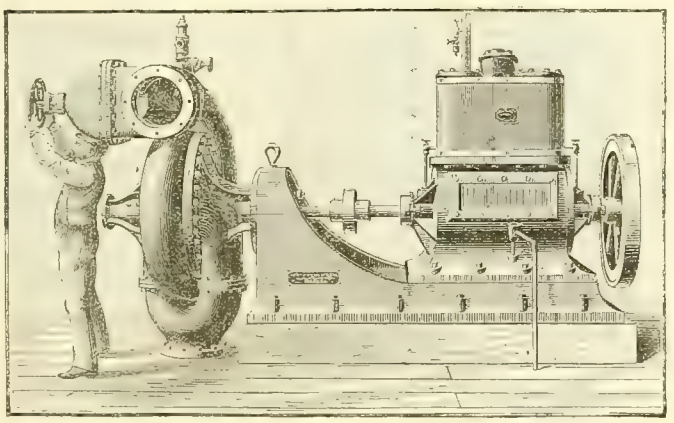
BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES

A SAMPLE INSTALLATION.

Standard Automatic Engine coupled direct to a Centrifugal Pump.
Speed 280 Revolutions.

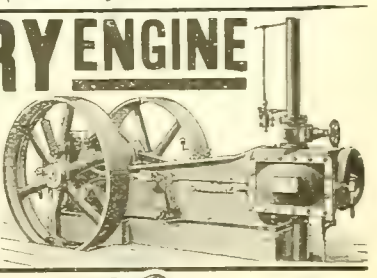


Over 4000 Westinghouse Standard Engines in use.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application.
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES | Philadelphia, 942 Drexel Bldg.
San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST.
CHICAGO.
HALF TONE PLATES A SPECIALTY

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

"BE YE THE JUDGE."

HAVE YOU TRIED THE

ECONOMIC INCANDESCENT LAMP?

If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again*. Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

GEO. L. KIRKHAM, Manager. 1017 Chamber of Commerce, CHICAGO.

Thomson-Van Depoele

ELECTRIC MINING COMPANY,

148 Michigan Avenue, Chicago.

Inspect Our Exhibit at Chicago Exposition Building, Opposite our Office.

Exposition Closes October 24th.

A SURE WINNER.

NO BLUFF.

We Carry a Large and Complete Assortment of

WEATHER-PROOF, MAGNET, OFFICE AND ANNUNCIATOR WIRES,

Which are Manufactured Expressly for Us by

THE CHICAGO INSULATED WIRE CO.,

Which Enables Us to Quote MANUFACTURERS' PRICES.

THE KNAPP ELECTRICAL WORKS,

54 and 56 Franklin St., CHICAGO, ILL.

THE WIRT AMPERE INDICATOR.

(PATENTED.)

This instrument is designed for the practical work of Station Electricians and answers the conditions more perfectly than any instrument yet sold.

The working parts being simple and well made, will stand handling, shipping and all ordinary use.

Made in any size from 10 to 1,000 Amperes.

THE WIRT VOLT INDICATOR.

(PATENTED.)

Is intended to be left in circuit continuously and can be relied upon for constancy and accuracy under the most trying conditions. The resistance of the instrument is high—making the consumption of energy small. An adjustable index permits *reading at a distance*, indicating variations from normal pressure.

Correspondence invited regarding these [illegible] Instruments.

THE ELECTRICAL SUPPLY CO.,

RANDOLPH ST. AND MICHIGAN AVE.,

CHICAGO.

[illegible]

No Argument

In favor of a proprietary article can be so convincing as a review of its record in past services.

The past record of Shield Brand, Moisture-proof Wire is evidence that it possesses a *superiority peculiar to itself.* The many miles of it in daily use for Arc and Incandescent Lighting, for Electric Railway and Power Circuits is a constant recommendation to the intending purchaser. While it may be that the reputation of a manufacturer carries considerable weight in favor of a particular article, of which he may be the exponent, the *article* itself must sooner or later bear evidence of individual merit, *else fail.*

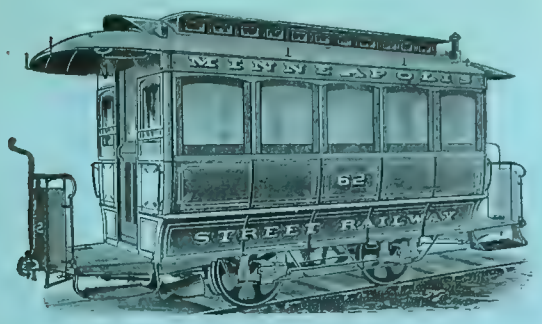
The purchaser of an Insulated Wire stands in somewhat the same light as the man who wanted a fast horse. He found several which gave promise of future swiftness—but they needed training. At length he exclaimed: "I won't have a horse that is *going to be* fast—I want one that *is* fast."

Shield Brand Wire *is* "Moisture-proof."

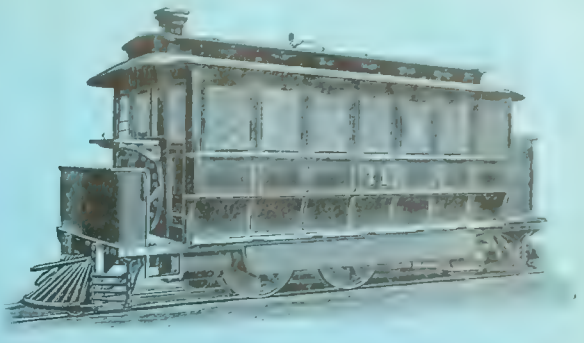
THE ELECTRICAL SUPPLY CO.,

CHICAGO.

Inclose business card for our Illustrated Catalogues.



STREET CARS



FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

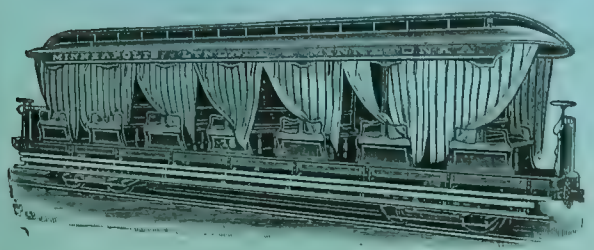
MINNEAPOLIS STREET RAILWAY CO.,

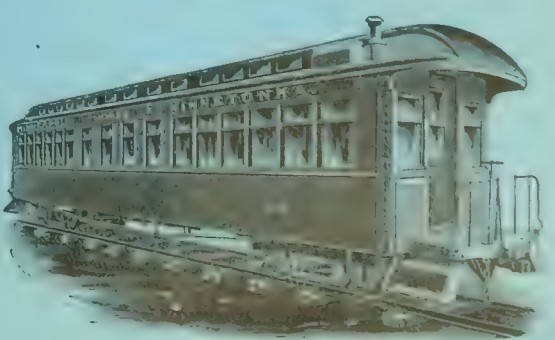
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

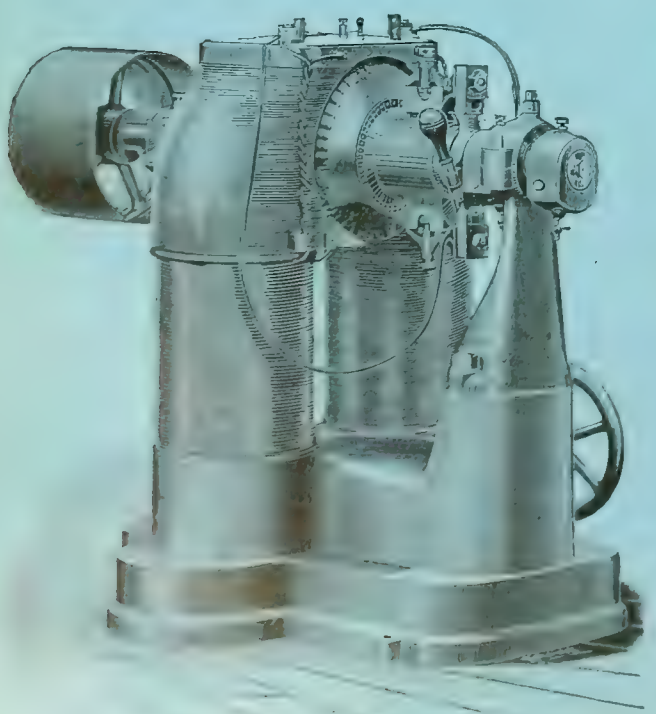
Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

COLUMBIA ELECTRIC CO.,

MANUFACTURERS OF



Large Stationary Motor, Columbia Make.

MOTORS, GENERATORS, DYNAMOS, LAMPS, SUPPLIES AND SPECIALTIES.

ALL GUARANTEED MECHANICALLY, ELECTRICALLY AND LEGALLY.

ST. PAUL, - - MINN.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, OCTOBER 24, 1891. No. 17

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling. ALL SIZES *Lead Encased Wires.* Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF
THE Packard HIGH GRADE INCANDESCENT LAMP

AGENTS
J. W. Peale, - - No. 1 Broadway, New York.
Electric Eng. & Supply Co., - - Syracuse, N.Y.
Central Electric Co., - - - - - Chicago.
The Electrical Eng. & Supply Co., St. Paul, Minn.
St. Louis Electrical Supply Co., - - St. Louis.

CLOWER, HARRIS & CO.,
CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.
The Largest Electrical Supply House west of the Mississippi River
Everything Electrical
289 ELM STREET. - - DALLAS, TEXAS.

For Isolatine Paint
See Page xii.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.

OKONITE TRADE MARK

INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

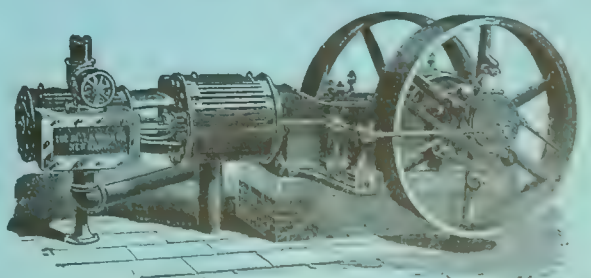
WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

THE 1891 ELECTRIC MOTOR AND BATTERY.

SIMPLE. DURABLE.
ECONOMICAL. EFFICIENT.
For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at
ONE-HALF PRICE.
Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IMPROVED BALL ENGINES,
BUILT BY THE BALL & WOOD CO., NEW YORK.



W. B. PEARSON, Selling Agent. Home Ins. Bldg., Chicago, Ill.

The Thomson-Houston ELECTRIC CO.,

MANUFACIURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co.. ---
Alexander, Barney & Chapin.....I
American Electrical Works.... xiii
Andrews & Co., A. H..... ... xxi
Babcock, W. H.... xiv
Baggot, E xiv
Bain Electric Mfg. Co..... xx
Ball Engine Co..... xxi
Ball & Wood Co., The I
Beggs, J. E., Mfg. & Supply Co. iv
Bernstein Electric Co..... ---
Blatz, L..... ---
Borden & Selleck Co..... xv
Braun Illustrating Co xxi
Brownlee & Co..... xii
Brookfield, Wm..... ... xii
Brush Electric Co..... ...xvii
Butler Hard Rubber Co ..... ---
Buxton, Geo. B xx
C. B. & Q. R. R..... xv
C. & C. Electric Motor Co..... xvi
Card E. Motor & Dynamo Co.. ---
Central Electric Co..... v
Chicago Electric Mfg. Co..... xiv
Chicago Electric Motor Co..... xiii
Clower, Harris & Co..... I
Chicago Insulated Wire Co... xvii
Colburn Electric Mfg. Co..... xx
Columbia Electric Co..... xviii
Coolidge, Fuel & Supply Co... ---
Consol. Elec. Mfg. Co., The.. ---
Cowles Elec. Smelt. Alum. Co..xiv
Crocker-Wheeler Elec. Mo. Co. xiii
Cutter, Geo..... xxvi
Day's Kerite Insulation..... I
Dayton Globe Iron Works Co..xxi
Delaware Hard Fibre Co..... xiv
Detroit Electrical Works..... vii
Densmore Typewriter Co..... xii
Eastern Electric Cable Co..... xiii
Easton Electric Co..... xx
Edison General Electric Co..... vi
Edison General Electric Co., Cable and Wire Department..... vi
Electric Construction & Sup. Co.. xv
Electric Merchandise Co..... x
Electric Secret Service Co..... x
Electrician Pub. Co..viii, x, xix, xx
Elec. Construction Co., The.... xiii
Electrical Engineering Co..... ---
Elec. Eng. & Supply Co., The.. ---
Electrical Supply Co., The... xxiv
Elektron Mfg. Co..... xvi
Empire China Works..... xx
Erie Electrical Supply Co..... xiii
Evans Friction Cone Co..... xvii
For Sale..... iv, xiii, xx
Foster, O. A..... I
Fort Wayne Electric Co..... xxvi
Franklin Electric Co..... ---
Freeman, Coleman & Co..... iv
Gleason & Bailey Mfg. Co. Ltd. xiv
Globe Carbon Co..... xv
Great Western Elec. S. Co..... ix
Greeley & Co., The E. S..... I
Hale Elevator Co..... iv
Heisler Electric Light Co..... xvi
Hill Clutch Works..... xx
Hine Eliminator Co..... ---
Holmes, C. H..... xiii
Holmes, Booth & Haydens... xvii
Hood, Wm..... x, xix
India Rubber & Gutta Percha Insulating Co..... xxv
Interior Conduit & Insulation Co. x
International Okonite Co..... I
Kartavert Mfg. Co..... ix
Keller & Degenhardt..... xii
Knapp Electrical Works..... xviii
La Roche Electric Works..... iv
Law Telephone Co..... xiii
Leonard & Co., H. Ward..... ix
Leffel & Co., Jas..... xiii
Loud, H. M. & Sons Lumber Co..xiv
McLaughlin, James xiii
Mason, James H..... xii
Milliken Bros..... iv
Minneapolis Street Railway Co. ---
Monitor Electric Co..... x
Munsell & Co., Eugene..... xiii
Murphy, T. J..... xv
N. W. T. H. Electric Co ..... ---
National Carbon Co..... iv
National Electric Mfg. Co ..... ---
N. Y. Belting & Packing Co.... ---
New York Insulated Wire Co..xviii
New York & Ohio Co..... I
N. W. Elec. Specialty Co.... ---
Nuttall Company, R. D..... I
Ostrander & Co., W. R..... xx
Paiste, H. T..... xii
Page Belting Co..... xiv
Partrick & Carter Co..... ---
Payne & Co., Geo. W..... ---
Pearson & Co., W. B..... xxi
Pelton Water Wheel Co..... xiv
Phoenix Glass Co..... xx
Pond Engineering Co xxi
Powell Co., The Wm..... ---
Queen & Co..... xiii
Ries Elec. Specialty Co., The... x
Rockford Electric Mfg. Co..... xii
Roessler & Hasslacher Chemical Co..... I, xii
Royal Electric Co..... ---
Samson Cordage Works xii
Sargent & Lundy..... xiii
Sawyer-Man Electric Co..... xi
Schawel & Co., Jas..... xii
Schieren & Co. Chas. A..... xii
Schoonmaker, A. O xii
Schuyler Electric Co..... iv
Short Electric Railway Co..... xii
Schultz Belting Co..... xiv
Sperry Elec. Mining Mach. Co.. xiv
Standard Underground Cable Co....I
Stanley Electric Mfg. Co..... xxv
Star Iron Tower Co..... ---
Stearns Mfg. Co..... xxi
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co ix
Taussig, S..... ---
Temple, J. C..... xv
Thomson-Houston Elec. Co.II, xxii
Turner Brass Works..... xiii
Union Electric Mfg. Co., The.. ---
Union Electric Works..... ix
Union Hardware Co..... xii
U. S. Electric Lighting Co.... xi
Van Nuis C. S..... i
Vulcanized Fibre Co..... xv
Western Electric Co xvi
Westinghouse Elec. and Mfg Co---
Westinghouse Machine Co..... xxi
Weston Electrical Instrum't Co.. xii
Williams Engine Works..... xxi
Woodbridge & Turner Eng. Co..xv
Woodhouse & Rawson, Ltd.... ---
Worthington, Henry R..... xii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelt. & Alum Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg & Supply Co.
Brush Electric Co.
Columbia Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Samson Cordage Works.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Franklin Electric Co., The
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.
Turner Brass Works.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co. The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co,

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Cars, Railway.
Minneapolis St. Ry Co

Castings, Brass.
Blatz, L.
Turner Brass Works.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Detroit Electrical Works
Edison General Electric Co
Electrical Engineering Co., The.
Electrical Eng. & Supply Co
Fort Wayne Electric Co.
Keller & Degenhardt
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg & Supply Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg Co.
Columbia Electric Co.
Detroit Electrical Works.
Easton Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Cutter, Geo
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Columbia Electric Co
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co., The
Turner Brass Works.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrollers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co
Colburn Electric Mfg. Co.
Edison General Electric Co
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co
Ball & Wood Co., The.
Beggs, J. E. Mfg & Supply
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.
Turner Brass Works

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Columbia Electric Co.
Cutter, Geo.
Detroit Electrical Works
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Gleason & Bailey Mfg. Co Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co. The.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Delaware Hard Fibre Co
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Roessler & Hasslacher Chemical Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables.
Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co
Columbia Electric Co
Edison General Electric Co.
Electrical Supply Co., The
Electrical Eng. & Supply Co
Gleason & Bailey Mfg. Co. Ltd
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co
Northwestern Elect. Specialty Co
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm

Mining Apparatus, Electric.
Bain Electric Mfg Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Card Electric Motor & Dynamo Co
Crocker Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Clower, Harris & Co
Ball & Wood Co., The.
Edison General Electric Co.
Electrical Engineering Co, The.
Electrical Eng. & Supply Co
Elektron Manufacturing Co.
Erie Electrical Supply Co.
Ford & Co.
La Roche Electric Works
Rockford Electric Manufacturing Co
Royal Electric Co
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.
Turner Brass Works

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Babcock, W. H.
Woodhouse & Rawson, Ltd

Packing.
Buxton Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Roessler & Hasslacher Chemical Co

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co
Electrical Supply Co., The
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works
Western Electric Co.
Weston Electrical Instrument Co

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co
Stanley Electric Mfg. Co
Westinghouse Electric & Mfg. Co

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James.
Pelton Water Wheel Co
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Type Writer Co.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. **THE NATIONAL CARBON CO.** CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

NOW THEN!! FOR SALE CHEAP!!

Eight 50-light Thomson-Houston Dynamos, 110 volts.
One 1200 16-C. P. Alternating Thomson-Houston Dynamo.
Two extra Armatures for same, new.
Two Sperry Arc Machines, 50 lights, 2,000-C. P.
Four American Arc Machines, 25 lights, 2,000-C. P.
Sixty miles No. 10 American Electric Wire, used about one year.
Ninety five American Arc Lights, single carbon.
One thousand Goose Necks, Lamp, Shades, complete.
Two Ball Engines, 80-H. P., A 1, with Base.
One Armington & Sims, 60 H. P., with Base.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

Experimental Work in Anything Electrical.

FREEMAN, COLEMAN & CO.,

53 and 55 South Jefferson Street, - - CHICAGO, ILL.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK. MANUFACTURED BY MILLIKEN BROS. 59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

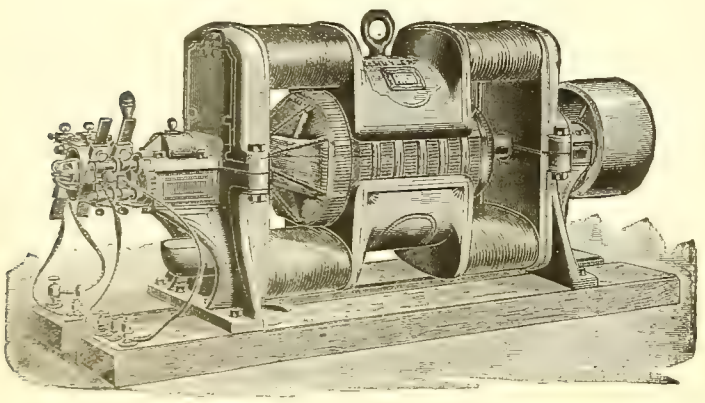
WRITE FOR CIRCULAR AND CATALOGUE.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.
Self-Lubricating Boxes.
Ventilated Armature, proof against a burn-out.
A Pure White Steady Light.

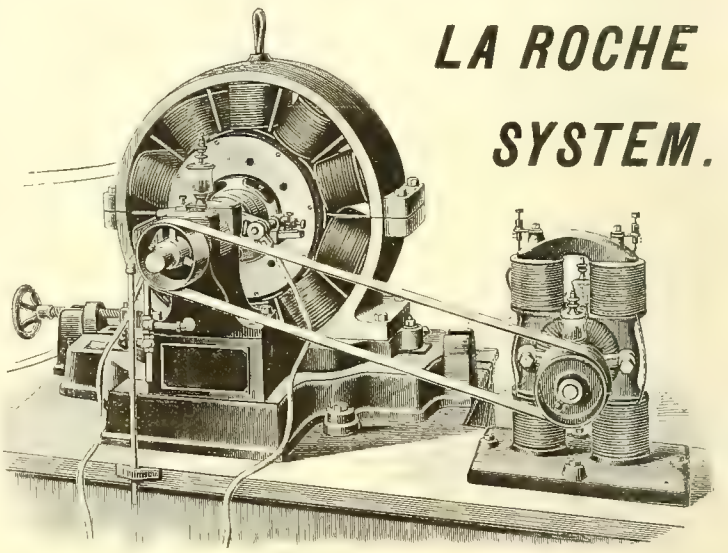
THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,

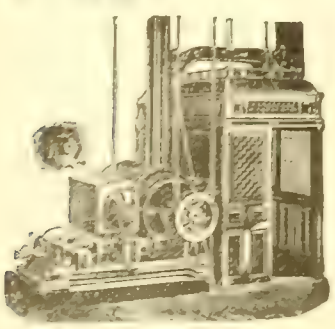
FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

OTIS



ELECTRIC ELEVATOR.

HALE ELEVATOR CO.,

187 La Salle Street, CHICAGO,

MANUFACTURERS OF

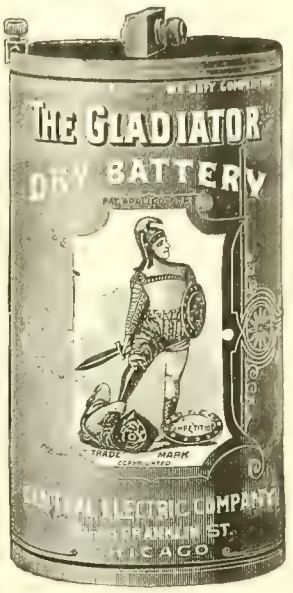
PASSENGER AND FREIGHT

Hydraulic and Electric

ELEVATORS.

DRY BATTERIES.

We have spent a lot of money and time in testing this dry battery, and believe it to be the best in the world. . . . .



$$C \quad \frac{E}{R}$$

In the Gladiator the

E = 1.6
R = .4
C = 4.

OUR ST. LOUIS BRANCH.

OKONITE

TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

OUR KANSAS CITY BRANCH.

OKONITE

TRADE MARK.

GATE CITY ELECTRIC COMPANY,
502 Delaware St., Kansas City, Mo.

TRADE MARK.

OUR OMAHA BRANCH.

OKONITE

TRADE MARK.

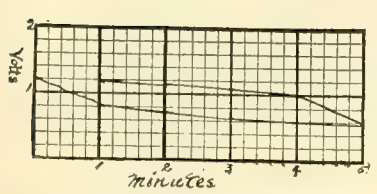
WESTERN ELECTRICAL SUPPLY COMPANY,
118 S. 15th St., Omaha, Neb.

OUR DENVER BRANCH.

OKONITE

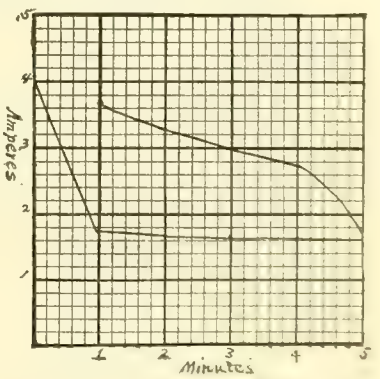
ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., Denver, Colo.

GET ON TO OUR GLADIATOR'S CURVES.



E. M. F. CURVE.

Showing drop of potential and recovery through 2 ohms of external resistance.



CURRENT CURVE.

Showing drop and recovery on short circuit

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

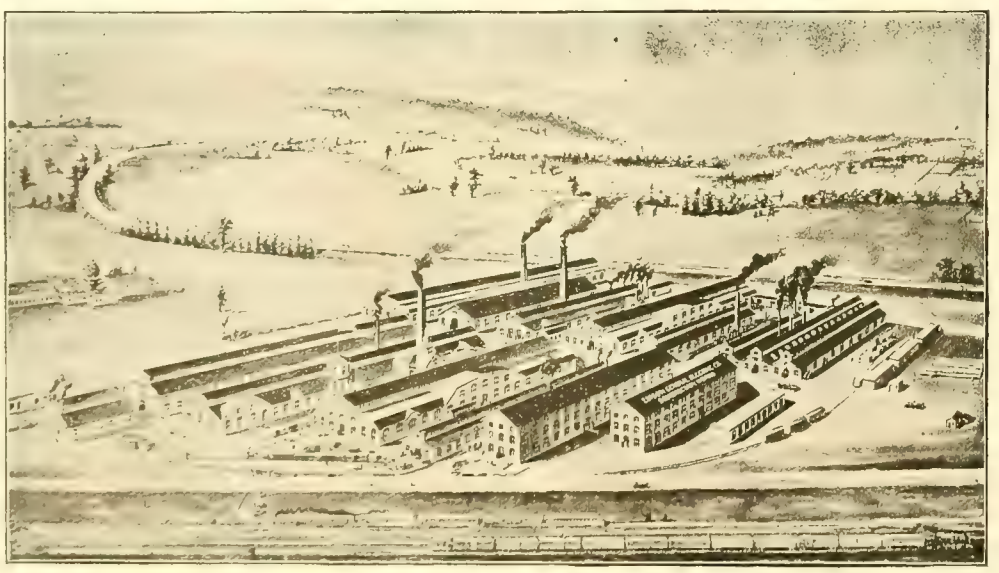
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street. Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

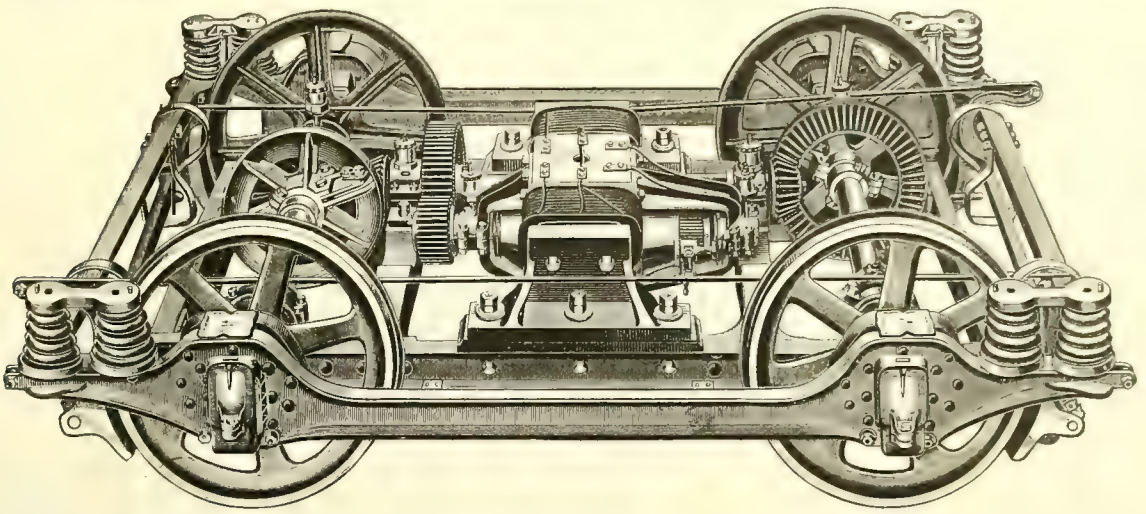
DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

FACTS, STREET RAILWAY MEN SHOULD KNOW ABOUT

The Detroit Electrical Works'

STANDARD RAILWAY SYSTEM.



Our *latest type "B"*, standard equipments have been ordered by street railway companies at Gloucester, Mass., 10 cars; Salem, Mass., 5 cars; Aurora, Ill., 15 cars; and by J. N. Beckley, President of the Rochester Railway Company, for his railway at Lawrence, Mass., 15 cars, after thorough *trial* and *experience* with the *latest styles* of equipments put on the market by the *other leading electric companies.*

Our equipments will operate with *less current* to do the same work, with less noise and with *less risk* to *burn-outs* of *armatures, fields* and *switches,* than any other equipment on the market, whether double or single reduction.

The advantages over two motors, of having but *one motor* to drive the car, are:

1.—*One-half* the number of electrical parts.

2.—*Uniform wear* on the system throughout.

3.—*Single Absorption* of the *current*, thus eliminating *losses incidental* to *dividing power* into *two* or more units.

4.—*Impossibility* of having one motor working against another, which often happens to the *destruction* of some one or more parts.

5.—*Ability* to *reverse motion* at *speed* in case of *danger*, where prompt action may save personal injury and subsequent damage.

6.—*Accessibility* of *motor parts* to *inspection* from the *car floor*, everything being in the *center*, under *one* trap door.

7.—The *indisputable fact* that *four wheels* of a truck, all *driven simultaneously* from *one source* of *power, give all* the *traction* on the rails due to the weight of the *car* complete, *regardless* of the *distribution* of the load in the car.

This is an *important consideration*, especially in *work* on *grades* where *all* the *traction* of the car is *needed* and where *slipping* of the *wheels* is *objectionable* and *expensive.*

In the *new style*, type "*B*", 30 and 40 H. P. equipments, the details throughout have been redesigned to meet hard service at a *low cost* for *maintenance* and *repairs.*

The *switches,* recently patented, are *strong, durable* and *safe* from *arcing*, or *burning* by breaking heavy currents.

The *rheostats* are made of German silver wire, and arranged in an improved casing for protection and durability.

These statements are facts, and we will furnish the means for any intending purchaser to verify them, both by inspection of the apparatus at our Works and by inquiry into the results of operation on the roads that we have equipped.

One of our Standard 40 H. P. Equipments will be in operation upon the track of the Duquesne Traction Co., at Pittsburgh, Pa., during the Convention of the American Street Railway Association in that city.

Street railway officials are respectfully requested to thoroughly inspect and investigate the equipment.

Full information and detail estimates furnished upon application.

DETROIT ELECTRICAL WORKS, - DETROIT, MICH.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

Leonard's New Method of Electric Motor Control.

By the use of this invention we are able to operate any electric motor so that the speed or torque can be automatically controlled at any point desired; the motor can be operated in either direction, and under all conditions the motor will be perfectly efficient and absolutely free from spark.

All countershafts, belts and gears can now be dispensed with.

Electric energy can be taken for operating the motors from any source of electric supply, three wire, two wire, continuous or alternating.

The cost of entire equipment from Central Station service to and including motor is about $80 per H. P. for small motors, and about $50 for large motors.

We guarantee to install a plant of 25 H. P. and upward to run any machine within five miles of any 1000-volt alternating plant for $80 per H. P.

The operation of elevators, pumps, hoists, tramways, traveling cranes, etc., etc., undertaken at moderate prices under full guarantees.

Applicable to any electric motor on the market.

H. WARD LEONARD & CO.,

Consulting and Contracting Electrical Engineers,

ADDRESS, **Electrical Exchange Building, New York City.**

UNION ELECTRIC WORKS,

207 South Canal St., CHICAGO, ILLINOIS.

The **Best Electric Bell** in the market; Nickel plated Gongs; Double magnet, Platinum Contacts, side adjustments with set screw. The simplest and most durable Annunciator, all sizes, for elevators, hotels and offices.

WRITE FOR PRICES.

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class work.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

WHERE OLD LAMPS ARE WELCOME.

B. B. Burley, Proprietor Burley House, Belle Plaine, Iowa.

"I am now too bright and lively, but when I get old and no one else will have me, I shall go to the Burley House."

Burley House. Belle Plaine, Iowa. The haven for decrepit incandescent lamps.

DO YOU want a long-lived lamp? If so, order it of us and we will give you one that will burn as great a number of hours as you wish. It is, however, as absurd to bring forward the length of life of lamps as an evidence of superiority, as it would be for a coal dealer to claim superiority for his coal on the basis of the number of hours it would take to burn out. The superiority of coal consists in the amount of heat returned per dollar of cost, and in incandescent lighting, in the amount of light obtained per dollar expended in cost of current. This holds equally true for lamps of high efficiency and for lamps that are not so efficient, but have a longer life.

QUERY: Is the Burley House the only tavern that has ever used a Thomson-Houston Incandescent Lamp? We judge so by the way they hold on to it.

THE SUNBEAM INCANDESCENT LAMP CO., 805 Chamber of Commerce Bldg., CHICAGO.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

Something Entirely New. NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED. Simple, Efficient, Economical.

Indorsed by the Electrical Press, and Prominent Electrical Engineers and Electricians. For Particulars and Prices write to

THE RIES ELECTRIC SPECIALTY COMPANY, PATENTEES AND SOLE MANUFACTURERS REGULATING SOCKETS.

Baltimore and Eutaw Sts., BALTIMORE, MD.

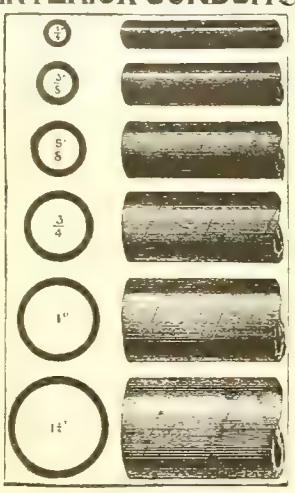
THREE GOOD BOOKS.

DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO, ILL.

ONE DOLLAR EACH.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding
ELECTRIC CONDUCTORS
Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.
INTERIOR AND UNDERGROUND
CONDUITS
MANUFACTURED BY
INTERIOR
CONDUIT AND INSULATION CO.,
WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,
General Offices: 42 & 44 Broad St., New York.

Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 236 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.
Any Socket.
Any Candle Power.

PRICES:

16 C. P.	Less than 100 lots,	55 Cents.
"	100 to 1000	" 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,
11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

MONITOR
CARBON
BATTERY

Unsurpassed in Strength and Durability.

LIBERAL DISCOUNT TO THE TRADE.
Write for Quotations.

G. A HARMOUNT, M'gr,
Monitor Electric Company
149 WABASH AVENUE,
Chicago, Ill.

Western Agents Alfred F. Moore's Wires and Cables.

THOMAS STURGIS, Prest. Wm. C. LANE. Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY. NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

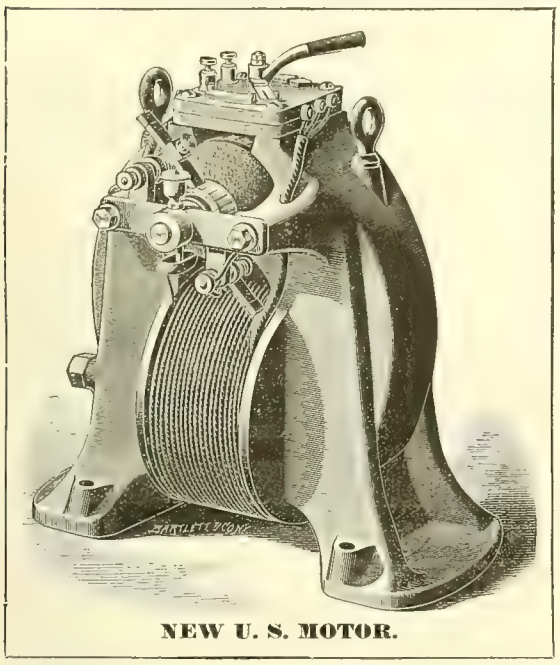
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

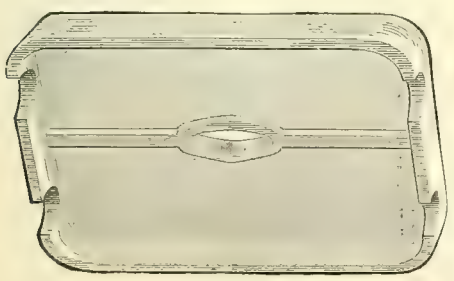
MOTORS and GENERATORS

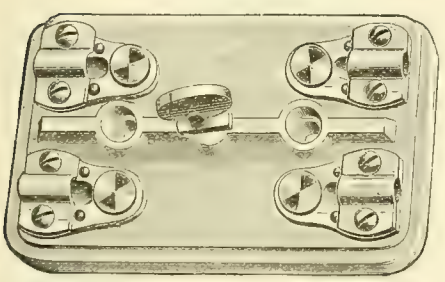
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

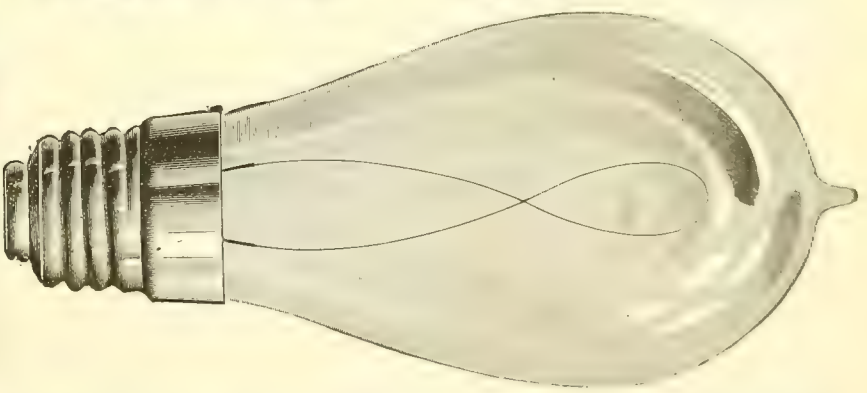
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

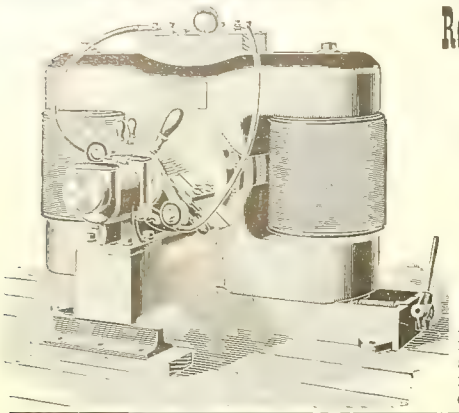
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway).

Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery. Chicago, Ill 1201 Market St., Philadelphia. Pa.

See our full page advertisement in issue Sept 12, for illustrations, prices, etc.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

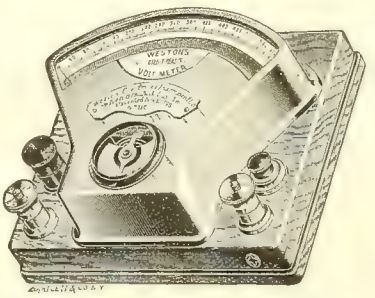
PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia.

46 SOUTH CANAL ST., CHICAGO. ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

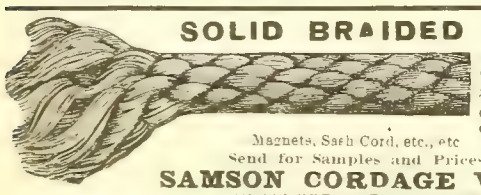
114 & 116 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

SOLID BRAIDED CORD.



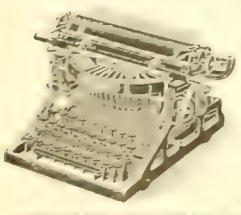
Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.



The "DENSMORE,"

The World's Greatest Typewriter.

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type bar machines

Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Same throughout

STANDARD SET BOARD with shift carriage for capitals. Call or send for catalogue.

To buy any other than the 'DENSMORE' is a mistake. Stenographer, National Park Bank.

DENSMORE TYPEWRITER CO., 202 Broadway, New York.

POLES CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

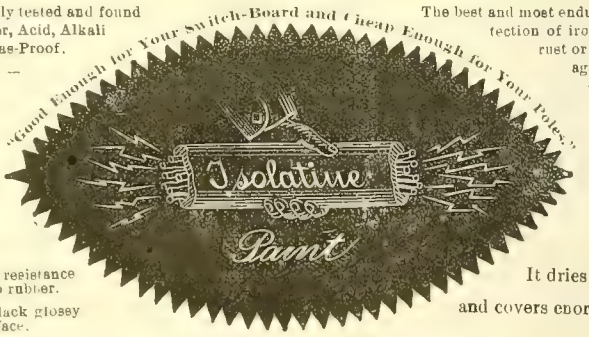
95 CHAMBERS STREET, NEW YORK.

FOR INSIDE AND OUTSIDE ELECTRICAL WORK.

Always Pliable! Highest Insulation! Permanently Protecting!

Thoroughly tested and found to be Water, Acid, Alkali and Gas-Proof.

The best and most enduring protection of iron against rust or wood against rot.



Insulation resistance equal to rubber.

Leaves a black glossy surface.

It dries quickly and covers enormously.

THE ROESSLER & HASSLACHER CHEMICAL CO.,

73 Pine Street, NEW YORK.

PLATINUM. JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

SEE

SHORT GEARLESS SINGLE REDUCTION STANDARD **MOTORS.**

IN OPERATION IN PITTSBURG

DURING THE

STREET RAILWAY CONVENTION.

Exhibit Two (2) on the "Barge." Room 10 Monongahela House.

THE SHORT ELECTRIC RAILWAY CO.,

Main Office, CLEVELAND, OHIO.

Western Electrician.

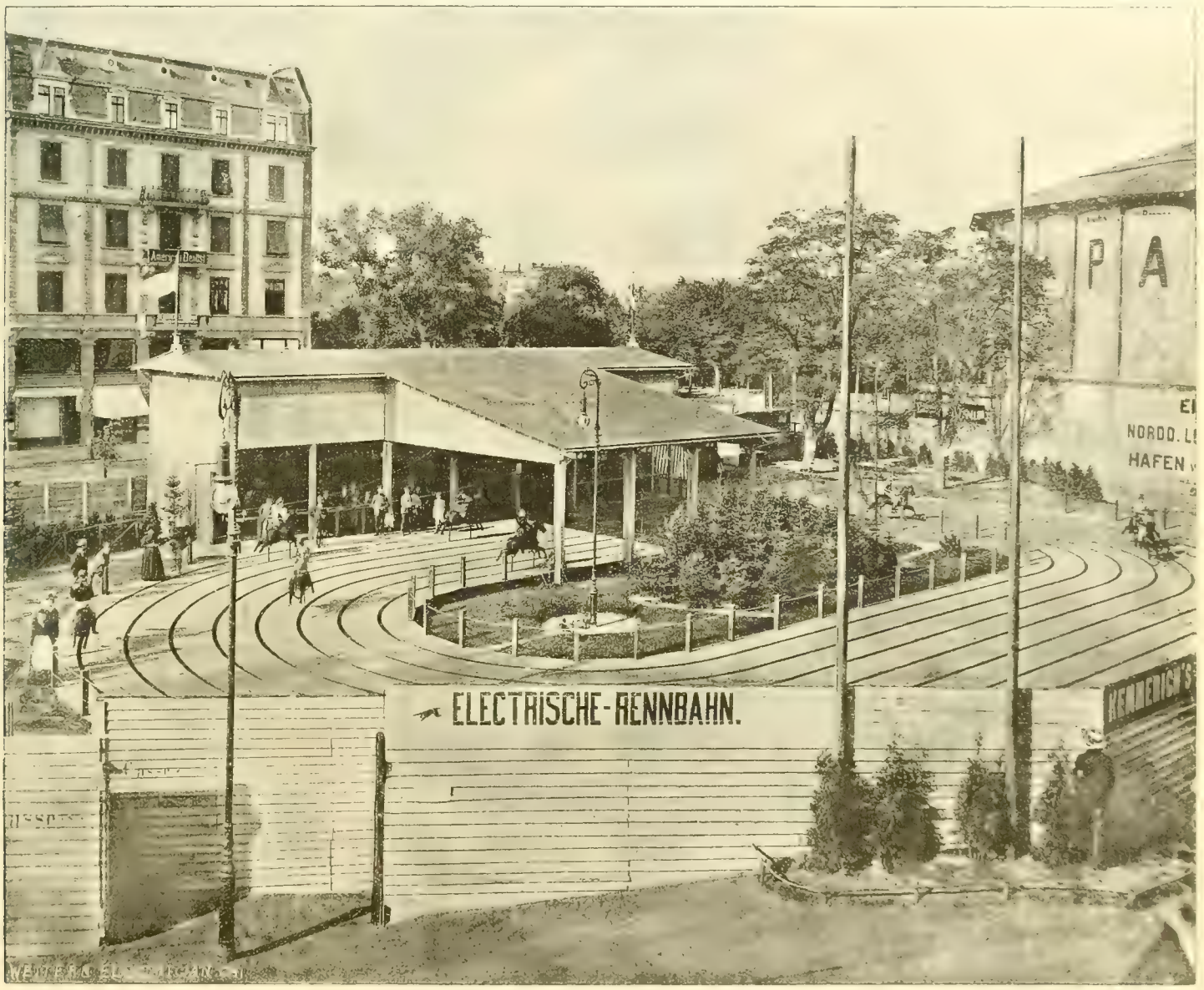
EVERY SATURDAY.

Vol. IX. CHICAGO, OCTOBER 24, 1891. No. 17

Electric Race-track at the Frankfort Exhibition.

The Frankfort Electrical Exhibition demonstrated that electricity could be used for the entertainment of man in many ways as well as furnish him the comforts and luxuries of life and relieve him of many burdens. Probably one of the most ingenious arrangements and one that attracted universal attention at the German exhibition was the "Electrische Rennbahn." This electric race-track takes a place in the holiday sports of the Germans corresponding to the merry-go-round in this country. It afforded much amusement to the visitors to the exhibition, especially those who were not interested in the details of construction of the apparatus shown. In the accompanying picture is presented an illustration of an electric race-track from which an excellent idea of the arrangement may be gained.

The tracks are laid in the shape of an ellipse and are eight in number. The length of the outer ellipse is 110 meters, the inner one being about 60 meters long. The horses are mounted on four wheeled cars, but the horses only are to be seen above the platform. The cars which support the horses and the electric motors which drive them are below. The speed of each horse is regulated by switches at the starting stand. All of the tracks are connected to one pole of a dynamo which furnishes the current. A copper rod is used to supply current for each car. These conductors are placed just under the platform. The electric motors, of two horse power each, are mounted on the cars, and geared to the driving wheels. The potential used is 150 volts, and the current required is about 15 amperes. A speed of 16 kilometers per hour is obtained with this equipment. The "Electrische Rennbahn" is well patronized by visitors at the Exposition.



ELECTRIC RACE-TRACK AT THE FRANKFORT EXHIBITION.

The incorporation of the Cataract Electric company of Buffalo, N. Y., is reported. The capital stock is placed at $40,000, and the promotors of the enterprise are Charles A. Sweet, Franklin D. Locke, Edmund Hayes, William Hamlin and Patrick H. Griffin, all of Buffalo.

Subways in Cincinnati.

The work of putting the telephone and telegraph wires underground in the streets of Cincinnati is well under way. The first telephone cable was run from Plum street to Central avenue, through Cathedral alley, on Oct. 14th, and the work was performed in an entirely succesful manner. The process, while not new, is interesting. Gas pipe was forced through one of the ducts in the conduit, section by section being screwed on until the opening at the other end was reached. Here a workman reversed the process, pulling the pipe and unscrewing its sections as the last, to which a wire had been attached, was reached. A rope was attached to the wire and this to the cable, the cable through Captain Stone, general manager of the company, was on hand, and expressed himself well satisfied with the [illegible] The [illegible] Western Electric company of Chicago, and E. H. Wiedenbeck, of that firm, personally superintended the work.

The telephone company has already over two-fourths of a mile of [illegible]

averaging from six to twenty ducts. The material used is vitrified brick, this being thought superior to iron pipes, wooden conduits or any other system in use in the United States. The present system is an experiment, and the outcome is awaited with much interest, as Pittsburg, Pa., is having a similar one put down. In building up a conduit the first ducts are laid in a bed of concrete and mortar, and then the next row is put on top, and so on, until the conduit, or collection of ducts, is completed. Then the whole is thoroughly imbedded, and only the duct openings protrude. It is believed that even if the ducts should decay the concrete would so harden as to form channels that would never give way.

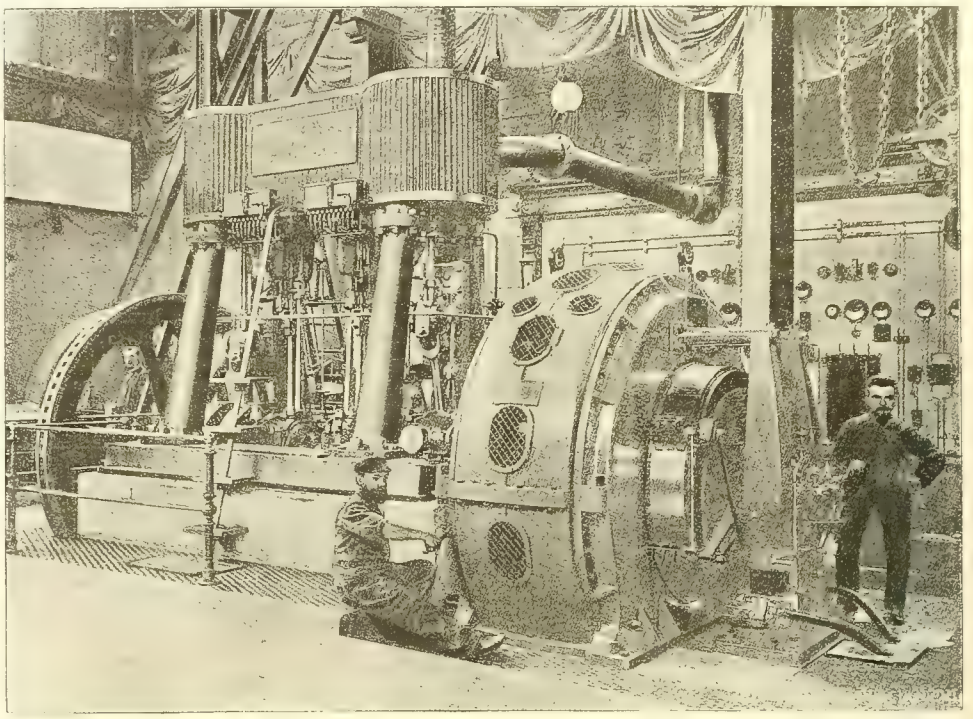
The large conduits will carry 4,200 wires (200 in each duct), and will thus supply 4 200 telephones. But few of this size will be laid. Most of those now being placed contain from eight to ten and fifteen ducts, and it must be a well-patronized street to use even this number. The smaller conduits will carry wiress sufficient for 1,200 telephones. It is not the intention of the telephone company to fill the ducts at once, as there is not demand enough for telephones to warrant it. The company has merely planned for the future, and can run in a cable whenever more service is needed.

Portable Electric Fire Apparatus.

The electric fire apparatus which is here with illustrated was shown at the Frankfort exhibition and excited much interest. It stands alone among machines of its own general class. The pump, as well as the carriage, is from the Lausitzer shops in Bautzen, Germany, which in the department of fire engines has produced apparatus that leaves little to be desired. The work of these machines equals that of the best steam fire engines. With a 6 horse power motor, and using a nozzle of 18 millimeters diameter, this apparatus will throw a stream a distance of from 110 to 125 feet

Iowa Electric Club.

A meeting of central station men of Iowa was held Oct. 16th at the Grand Hotel, Cedar Rapids, for the purpose of forming a state organization. The representatives of electrical work have for some time realized that this was necessary to enable them to interchange their ideas on matters of common interest. Some correspondence had passed on the subject and the meeting was the result. It



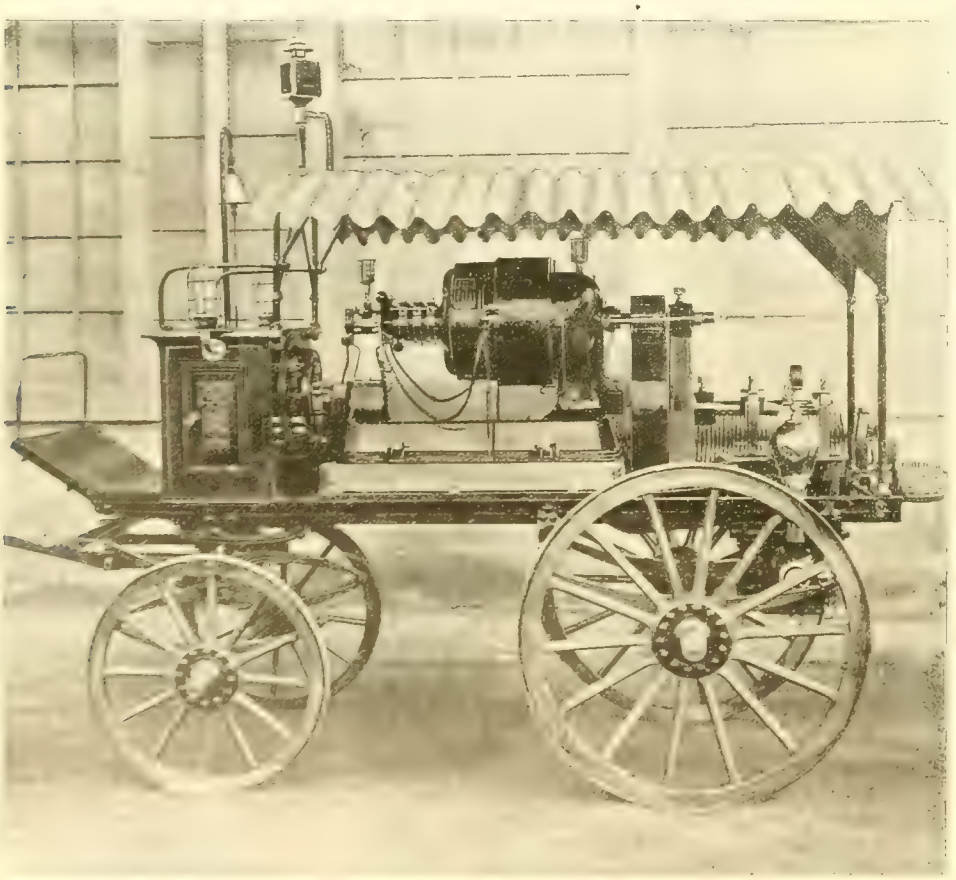
SCHUCKERT DYNAMO AT THE FRANKFORT EXHIBITION.

After a short preliminary discussion it was decided to form a state association under the name of the Iowa Electric club. A constitution and by-laws setting forth that the new society was for the purposes of mutual benefit and growth were then adopted. The election of officers resulted in the choice of the following named gentlemen:

by, Des Moines; E. M. Cobb, Des Moines; T. L. Seevers, Marshalltown; C. D. Jones, Waterloo; V. Heinrichs, Carroll; B. S. Wilder, Cedar Falls; W. A. Hunter, Belle Plaine; M. Snyder, Grinnell; C. H. Brampton, Cedar Rapids.

seevers of Marshalltown; L. L. Kellogg of [illegible] City and C. A. Jones of Independence.

At the conclusion of the business meeting a banquet was announced and the members closed the day's proceedings with an informal social gathering. It was decided to hold the annual meeting in July, 1892. Spirit Lake will probably be selected as the place of meeting.



[illegible]

W. L. Dean of Ottumwa was elected president; H. M. Vaughan of Newton, vice-president; C. H. Brampton, Cedar Rapids, secretary, and L. A. Colby, Des Moines Edison company, treasurer. The executive committee is composed of the president and vice-president and T. L.

Schuckert Dynamo at the Frankfort Exhibition.

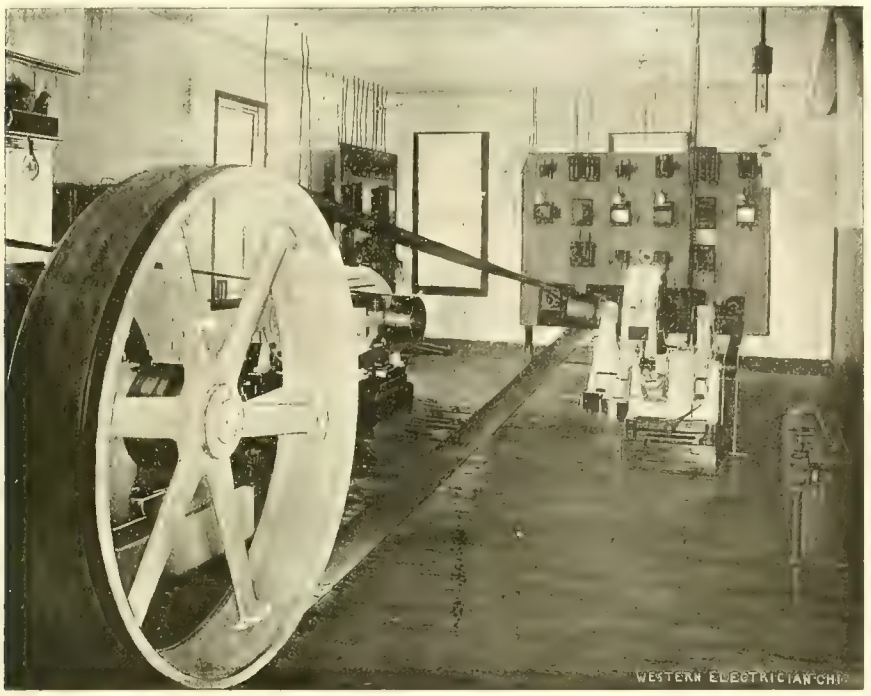
The firm of Schuckert & Co. is represented in the Frankfort Exhibition in many departments. The principal space occupied by this firm is in the eastern portion of the Machinery Hall, on both sides of the main aisle. On the north side are a number of the well known Schuckert ring armature machines, together with a 100 horse power compound engine of the Machine company of Nurenburg. South of this main aisle is also a display of generators, among which is conspicuous the large dynamo coupled directly to a 300 horse power compound vertical steam engine, made by G. Kuhn of Stuttgart-Berg.

As the cut shows, this machine does not differ materially from the well known Schuckert model of ring armature dynamos. One remarks first of all the iron-clad form of the machine. To the casing the magnet cores, shortened in length but enlarged in diameter, are cast. The magnetic field consists of 2x14 magnet poles arranged on opposite sides of the face of the ring armature, which is fastened to the shaft by means of a number of stout iron spokes. The diameter of the armature is seven feet ten and one-half inches, the other dimensions being of correspondingly large proportions. The commutator, of 1.5 meters diameter, is made of 560 separate pieces, each of which is connected with but two windings of the armature. While it is a common thing to find on machines of this kind as many brushes as there are poles (in this case 14), yet with this particular dynamo the brushes are so grouped that only four are necessary, this being accomplished by connecting the brushes in parallel. Such an arrangement of powerful magnetic field, with abundant mass of iron, large number of coils on the armature, yet withal a small number of turns in each, allows the current to be taken off almost absolutely without any sparking. The machine has an output of 1,000 amperes with 230 volts at 160 revolutions. The illustration shows further that a very complete ventilation is accomplished by openings in the casings, covered merely by wire screens. Machines of this class have been furnished by Schuckert to the central stations of Hanover and Altona, each with a capacity of 15,000 incandescent lamps, as also in Dusseldorf with 20,000 lamps. These last named dynamos have an output of 350 kilowatts.

The Schuckert works employ about 900 workmen and 200 clerks in various capacities, beside a large number of workmen engaged in erecting machines in plants throughout Germany. One thousand dynamos, 6,000 arc lamps and 3,000 measuring instruments are yearly turned out of these shops

Model Central Station at Dixon, Ill.

Evidence of the advancement in central station methods is presented in the appearance of many company's plants. Formerly a barn or a damp cellar which could be used for no other purpose, was devoted to the lighting and power plant, but experience has shown the owners of electrical apparatus that to secure good results and insure durability they are required to properly house their apparatus. In the accompanying cuts are presented two views of the Electric Light & Power company's station at Dixon, Ill. This plant is one of the most expensive in this section. The station is handsomely fitted up, the machines are highly polished, and the engine room presents a most attractive appearance. The station was first equipped with one Armington & Sims engine, one 650 light alternating Thomson-Houston dynamo, and one 50 light Thomson-Houston arc machine. A year later the demand for light had exceeded the capacity of the plant, and it was decided to duplicate the installation. The steam plant was installed by the Pond Engineering company, through its Chicago representative, Albert Blanchard, who gave the work personal supervision.



MODEL CENTRAL STATION PLANT AT DIXON, ILL.

The engines, dynamos, ceiling, steam pipes, and all foundations are enamel white, with the exception of the dynamo fields, which are painted vermilion red. All guards about the machinery are polished brass, which, with the finished work on the machinery are kept without a tarnish. The floor is laid with narrow maple flooring, and polished in oil. The switch-board is handsomely designed in oak, with connections made from the back.

The officers of the company are: President, F. A. Watson; secretary and treasurer, J. P. Plummer; engineer, A. J. McDugal. Mr. McDugal has been in charge of the station two years, and during that time there has been but one stop in the operation of the machinery. He takes great pride in the station, and in his efforts to make it a model plant has the hearty co-operation of the management. The people of Dixon are also proud of the station, and patronize it liberally. The service is excellent, and the management finds that its policy is proving profitable to itself as well as agreeable to the public.

Printed by Electricity.

It will doubtless be of interest to the readers of the WESTERN ELECTRICIAN to learn that the presses on which it is printed are soon to be operated by electricity, if, indeed, the motor is not connected by the time this issue goes to press. A 25 horse power Edison motor has been installed by the Blakely Printing company of 186 Monroe street, which prints the paper. This motor, it is expected, will furnish enough power to operate a large number of the presses, including those on which the WESTERN ELECTRICIAN is run off. Current is supplied from the Adams street station of the Chicago Edison company. W. L. Beckwith, of the Edison General Electric Company, had charge of the installation.

The Delaware avenue street car line of Wilmington, Del., is being transformed into an electric road.

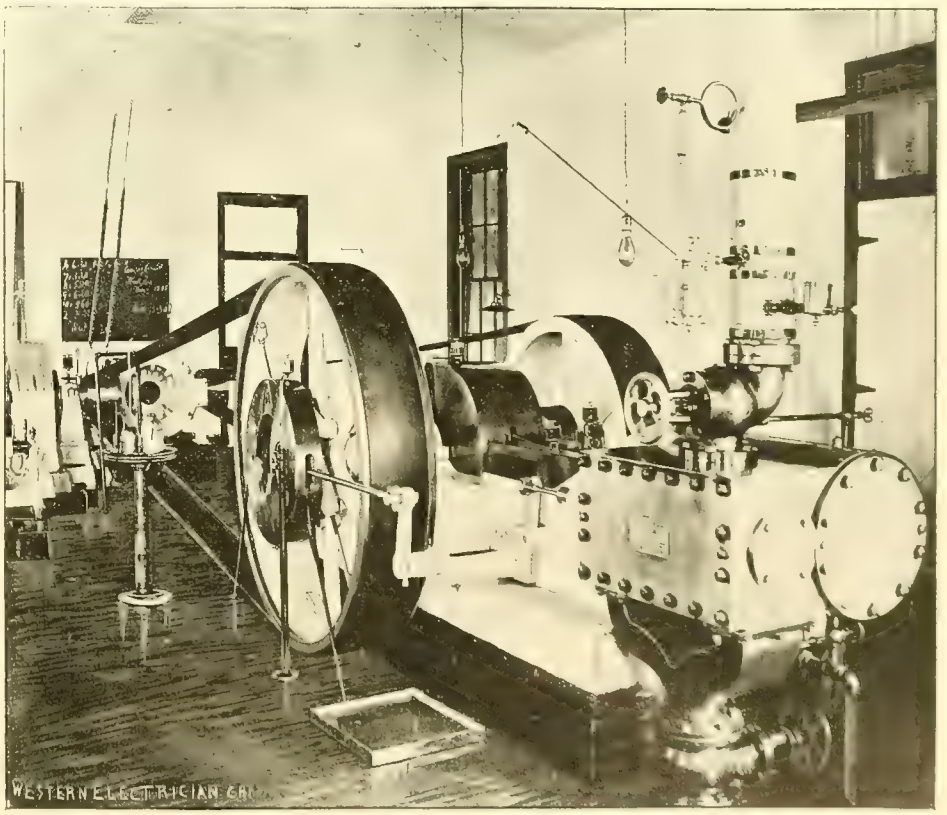
American Street Railway Association Convention.

The American Street Railway association convention in Pittsburg promises to be the most important convention in the history of the organization. It is notable from the fact that for the first time in the association's career there will be a meeting at which the horse as a motive power will be entirely disregarded. The members of the association are far too progressive to consider subjects that have ceased to be of interest, and this is certainly true in the case of the much abused horse and mule. At the Buffalo convention last year there was a paper on "A Perfect Street Railway Horse." Commenting on this fact President Lowry said that "We must assume that the association has not yet discarded the idea that the horse is the most reliable power for street cars. I am so thoroughly convinced that electricity is the coming power for street railways, and that it will prove so effective, as a means of rapid transit for cities, that I believe this is the last convention that will ever seriously consider horses for the operation of street railways." The [illegible] secretary announces that special committees will report on the following subjects: "A Perfect Electric Motor;" "A Year's Progress of Cable Motive Power;" "[illegible] State Treatment of Corporations [illegible] ment—Overhead or Underground [illegible] Motive Power, and The Independent [illegible] Battery—System of Electric Motive Power [illegible] been received by the secretary from the president of one of the member companies that a [illegible] on "Standards in Machinery and Appliances for Electric Railways."

Representatives of the leading companies manufacturing electric railway apparatus will be present to explain the operation of their systems. This will probably be the most interesting part of the proceedings to the delegates, as the majority of the 172 companies comprising the association are operating electric plants or contemplating the introduction of an electrical equipment. Comparisons of the several systems, therefore, cannot fail to prove both interesting and instructive to these delegates. There will also be a full line of electrical novelties displayed on the boat which has been prepared for the occasion, and moored near the headquarters. Heavy supplies will be placed on the lower deck and lighter ones on the upper. The boat will be suitably decorated, and lighted in the evening, and will be made a pleasant and interesting place for the exhibition of supplies.

The Pittsburg street railway companies have completed the arrangements for the special entertainment of those in attendance. Preparations for two excursions are completed, and they will assuredly be of a very enjoyable character. A handsome souvenir of the meeting is being prepared. In addition to the representatives of the companies included in the association, there will be the usual number of supply and construction companies represented, and many of them will have interesting displays. The electrical features of street railway work will no doubt occupy the greater part of the attention of the delegates and visitors.

An interesting event will be the banquet at the Monongahela House, Thursday evening. This, it is promised, will be the most pretentious affair thus far undertaken by the association.



MODEL CENTRAL STATION PLANT AT DIXON, ILL.

Several "transportation parties" were organized in different parts of the country and "special cars" were in demand. The Chicago delegates had a variety offered them for consideration. Three parties were proposed.

The census department has adopted the form of blank for the collection of statistics on city lights recommended by the National Electric Light association at the Montreal convention.

Electrical Plant at Cassel, Germany.

At a distance of about four to five miles from Cassel, on the river Fulda in Germany, there is a mill in which there is a power plant of 200 horse power. The mill was purchased by the city authorities to furnish power to operate a reserve pump to maintain the city water supply during the hot summer months. In winter the power was scarcely used at all for pumping purposes, so a central station was erected to furnish the city of Cassel with electric light, thus employing the reserve power of the pumping station for operating the electrical machinery. As the amount of light required in the summer months was small, the conditions were favorable, for the greater part of the power could then be utilized for pumping purposes.

Herewith are presented illustrations of the Cassel station.

Two turbines, as seen in Fig. 1, were connected to the main shafting, and a reserve steam engine of 100 horse power was arranged so that it could be used at any time of emergency. The main shafting communicated the power to two alternating current machines of 100 horse power each. The machines were connected in parallel, and together supplied a current of 60 amperes at 2,200 volts.

This current was transmitted through a double concentric cable with a conductor 60 square millimeters in cross section to two sub-stations in Cassel. The accompanying view, Fig. 2, shows one of these secondary stations. The high potential current drives an alternating motor of 80 has been installed, which is charged during the day while the load on the machines is at minimum. During the night, at the time of maximum consumption, this battery assists the dynamos.

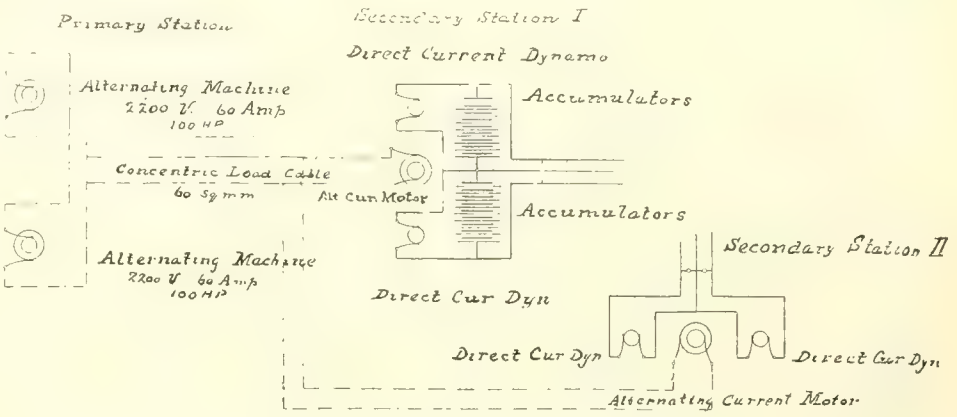


FIG. 4. ELECTRICAL PLANT AT CASSEL, GERMANY.

As may be seen from Fig. 4, the arrangement is nothing more than a single transmission of power on the three-wire system, using an accumulator plant to increase the capacity of the station, the dynamos being driven by electric motors instead of steam engines.

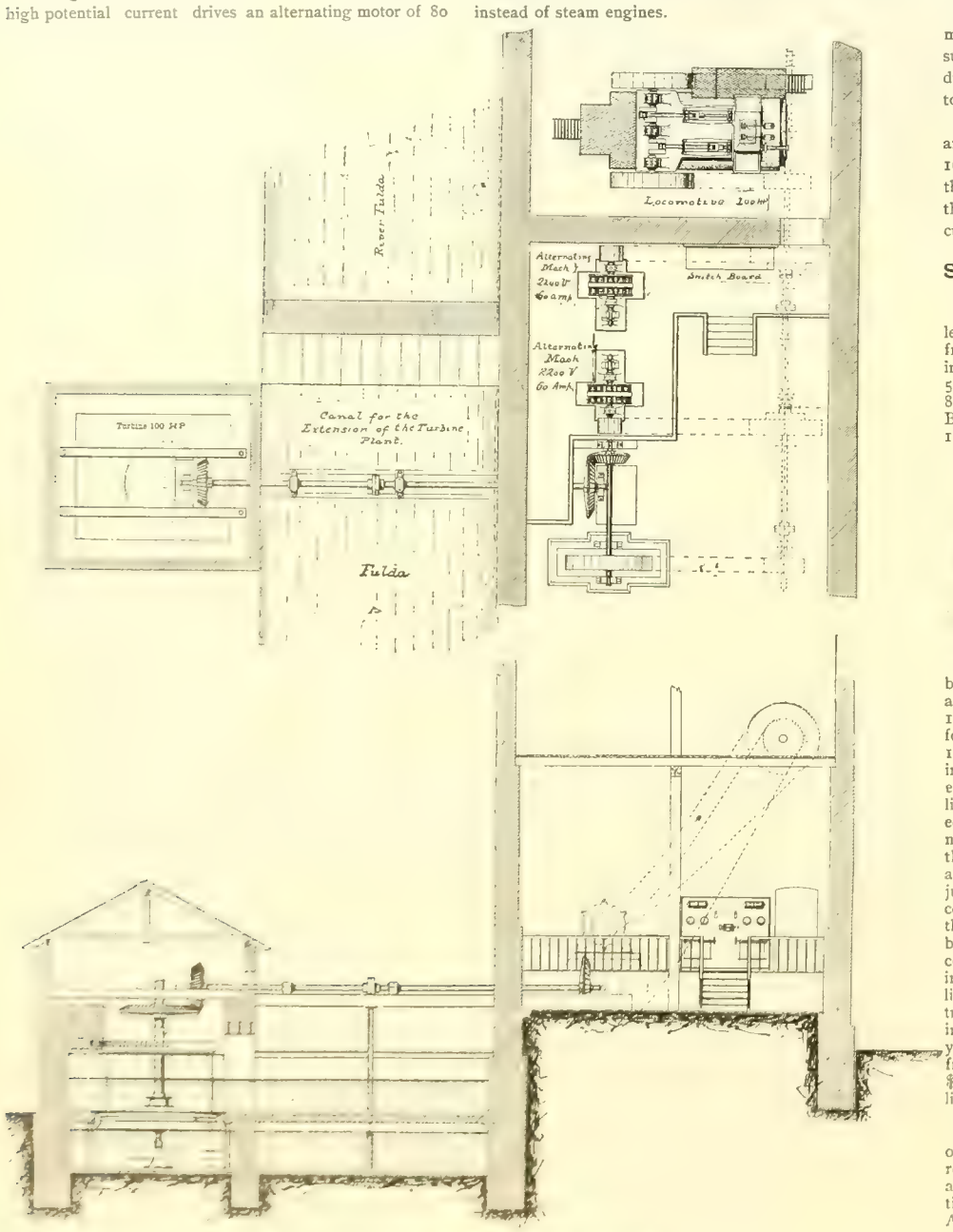


FIG. 2. ELECTRICAL PLANT AT CASSEL, GERMANY.

Oscar von Miller, who was the designer of this plant, states that the ordinary alternating current motors were chosen for this transmission because these machines possess no commutators and therefore were better adapted to be isolated than direct current machines, operated with a pressure of 2,000 volts. The disadvantage of the alternating current motors, that is, great sparking while in operation, was avoided by making the secondary alternating current machines serve as motors connected directly with the direct current dynamos. These direct current machines are so arranged that they may receive current from the accumulators and thus be employed to drive the secondary alternators up to synchronism with the primary alternating generators.

This mode of distribution, by which continuous current may be had from secondary stations, is well adapted to such cities as Cassel, where a small water power at some distance may be utilized to store current in accumulators to increase the capacity of the plant.

This system has been in operation since May 15, 1891, and is of sufficient capacity to furnish current for 2,600 16 candle power lamps burning at once. By an increase of the accumulator plant and the addition of more turbines, the capacity of the station may be made sufficient to supply current for as many as 12,000 16 candle power lamps.

Statistics of Accidents Caused by Lightning in Germany.

Interesting and valuable official statistics have been collected by the German government regarding damages from lightning to state property. The number of buildings with regard to which returns were collected was 53,502, of which 22,682 were actual state property, and 30,820 were entitled to state subsidy for rebuilding or repair. Buildings were struck in 264 cases, or about five for every 1,000 buildings in ten years. Of the various classes of

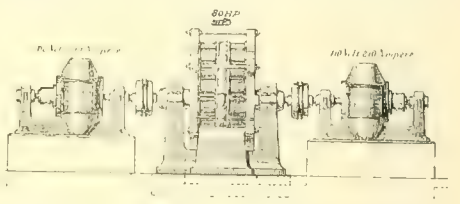


FIG. 3. ELECTRICAL PLANT AT CASSEL, GERMANY.

buildings the number struck per 1,000 for this period are as follows: Elementary schools, 0.8; parochial houses, 1.4; revenue buildings, 1.7; prisons and penitentiaries, 3.4; forest rangers' houses, 7.2; churches, 8.2; court-houses, 11.9; seminaries, 14.6; gymnasia, 15.4; university buildings, 24.1; domain buildings, 44 9; and horse-breeding establishments, 312.5. Out of the 264 cases in which the lightning struck, 81, or not even one-third, resulted in a fire. The amount of injury wrought by lightning on the 53,502 houses coming within the scope of these statistics was $284,170, or $1,075 for each casualty, about 48 cents per building per annum. The amount of injury done to domain and horse-breeding establishments was considerable, amounting to $210,000, or more than two-thirds of the total injury caused by lightning. It has been calculated, from the returns of sixty fire insurance companies of Germany, Austria, and Switzerland, embracing the period from 1855 to 1877, that the danger from lightning has increased two and a half times in those countries during the period named. The danger is said to have increased three-fold in Germany within the last thirty years. The average loss sustained annually by Germany from this cause is computed at from $1 500,000 to $2,000,000. Casualties have thus increased in the period of lightning conductor extension.

Mr. Wharton of the Lang, Wharton & Down syndicate of London visited the Thomson-Houston factory at Lynn recently. This concern installs isolated lighting plants, and Mr. Wharton gave a reporter an interesting description of some of the most elaborate plants in England. Among other things he said that the Rothschild country place has a plant to furnish 4,000 lights, while the town house has none at all. Two electric mains pass the house, however, and on the three occasions in the year when the financial magnate gives big receptions to the Prince of Wales and others, the mansion is specially wired and connected temporarily. Baron Rothschild has three crystal chandeliers in the house, each worth $10,000, which, perhaps, accounts for his disinclination to having the establishment permanently wired.

The World's Congress of Electricians of 1893.

By Elisha Gray, Ph.D., LL.D.

From time immemorial it has been the habit of men to assemble in congress to deliberate upon all sorts of important subjects. The first electrical congress of which there is any mention is recorded in the Book of Job; but this could scarcely be called an electrical congress, for all sorts of scientific conundrums were propounded to Job, who was one of the delegates. Among others were the following: "Who hath divided a watercourse for the overflowing of waters, or a way for the lightnings of thunder?"

And again, "Canst thou send lightnings that they may go and say unto thee—here we are?"

It is not recorded that any satisfactory answers were given to these questions, although Job was considered a wise man in his day and generation. It is very evident that lightning rods were not in vogue in those days, for not even the presence of Omnipotence, who, we are told, spoke from a whirlwind, would have prevented the enterprising "agent" from exhibiting his doubled and twisted compound lightning conductors to the convention when the first question was propounded.

Notwithstanding all these years of discussion as to when, how and by whom the telephone was invented, it is very certain that it was subsequent to the meeting of this scientific congress; for otherwise, could not Job when asked the second question, "Canst thou send lightnings that they may go and say unto thee. Here we are," have answered: "Certainly, we can send lightnings, and make them say, 'Hello, here we are,' and say it in the vernacular."

Since the first electrical congress there have been many held, but perhaps the most important one, and the one most fruitful in results, met at Paris in 1881. The benefits growing out of this congress to electrical engineering, and to the great army of inventors, teachers and workers in the lines of electrical progress, would be difficult to estimate.

Ten years have passed since the Paris meeting and they have been years of unwonted activity. Where thousands were invested in electrical enterprises ten years ago, millions are employed now. And yet we are only stepping over the threshold of the door that leads to a vast unexplored region in the domain of electrical science.

Over fifty years ago there lived and taught a certain professor of physics. One day he explained to his class the experiments of Dr. Franklin with his kite, by which he established the identity of lightning and frictional electricity. At the close of his lecture he said to his class; "Young men, you were born too late to witness the development of this great science!" If the shades of the departed are allowed to visit this earth and know what is going on, we can easily imagine the prolonged state of astonishment that our good professor has been in, during the years of his sojourn in the land of shadows, at what some of his pupils have lived to see.

It is eminently fitting that at suitable times and on suitable occasions, men in all departments of science and industry should come together for interchange of thought and the discussion of subjects that have to do with the great activities of life—practical and intellectual. What more fitting time to hold a series of congresses than during the great World's Columbian Exposition of 1893?

In pursuance of this object the World's Congress Auxiliary of the World's Columbian exposition, has been organized, under the support of the exposition corporation, and has been recognized and approved by the government of the United States. Under this organization local committees have been appointed to organize a series of congresses. Among others a committee in part to organize a World's Electrical Congress has been appointed. The movement, as yet, is in a formative stage, and much thought must be given to it before a detailed programme can be formulated. An advisory council must be appointed from the most eminent electricians of this and other countries. Some one, or more than one, must visit and confer with the noted men of the world, and no stone should be left unturned to make the electrical congress of 1893 the most important that the world has ever seen; not only in point of numbers, but in the eminent character of the men who attend, and the excellence and great importance of the work done.

While the hardest part of the work of organization must necessarily fall upon the local committee, we expect much from the advisory council, especially that portion of it residing in the United States. The fact that the great exposition of 1893 happens to be held in Chicago is an incident over which we have no control. But this fact makes Chicago the place, *par excellence*, for the assembling of the proposed electrical congress. The representatives of the world's best thought and best work will be centered here. The congress will meet under the shadow of the greatest palace of electricity the world has ever seen. In it will be found science applied, great thoughts translated into machines, for the service of man.

To make the most of such an enterprise, all petty jealousies between cities, states and nations, must be dropped and all must work as one common brotherhood for one common cause. Men must be selected on account of their fitness for the work assigned them, and for no other reason. Science and art know no East, no West, no North, no South. They belong to the brotherhood of man, however widely scattered they may be.

When a detailed programme has been systematically formulated by the properly constituted authorities—which will not be done till after consulting the most eminent minds on the subject—we invite and expect the most hearty co-operation from all men and societies that are interested in electrical progress.

Before the present movement had been set on foot under the auspices of the government of the United States, through the exposition authorities, several electric associations (notably, the Chicago Electric club, the National Electric Light association and the American Institute of Electrical Engineers) had started a movement for a congress to be held in 1893. If the congress were to be held under the auspices of any society, undoubtedly the American institute would be the best selection in this country.

FIG. 2. ELECTRICAL PLANT AT CASSEL, GERMANY.

As it is now, it remains for the officers of the World's Congress auxiliary to suitably recognize the good work done by these associations, and for these associations to give us the benefit of their work already done, together with their hearty co-operation in the future.

The general outline of the congress will probably be as follows: It should be divided into sections according to the various interests represented. First, there should be a section devoted to the more purely scientific phases of the subject. This section should be composed of the most eminent scientific men in this and foreign countries. The standards that were adopted ten years ago will have had twelve years of trial by the time the congress assembles. It may be that other units should be added to those already adopted, or that better definitions may be given to some of those already in use. Papers should be read by different individuals, relating to the different theoretical and scientific phases of the subject.

Other sections should be organized, in the various interests of applied electricity, the number of which will be hereafter determined.

In order to give all a chance to see and hear the great men of the world, all of the sections should meet together, on stated occasions, forming one grand general congress, to listen to papers and discussions by the most eminent men of the world in electrical matters.

It is suggested that all of the regularly organized electrical associations should hold their meetings in Chicago in 1893. Suitable halls will be provided, in which to assemble, for these various congresses and association meetings. The congresses to be held under the auspices of the auxiliary department of the exposition will begin at the opening of the exposition and continue to its close, so that one will not interfere with each other. The [illegible] of the electrical congress is not fully determined, but due notice will be given at a later date.

A little reflection will convince any friend of electrical progress [illegible]

The result [illegible] ered upon one general subject, cannot be too highly estimated. Finally: Success will be assured from the beginning if all our interested friends act harmoniously and are actuated by one common desire that the best thing shall be done, without regard to geographical boundaries or local prejudices.

1 Read before the Chicago Electric Club, Oct. 19, 1891.

Englishmen Interested in the Montreal Convention.

Unusual interest has been manifested in the National Electric Light association this year by the electrical engineers of England, and the proceedings of the Montreal convention have occupied considerable space in the columns of the English electrical journals. Regrets are expressed that there is no such body of electrical representatives in Great Britain. Thus the London *Electrician* says:

"In many respects it is to be regretted that there is nothing in this country to correspond with the National Electric Light association of the United States. The members represent the class which attend, or ought to attend, the meetings of the London Chamber of Commerce; in the holiday aspect of the convention it resembles the British association, and for carefully prepared papers and practical discussions it may be compared with our Engineering Institutions. The papers are limited in number; they are printed before hand, and in the hands of the members, and they are of a solid and representative character. Some of the topics, such as arc light supply and street railways, do not at present largely concern us on this side of the Atlantic; but they were dealt with in a practical way, which must have been appreciated by the American audience. The zone system advocated by the president is open to the criticism that if it be admitted that distribution at high electrical pressure is satisfactory and advisable it may as well be used for the center of the town as for the outlying districts. It is easy to see the advantage of throwing out high-pressure feeders to the suburbs of a town, while no such feeders are required for the streets neighboring on the supply station. But to use two systems concurrently, to say nothing of the multiplication of different voltages for different distances, reminds us of the hole which Sir Isaac Newton made in his door for the kitten, alongside the one provided for the cat.

"Fortunately for us in this country we know little of the tyranny of parent companies, over supply companies and it is difficult to realize the serious complaints which are made against them by the supply companies in the United States. This appears to be an outcome of the American 'electric light systems.' An Edison supply company uses everything of the Edison brand, and a station fitted by the Brush company has not a single article in common with the Edison. Our American friends seem to suffer particularly in the measuring instruments thus supplied to them.

"The remarks which were made at the meeting of the National Electric Light association about measuring instruments ought to encourage our manufacturers to brave the McKinley tariff, and show what can be done in the way of ammeters and voltmeters for station work. We would call attention to the observations of Dr. Louis Bell, and recommend those of our readers who are specially interested in the matter to read the remarks of Mr. Ayer and of Mr. Scott. We need not go so far as Montreal to hear grumbling about the accuracy of instruments. Prof. Kennedy, in the discussion on Mr. Crompton's paper before the Institution of Civil Engineers, said that he had been scoffed at because he wanted a voltmeter to [illegible] to a volt, and was told that he should not expect it. This sounds rather like the 'parent company' tyranny. We hope that before long we shall have reports of the work done by the Electrical Standardizing [illegible] giving details, like the Kew report, of the accuracy attained and the number of instruments examined. Such information is much needed by instrument makers who really try to turn out good work. We shall not be surprised to learn that voltmeters may be purchased for five pounds which will read to a quarter of a volt."

The streets of the historic town of Kilkenny, in Ireland, are to be lighted by electricity.

Western Electrician

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. B. O'HARA, F. I. PERRY, W. E. KEILY, - - - - - Associate Editors.
J. L. BAKER, - - - - - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.
Electric Race track at the Frankfort Exhibition. Illustrated.... 241
Subways in Cincinnati....241, 242
Portable Electric Fire Aapparatus. Illustrated.... 242
Iowa Electric Club 242
The Schuckert Dynamo at the Frankfort Exhibition. Illustrated 242
Model Central Station at Dixon, Ill. Illustrated.... 243
Printing by Electricity 243
American Street Railway Association Convention.... 243
Electrical Plant at Cassel, Germany. Illustrated.... 244, 245
Statistics of Accidents Caused by Lightning in Germany.... 244
The World's Congress of Electricians in 1893, by Elisha Gray, Ph. D., L. L. D. (Chicago Electric Club).... 245
Englishmen Interested in the Montreal Convention.... 245
Editorial.... 246
Electric Welding Plant at the Okonite Factory, Passaic, N. J. Illustrated.... 247
Use of the Telephone 247, 248
Electric Elevator at the Chicago Athenæum. Illustrated.... 248
Electrically Regulated Clocks in Chicago 248
New Trolley Hanger. Illustrated.... 248
The [illegible] Break Switch. Illustrated.... 248
[illegible] Aspects of Electric Traction.... 248, 249
[illegible] Compensating Voltmeter. Illustrated 249
New Type [illegible] Wooden Toothed Gearing. Illustrated 249
[illegible] Trolley Connector. Illustrated.... 249
Electricity at the World's Fair 249, 250
The Multiple Current.... 250
[illegible] Department.... 251
[illegible] of the Westinghouse Company.... 251
[illegible] of Heat into Electricity 251

DEPARTMENTS.

Correspondence 252, 253
New Incorporations 253
Electric Light 253
Electric Railway 253
Trade News 253, 254
[illegible] 254
[illegible] 254

[illegible] report of the convention of the American Street Railway Association at Pittsburg will be presented [illegible] of the WESTERN ELECTRICIAN.

[illegible] paper pronounces the exhibits at [illegible] on the most interesting from a technical standpoint that have ever been shown. [illegible] transmission scheme was [illegible] it may be expected that even [illegible] World's Columbian Exposition [illegible] both in [illegible]

[illegible]

electrical department is given, together with the rates for each class. These tables should be preserved for reference.

IN connection with the experiments in long distance transmission between Lauffen and Frankfurt it has been stated that the multiphase current was the means of insuring the success of the enterprise. According to the London *Electrician*, however, Mr. Brown says the multiphase current made the undertaking more difficult, as it involved many new complications in the dynamo, transformer, switch-boards, and line. It was only chosen because of the possibility of driving self-starting motors without commutator.

PROF. GRAY has clearly defined his position in the paper before the Chicago Electric club on the "World's Congress of Electricians in 1893," which is presented elsewhere in this issue. The work done by the several electrical organizations in this country with a view of creating interest in the proposed congress is recognized and acknowledged, but in view of the fact that provision has been made for the congress in connection with the World's Fair it is expected that all independent movements shall cease or at least that their efforts be turned in the direction of assisting the gentlemen authorized by the exposition management to promote the congress.

The American Institute of Electrical Engineers has been particularly prominent in all measures relating to the proposed congress, and many of its members appear to be under the impression that the congress should be held under the auspices of that body. It is to be hoped that the institute shall not take any action in this matter that will in any way conflict with the arrangements of the exposition authorities, as such action would necessarily tend to injure the proposed congress. It is expected, however, that the Institute will join the other electrical organizations in their efforts to make the congress a great success and will co operate with Prof. Gray and his associates in making the gathering the most representative ever held in the world.

MEMBERS of the Chicago Electric club have frequently displayed their interest in the World's Columbian Exposition, and especially the electrical department. In every movement tending to promote the interest of this department the Chicago Electric club has taken the lead, and this week it is engaged in promoting the interest of the proposed electrical congress.

Last Monday evening the club listened to a paper by Prof. Gray, on the congress. He outlined the proposed plan of organization as follows: "It should be divided into sections according to the various interests represented. First, there should be a section devoted to the more purely scientific phases of the subject. This section should be composed of the most eminent scientific men in this and foreign countries. The standards that were adopted ten years ago will have had twelve years of trial by the time the congress assembles. It may be that other units should be added to those already adopted, or, that better definitions may be given to some of those already in use. Papers should be read by different individuals, relating to the different theoretrical and scientific phases of the subject. Other sections should be organized, in the various interests of applied electricity, the number of which will be hereafter determined."

It is also suggested that in order to give all a chance to see and hear the great men of the world, all of the sections should meet together, on stated occasions, forming one grand general congress, to listen to papers and discussions by the most eminent men of the world in electrical matters.

CONSIDERABLE attention has been directed to the discussion of the subject of the multiple current of late. One of the most interesting articles on this subject appeared recently in London *Industries*, and is reproduced in another column. The conclusion which the writer reaches is: "We have reluctantly come to the conclusion that it has no great future before it, and that it is not really the solution of the problem; and as this opinion seems to be opposed to that of nearly the whole electrical engineering world, we felt obliged to give reasons to support it. For transmission of large powers from one dynamo to one motor, or from several dynamos in parallel to several motors also coupled in parallel the multiple current has some advantage in starting. This is small, because there is no difficulty in starting a large motor by means of cells or by starting the dynamo and motor together. The multiple current also has the advantage that a given machine will give a somewhat larger output because the whole of the available armature space is utilized. These small advantages are much more than counterbalanced by the extra cost of insulating and installing three wires, even though the weight of copper is the same in all cases. In addition to this, a single alternate current transmission may supply large motors, and may also feed lamps, etc., at the other end, without a complicated three-wire system. We therefore think that the multiple current has no advantages for use in connection with large motors."

Many other disadvantages are pointed out, and on the whole the work of the investigators in other fields is commended.

THE members of the American Street Railway association are holding their convention at Pittsburg this week. This organization is one of the most progressive in the country and its members have done much toward introducing improved methods in street railway work. At the last meeting of this body the president, who is, by the way, at the head of one of the largest street railway systems in this country, announced his faith in the electric railway in no uncertain tone. He said he believed the electric railway had made such progress during the preceding year, that it had practically crowded all other methods of transportation out of the field. He further expressed his belief that the Buffalo convention would be the last at which the horse would be seriously considered as a motive power. This was due, he believed, to the progress of the electric railway.

Mr. Lowry, moreover, has given assurance of his faith in the electric motor by introducing it on his system of street railways in St. Paul and Minneapolis. He had made arrangements to build a cable line but was convinced of the superiority of the electric system and substituted it for the cable. Mr. Lowry's successor as president of the association, Col. Watson, of Buffalo, is another advocate of the electric system, and the same may be said of a large majority of the members of the association. This is evident from the fact that the conventions of late years have assumed the character of electrical gatherings. This is especially true this year, when all but one of the papers read before the convention, are on electrical topics. The exhibits, too, have taken on the appearance of electrical displays. This, of course, is due to the activity in electric railway circles. All the large construction companies report that the demand for electric railways is increasing, and that this is particularly noticeable in small cities where the economical features are fully appreciated. Most of the large cities are now putting in electric systems.

ONE of the most popular and attractive features of the electrical department of the World's Fair, if the present plans are carried into effect, will be the display of historical electrical apparatus—instruments and appliances that mark the progress of the science from the earliest times to the present day. This exhibit will be of great interest to the general public as well as to the electrical engineer. Who, for instance, would look with indifference on the apparatus by which the learned Faraday conducted his researches? It cannot be doubted that many of the appliances devised by this eminent scientist to reveal and investigate the phenomena of electricity are still in existence—perhaps in some British museum; possibly in some dusty store-room. Who knows but that the identical key of which every school-boy has heard in connection with Franklin and his kite may be produced and serve to grace the collection? It should not be very difficult to gather together some of Morse's earlier instruments, and the appliances used by Henry in many of his experiments could be easily obtained. Mr. Varley has already written from England to Chief Barrett offering to send the machine which, he claims, is the "original dynamo." Possibly apparatus used by Davy, Arago, Volta and other investigators of the last century, and even earlier, might be secured. Of course an exhibit of this character would be largely a loan collection, and the owners would demand, and should receive, assurances that their treasures would be scrupulously guarded. As a graphic presentation of the growth of electrical development nothing could equal a display of this kind. It would be attractive alike to the expert and to the average visitor, and its educational power would be very great. A determined effort will be made to secure a collection of historical apparatus for the World's Fair, and it should succeed. The project has been taken up by E. E. Keller, Prof. Barrett's assistant in the department of electricity. Mr. Keller has already opened a correspondence with several persons who, it is thought, can contribute to the success of the contemplated exhibit, and he is determined to make the project a reality. He deserves commendation for his zeal and energy, and it is to be hoped that his efforts will be crowned with the success they deserve.

Electric Welding Plant at the Okonite Factory, Passaic, N. J.

In no department of electric welding has so much interest been manifested by electrical construction companies as in the splicing of wire. This was one of the first branches developed, and its advantages were at once appreciated and taken advantage of. As soon as it was apparent that this process had been developed into a commercial success the Okonite company installed two small welders, one for copper and the other for iron sheathing, at its works in Passaic, N. J. The small generator was immediately worked to its full capacity, and the results so encouraged the Okonite company that it was decided to completely abolish the old method of hand splicing, which, although in the hands of skilled workmen, was, when compared with electric welding, a most tedious and crude process. The small generator was very soon supplanted by the present installation. The generator is a self-exciting, constant potential alternator of a capacity of 30,000 watts. It is belted directly to a Ball automatic engine provided with extra heavy or "railroad" fly-wheels in order to maintain constant speed during the sudden demands on the generator.

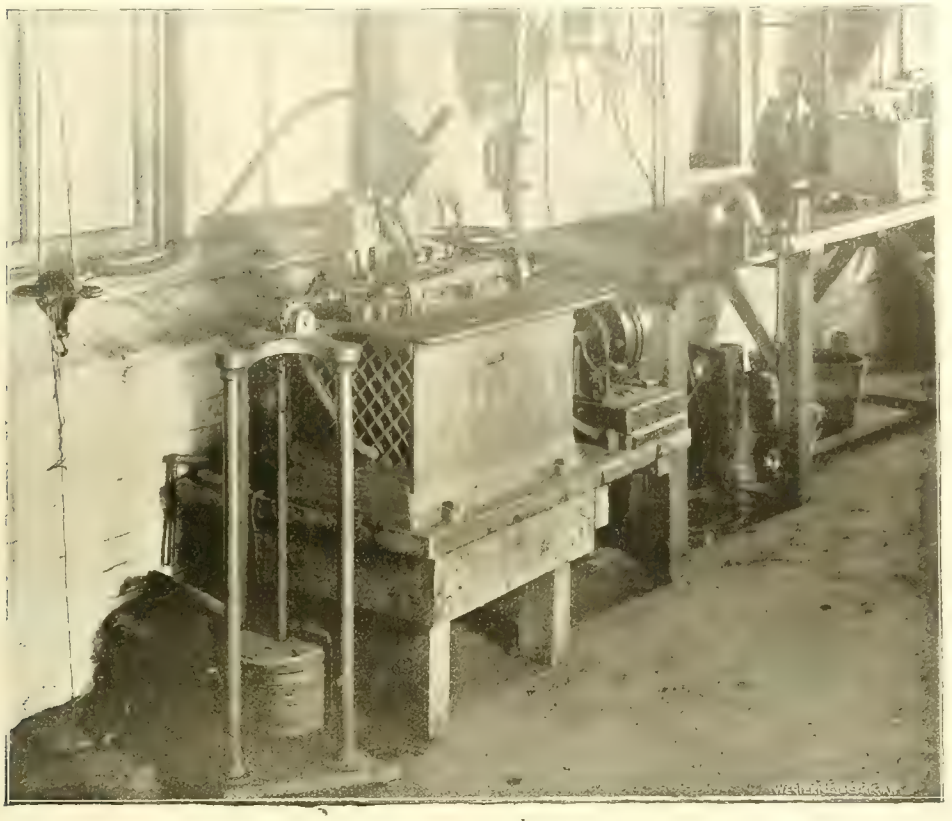


FIG. 1.—ELECTRIC WELDING PLANT AT THE OKONITE FACTORY.

The welders used are one of type "1 A" for iron armoring or sheathing wires; two of type "2 A. A" for copper from No. 6 A. W. G. to No. 20 A. W. G.; two of type "10 A. A" for copper from half-inch to No. 6 A. W. G.

After the wires are clamped and given the proper projection for the weld, the time of application of the curren is but a small fraction of a second for all of the smaller sizes, such as telephone and telegraph wires, and the heat necessary to form a perfect union is all concentrated in the tip ends of the abutted pieces. Advantage is taken of this fact in welding wire, already insulated, into continuous lengths.

The average daily output of copper, including all sizes, is about five tons, and the average number of welds is about 200.

The present plant is now running at almost full capacity. The welders are in different parts of the factory, and many times there is simultaneous welding on all machines making very heavy and sudden demands upon the generator.

In the illustrations herewith presented, Fig. 1 shows two welders on the main floor. One is a small bench machine, while the other is a larger machine. In Fig. 2 there is shown a welder for splicing iron wires in the armoring department. All other machines are used for splicing copper wire.

The experience of the Okonite company in operating electric welders has been highly satisfactory. Of course the introduction of the machines made it necessary to give special attention on the part of the workmen to the operation of the new process. Different wires require different projections of abutted pieces, different current strengths and different pressures on abutted pieces; and, again, the current must be interrupted at the proper moment. However, to apply the proper conditions to every wire in making a weld requires no extra amount of skill on the part of the manipulator. In the case of end pressure on the abutted pieces it is only required to apply the number of

FIG. 2.—ELECTRIC WELDING PLANT AT THE OKONITE FACTORY.

placed near the welder.

Use of the Telephone.

phone exchange, and an entertaining article was the result. The following extract relates to the use and abuse of the telephone:

There were people who could be heard saying cuss words because they thought they had not sufficiently prompt service, though they had no reason to do so, and if they had just glanced at the rules hanging up by their instruments they would have seen that they were very much out of order. That is one thing about the telephone. People feel about as safe in saying cross and bad things over the wire as they do by mail. They say things that they wouldn't begin to say face to face to a lady or to a man who happened to be bigger than they. They also say cross and bad things with such a perfect recklessness that would indicate that they have an idea that the wire softens the words and causes them to have less effect on the other's feelings. The feelings of these servants of the public are just as easily hurt, however as any other's. They can not see the person who wounds them; they can not tell who he is unless they have answered so many calls for him that they know his voice; but they know the number of the instrument, and that same voice is not liable to get any better treatment than he deserves on the next call.

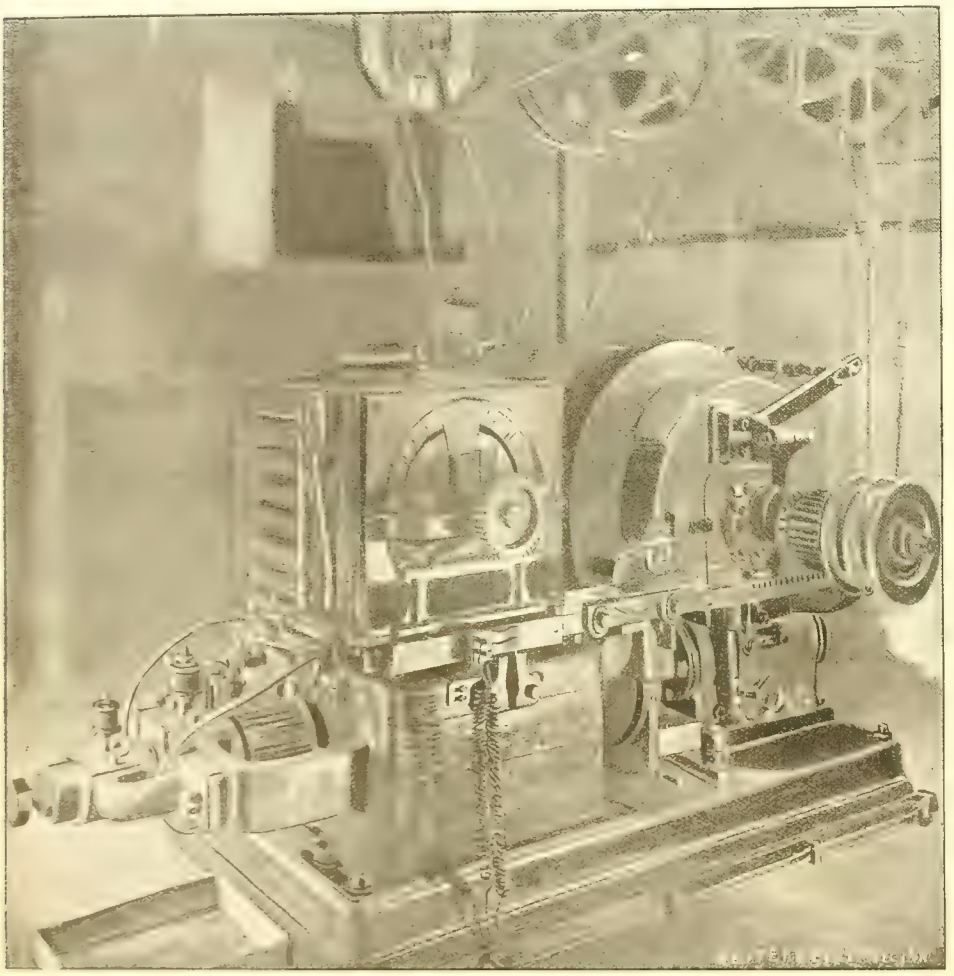
Remark has been made about the ignorance of people using the telephone. This is not only applied to occasionals, but to those who use it regularly. Abundant evidence was had of this. One man gets right close up to the instrument and yells what he wants loud enough to be heard a square away. The next one stands away back and does the same thing. Another comes along, gets up close and comes as near whispering as possible. There is one way to talk through a telephone, and only one, and few mistakes would be made by "Central" if all users would become acquainted with that fact. That way is to stand back just a little and talk in an ordinary tone, as if you were speaking to a man a couple of feet away instead of to one three or four miles away, over a wire. Don't yell; don't whisper; simply speak in an ordinary tone and distinctly. The words are carried by electricity, not by the force of your enunciation. The instrument is not to be compared to a deaf man, but, to the opposite, is exceedingly sensitive.

A great many people have an idea that there is a great deal of love-making and flirting over the wires. Well, there is some, but not a great deal, by any means. An amusing thing in this connection is that some telephone

subscribers, or their employes, have been attracted to "Central" and struck up a flirtation, thinking it was a young girl, when as a matter of fact "Central" was a man whose voice had been so finely tuned by constant use over the [illegible] to simulate a female voice. The "Central" in this case always enjoys the flirtation, and frequently makes engagements to go to the theater which he never keeps, making some excuse. The young lady "Central," if she has time, may indulge in an innocent and short conversation, but she seldom indulges in a straight out-and-out flirtation. There are cases where there has been a mutual attraction, where introductions and acquaintances leading up to marriage have followed, but they are not numerous. The young lady "Central" knows that such telephonic flirtations are a waste of time and pure nonsense or lead to no good, and she very sensibly avoids them and attends to business.

Electric Elevator at the Chicago Athenæum.

The application of the electric motor to the operation of elevators is of recent date, yet the mechanism has been so quickly perfected and the many advantages are so apparent that the electric elevator to-day takes precedence over all others in large cities, where current can be obtained for the operation of the motor. In the accompanying cut is shown the mechanism and connections for operating the Otis electric elevator at the Chicago Athenæum,



ELECTRIC ELEVATOR AT THE CHICAGO ATHENÆUM.

installed recently by the Hale Elevator company of Chicago. An Edgemeyer motor is used and current is supplied from the Chicago Edison company's mains. A glance at the cut will show that the substitution of the motor for other forms of operating mechanism has not materially changed the general arrangement of the apparatus. The [illegible] of the new method, aside from its superiority in operation and cost, is the fact that the motor [illegible] that it occupies little [illegible] requires no attention whatever. [illegible] then. [illegible] of the cars.

Electrically Regulated Clocks in Chicago.

[illegible] on its rim, to make a fifth of a revolution, which lifts a spring called the "circuit-breaker." Every clock in the system is connected through relays with this transmitter, and thus every other beat of the master clock is instantaneously telegraphed to all the clocks. One minute before each hour the transmitter stops working and a large "relay" takes up the service and exactly on the hour rings the bell and sets the hands of the connected clocks.

The naval observatory in Washington is the official time-maker of the United States and its master clock telegraphs the correct time at 12 o'clock noon every day to all the great centers of population of the country. When it is noon in Washington, it is 11 o'clock in Chicago, standard time, and just three minutes before that time Frank W. Brainard, superintendent of the Western Union time service in Chicago, stations himself beside the "chronograph" with his eyes fastened on the paper tape which will tell him whether his "master clock" is fast, slow or exactly right with the master clock in Washington. The chronograph (time-writer) is an instrument for comparing time. It resembles an old fashioned Morse register in its make-up, with paper tape passing under the "pen" or marker. This pen is simply the extension of a lever which is the armature of an electro magnet. When the circuit is on the armature lever is attracted to the magnent, and the point presses against the moving tape, leaving a line impression. Superintendent Brainard's chronograph has four "pens," one connected with Washington, one with his own "master" clock, one with the Wisconsin State university at Madison and one with the observatory at Allegheny city. The Lick observatory in California can also be connected if desired. As each pen leaves its individual impression on the paper tape the fastest clock will mark first and the slowest last on a glass scale, just the length of the space through which a point on the paper tape will travel in two seconds. This scale is divided into sixtieths of a second and the difference in time between any two points is found by simply counting the degrees between the beginning of the two "pen" marks. When this is determined little weights are placed on or taken off the pendulum of the master clock to correct it. It is said that Chicago has more electrically regulated clocks than any other city in the country.

New Trolley Wire Hanger.

The Electrical Supply company, Chicago, is placing on the market a new trolley wire hanger, invented by T. J. McTighe of the electrical engineering firm of Parry & McTighe, New York. The hanger has many interesting features. The clip is a single piece of sheet copper stamped out and folded into a U shape. This is slipped around the [illegible] and the ends are then drawn together between the [illegible] of a hanger bolt depending from [illegible] iron bow. The bell is filled under hydraulic pressure, with rubber and then vulcanized, the cross bolt passing through the folded ends of the clip. The final tightening on the wire is done by means of the wire key shown in the cut. This key, acting on the interlaced portions of the clip, causes the latter to tighten around the wire after the manner of a strap. By suitable selection of the size of key, any degree of grip may be obtained, and any of the usual sizes of trolley wire may be used without changing the construction of the clip. The most important advantage, however, and one which will be appreciated by expert linemen, lies in the fact that the clips may be attached to the trolley wire and to the line hangers without actually tightening the clips themselves on the trolley wire. This operation may be deferred until such time as

NEW TROLLEY HANGER.

the entire line is ready for drawing in and straightening. Then only is it necessary to apply the keys.

Again, after a line has become stretched and needs tightening, the keys can be withdrawn over any desired section of the line, so that the latter may be adjusted. There is no possibility of the trolley wire falling to the street.

It is claimed that it is impossible for a blow from a trolley harp or wheel to whip the wire out of the hanger.

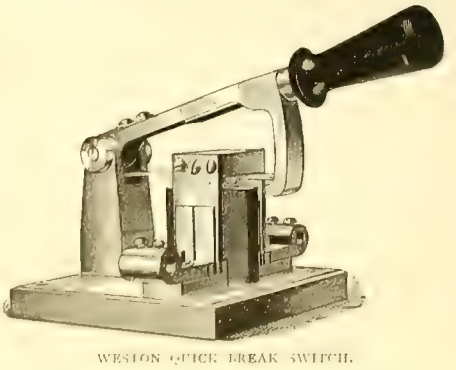
For curve hangers the suspension bolt is made with a broad downward extension which neatly fits the face of the clip, and gives it all necessary lateral support.

The Weston Quick Break Switch.

The accompanying cut illustrates the new railroad switch just put on the market by Wm. H. Weston & Co., Philadelphia. The switch has been highly indorsed by practical railroad men, and will be on exhibition at the Pittsburg convention. The parts are of highly polished red brass, and hard rolled sawed copper, mounted on a handsomely marbleized slate base. The switch is well designed mechanically, the wearing parts are strong and durable, and easily replaced, as all parts are interchangeable. The contacts are of ample proportion on all cases, so that they carry the rated current without heating. The breaking is accomplished by means of a tempered steel spring, so quickly that all arcing is prevented. The switches are made in three sizes ranging from 150 to 450 amperes capacity, and special sizes are furnished up to 1,000 amperes.

Sociological Aspects of Electric Traction.

Is the electric railway a real benefactor of mankind? asks the *Age of Steel*. Does it add to the general fund of man's happiness? For whatever benefits man tends to increase his happiness, either directly or indirectly. In discussing this matter from a sociological point of view, Prof. Crosby rightly says that we are rather prone to suppose that every advance made in the physical sciences is to be taken at once as meritorious. One of the tendencies of the electric railway is to hasten the already rapid movement from country to cities, as it makes available those lands immediately adjoining the great cities, which heretofore offered barriers to settlement on account



WESTON QUICK BREAK SWITCH.

of distance from the business portions. City life, too, has been enhanced by the electric railway. Placing the low estimate of $1 upon a day's work, let us see if any economy has been effected by the advent of electric cars. It has been estimated that there are, all told, 33,700 street railway cars in operation. The distance traversed by them during a year is 490,000,000

miles. Assuming that 4 cents per car mile will be the economy effected by the universal adoption of electric instead of horse cars, the saving expressed in money would be about $19,600,000 per annum, or, expressed in work, means 19,600,000 days' work. In other words, it appears that 53,700 men would be thrown out of employment. Nearly all of the great inventions made during the century which is about to close, have been more devoted to the increase of production than to increase of leisure. At the present time, however, there seems to be a tendency to appropriate more of the economics of invention by the actual withdrawal of labor. Another effect of the change would be to save time. The average schedule of speed of horse cars is about six miles an hour, while that of electric cars is about nine miles, the gain in time being three and one-half minutes per mile. The number of passengers carried during the year ending June 30, 1890, has been estimated to be 2,000,000,000. Assuming the average distance traveled by each of these to be half a mile, there would be a saving of three and a half billion minutes, which is equal to about 58,000,000 hours, or 5,800,000 days, allowing ten hours for a day's work. This time is merely saved from the time that otherwise would be spent on the cars; whether it is to be spent to better advantage, of course, cannot be determined. Dealing with the matter more in detail, the transfer appears much more complicated. The manufacture of electric motors and machinery will absorb a considerable part of the higher class of labor engaged in general mechanical pursuits, and the void thus left will be filled from the rural districts. It will doubtless be found, after all the changes have been made, that the ratio between the various occupations will remain about the same, with perhaps a small falling off in the numerical value of the agricultural population.

Bain's Compensating Voltmeter.

Managers and superintendents of electric plants realize the necessity for having reliable measuring instruments at hand which will indicate instantly small changes in current. With this fact in mind Foree Bain, of Chicago, has designed several station instruments, in the operation of which the forces of repulsion and attraction are utilized in a compensating manner.

The motor or moving portion carrying the pointer is of the lightest weight possible. The instrument combines the effect of the dynamics of moving electric currents and that due to electro magnetism, both affecting in a varying but compensating manner the movable armature, which is made of a small bit of chemically prepared sheet iron, one fortieth of an inch in thickness. The moving portion weighs only one sixtieth of an ounce complete, the whole being mounted on very delicate trunnions. There is

BAIN'S COMPENSATING VOLTMETER.

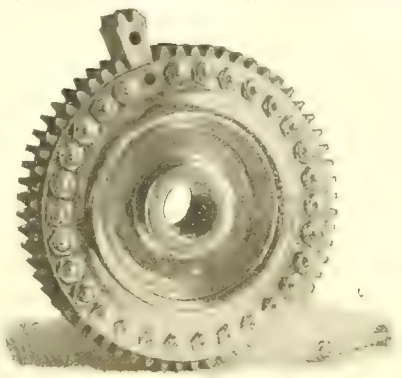
no appreciable friction. The pointer will come to rest every time at the same postion, when not in use.

The controlling force is gravity, with the parts balanced in such manner that its value is unchangeable during the entire excursion of the responsive system. The two forces, electro dynamic and electro-magnetic, act upon this system from opposite sides, so that the increment of one of the forces is coincident with the decrement of the other to a degree that is exactly compensating. These forces in the relation described neutralize any tendency to magnetic lag or retardation. The instrument has no permanent magnets which are subject to change of strength and to tempered strain fracture. There are no large moving masses of metal which require a large portion of the energy to operate them, and which are otherwise objectionable.

The instrument is absolutely dead-beat and yet extremely sensitive, having practically no inertia. The indicating pointer quickly and positively moves to new positions with slight variations of current. There is positively no continued oscillation, which so seriously affects the value of such instruments.

The voltmeter illustrated in the cut is wound with a resistance wire which does not change in resistance but very slightly with increased temperature, so that it may remain in circuit indefinitely.

The proportion of current necessary to operate these instruments is extremely small. They have a scale from 0 to 150 volts and are wound for 15,000 ohms resistance,



NEW TYPE OF WOODEN TOOTHED GEARING.

therefore requiring only one-hundredth of an ampere to deflect the needle the full length of the scale.

The appearance is neat and substantial without being clumsy. The brass case is circular in form and is firmly mounted on a highly polished hardwood base. The relation between the scale and the movable indicator is firmly maintained by a metallic structure, the moving portions are light, weigh about one-sixtieth of an ounce and are of such shape that they may be readily duplicated.

The aluminum pointer extends over a mirror to an engraved metallic scale, so that an error by displacement, due to parallax, may not be made when taking readings.

When used as a portable instrument, it may be hung on the wall, or held in an upright position in the hand. These instruments are made in single and double scale. They are manufactured by the Knapp Electrical Works of Chicago.

A New Type of Wooden Toothed Gearing.

The gear wheel illustrated herewith is the invention of T. J. McTighe, of the firm of Barry & McTighe, electrical engineers, New York, and is about to be placed upon the market. This wheel is composed of a single iron casting, with a deep groove around the circumference, into which are placed segmental blocks of wood, cut to the exact angle required, after the manner of a commutator. When the groove has been filled with these blocks, there is no room whatever for circumferential play. The most novel feature lies in the construction of the blocks with two teeth on their outer ends, and in the independent fastening of each block by a transverse bolt passing through the side walls of the wheel, and through the block at a point comparatively near the pitch-line. By using a tough quality of cast iron, the tightening of the bolts causes a slight compression on the wood blocks, the result being that there is no possibility of play taking place between the blocks, and consequently they remain tight until the teeth are worn out or broken. When they become worn out or broken, so as to require renewal, it is only necessary to withdraw the bolt which holds a particular block, then remove the block and insert a new one. All of this can be done without removing the wheel from its position in the motor or on the axle. The construction is also adapted to split gears for the car axles. The teeth, being made with ordinary high speed wood shapers, are comparatively inexpensive and the entire renewal for a wheel is a matter of small expense.

Wood's Trailer Connector.

The trailer connector shown in the illustration is intended to connect trail cars with the motor car for furnishing current for lighting purposes. The case is made of polished hard rubber and contains the binding posts for the cord terminals. The projecting metal plugs are not in circuit until the two parts are locked together as designed. It is therefore impossible to get the slightest shock by handling when not connected. The device is made by the Electrical Supply company, Chicago.

Electricity at the World's Fair.

matter in hand and has opened correspondence with persons supposed to have in their posession various devices of this kind. The intention is to secure apparatus used by the old investigators in their researches, and to combine this in an exhibit showing the progress of the science from as early a date as possible. There is doubtless considerable apparatus of this nature in existence in Europe and in America, and the problem is to get the possessors of these relics to place them at the disposal of the department of electricity. Mr. Keller is fully aware that it is no easy task to which he has addressed himself, and he is anxious to have all persons having a knowledge of [illegible] anything in the line of historical electrical apparatus communicate with him and aid him in the location of apparatus of interest.

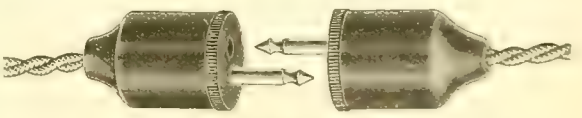
It is the intention of the exposition authorities to install a mammoth central station plant in the southern part of Machinery hall, which will be itself illuminated by 672 arc lamps of 2,000 candle power each. This plant will consist of a number of model lighting and power stations installed by manufacturers of electrical machinery throughout the world, according to their own designs, after approval by the exposition management, thus giving each exhibitor of this class a distinct, modern, model lighting and power station of his own construction shown in actual operation. The various systems will thus be seen under every-day conditions.

Electrical Engineer Sargent and Luther A. Stieringer, who is at present working in conjunction with Mr. Sargent, in the employment of the World's Columbian Exposition, have their headquarters in the office of the construction department at Jackson Park. A force of twelve or fifteen draughtsmen is employed under them on the plans for the lighting and power installations.

The construction department is now perfecting plans for the location of restaurants, lavatories, cloak rooms and offices in the electricity building for the consideration of Chief Barrett and his assistant.

Prof. Barrett has received a second letter from Secretary Hornsby, dated September 30th, which contains many interesting allusions to the Frankfort exhibition and the men back of it. Following are extracts:

"On Tuesday, the day after my arrival, I had the pleasure of dining with Herr Sonnemann, president of the exposition, Herr Oscar Von Miller, electrical engineer in chief, Herr Stiebel, secretary, and a few other gentlemen who did me the honor to be of a party invited to meet me. Afterward I took a ride on the famous Electra, the accumulator boat being operated by Siemens & Halske on the Main. * * On Wednesday I had the pleasure of dining with Dr. Wortmann, chief engineer for Siemens & Halske, Herr Fischer, chief engineer for Siemens Bros. of London, and a party of gentlemen and several ladies. * * * *



WOOD'S TRAILER CONNECTOR.

"They have a model theatre here, lighted by a direct current machine by Siemens & Halske, that is simply great. They have the current so controlled that they can present a scene from nature, begining with the dawn, bringing forward the light—sunrise, mid-day, evening, twilight, sunset, dark, moonlight, with sun and moon represented—a scene, in fact, that can give nature 'cards and spades,' and beat her out, with never a flicker.

"Then there is a loan collection of paintings in three galleries, lighted by different systems of reflection—one of incandescent lamps by H. Poege of Chemnitz, which is not good, and two arc light systems by S. Elster of Berlin, one of which is simply perfect, in that you do not get a bad ray of light in any part of a single picture, standing at any point, and the light is exactly diffused over every part of the walls, high and low alike."

A cablegram from Berlin, dated October 18th, states that Mr. Hornsby left the German capital for St. Petersburg on that day. The secretary appears to [illegible] for their excellent electrical machinery, but adds that America is ahead in the every-day applications of electricity for commercial use.

Electrical Engineer Keller, at the expense of much time and effort, has amassed much valuable information [illegible] to freight rates and traffic arrangements for the fair. It is of practical interest to every electrical concern [illegible] Chicago that intends to make a display. Mr. Keller announces that the twelve principal freight and traffic associa-

tions of the country have accepted the proposition to return free to the point of original shipment, over routes [illegible] pay full tariff rates on the forward journey. These twelve associations represent 230 of the leading transportation lines. There are nearly 500 railroads not members of any traffic association; a great many of these have indicated a willingness to be governed in the matter of freight rates by the action of the associations. Twenty-four of these railroads have made half-rates in each direction, while fifteen have granted free transportation each way. A number of the Pacific steamship lines and the Atlantic coast lines have volunteered to carry freights for exhibition purposes without charge or at very low rates. The Atlantic Transport line has volunteered to carry handy packages from London to New York without charge. On packages requiring expenditure for handling there will be a charge to cover such service. It is expected that a number of other steamship lines will soon follow this example.

The following is a schedule of the current class rates of the principal seaboard ports to Chicago in cents per 100 lbs. These rates include the terminal charges to cover the placing of exhibits on or adjacent to the place allotted in the exposition, but do not include the installation.

From	1st Class.	2d Class.	3d Class.	4th Class.	5th Class.	6th Class.	A.	B.	C.	D.
New York, rail	[illegible]	73	53	43	33	33	......		..	...
Rail and Lake	62	55	45	35	31	28	.....	..	....	....
Philadelphia	77	67	50	41	[illegible]	31	......	....	...	.
Baltimore	75	65	55	[illegible]	[illegible]	30	......	. .	....	.
Boston	83	73	58	43	[illegible]	33	......	. .	.	....
Portland, Me	73	65	52	[illegible]	[illegible]	30	......	..	..	....
Newport News	[illegible]	[illegible]	51	37	33	[illegible]	......		..	...
[illegible]	[illegible]	65	53	[illegible]	34	30	.. ..	.		....
New Orleans	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	......	...	....	..
San Francisco	[illegible]	[illegible]	3.03	[illegible]	[illegible]	..	2.081	[illegible]	531	[illegible]
Portland, Ore	4.28	[illegible]	[illegible]	[illegible]	2.08	...	2.081	[illegible]	531	[illegible]

From the above rates it will be seen that freights from New York to Chicago, including switching and placing exhibits on alloted space and terminal charges, vary from ½ cent to 1½ cents per ton mile. The rates, of course, may vary slightly before the opening of the exposition.

The following is the classification of the principal articles in the electrical line, and will enable an intending exhibitor to arrive very closely at the cost of transportation:

	Less than carloads.	Carloads.
Carbons, electric light, boxed	2	4
Car [illegible]	4	5
Car [illegible]	1	[illegible]
Cars, street, electric and cable (minimum [illegible])	1	
Dynamos	1	3
Electric light globes, C. L. minimum weight [illegible]	1	3
Electric light lamps, nested [illegible]	2	5
Electric meters, boxed	1	3
Electric motors, same as dynamos	1	3
Electric instruments and fixtures, boxed	1	3
Engines and boilers, not exceeding 30 feet in length	1	5
Engines and boilers exceeding 30 feet in length		5
Engines, caloric, gas or naphtha	1	4
Engines, stationary	2	5
[illegible] packages	3	
[illegible]	4	5
[illegible]	1	3
Gutta percha goods	1	
[illegible]	1	
[illegible]	1	
[illegible]	2	5
[illegible] telephones, telegraph	1	3
[illegible] packages	1	
[illegible]	4	5
Insulators, porcelain or glass, boxed or in barrels	4	5
[illegible]	[illegible]	3
[illegible]	1	
[illegible]	1	3
[illegible]	[illegible]	5
[illegible]	1	
[illegible]	[illegible]	5
[illegible] and [illegible]	[illegible]	[illegible]
[illegible]	1	3
[illegible]	[illegible]	5
[illegible]		4
[illegible]		4
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	4
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	4
[illegible]		5
[illegible]		5
[illegible]	[illegible]	
Vitriol, barrels or casks	[illegible]	[illegible]
[illegible]		4
[illegible]		[illegible]

[illegible]

[illegible]

The above arrangements apply to almost all articles exhibited in the electrical department. The direct rail routes between New York and Chicago are: New York Central & Hudson River, Baltimore & Ohio, Lehigh Valley, New York, Lake Erie & Western, the Pennsylvania lines, New York, Ontario & Western, New York, West Shore & Buffalo, Delaware, Lackawanna & Western. Arrangements have been made for storing empty cases and packing material as follows: For removing, storing and returning empty cases and packing material without insurance, 2 cents per cubic foot will be charged. For the same service with insurance 2½ cents per cubic foot will be charged.

London *Industries* is authority for the statement that "an electrical tramway will be built at Chicago on the model of that at Buda Pesth by Siemens & Halske.

The Multiple Current.[1]

There are really two types of multiple current motors; in one the field magnet is separately excited, in the other it is excited by the armature.

In the first, or separately excited kind, the action is practically the same as in an ordinary single current machine, except that there is some tendency to start. The efficiency is the same whether the machine is wound for a double or a triple current. The only point to be noticed in comparing the double and single current machines is that the output of a single current dynamo or motor is somewhat less because the armature is not fully utilised, some of its available surface not being occupied with wire. We find ourselves in opposition to no less an authority than Herr Dolivo Dobrowolsky as to the relative output of a triple current machine when coupled with three independent circuits, that is to say, with six leads, and when coupled to three leads. If the electromotive forces in the armature circuits vary harmonically, we find the output with a given number of armature turns, and the same size of copper, and the same current density, whether coupled up to three separate circuits or to three leads, will be the same. We will leave the reader to form his own opinion; but, according to our view, the efficiency of the triple current machine is high whether used as a generator or motor.

Passing to the motor of the Tesla short circuited type, we have a machine whose field is excited by armature reaction. It was pointed out some three years ago by the present writer that to make a Tesla motor efficient the armature wire must be large enough to carry the large number of ampere turns necessary for exciting the field magnet, and that the best way of meeting the difficulty was to make the armature large and to keep the air space small, so that few armature ampere turns are necessary to excite the field. It was suggested that the machine should therefore be made with an armature of the Pacinotti type. The Allgemeine Electricitæts Gesellschaft have come to the same conclusion apparently, but have gone further, adopting the embedded winding, which has the advantage of Pacinotti's teeth without the drawback of producing useless Foucault currents that merely cause waste of power. If the loss by the resistance of the copper of the armature is kept down, there is no reason whatever to suppose that a Tesla or Dobrowolsky motor is not just as efficient as any other type.

It is urged that the triple current gives a more uniform field than the double, and that the triple current as used in Germany is, therefore, more efficient than the double as used in America. As the loss of efficiency due to the variation of the field throughout the period caused by a single current is not appreciable in the ordinary alternate machine, even when the armature reaction is considerable, it is hardly likely that there can be any loss to speak of with a double current. Moreover, the closed field circuit is itself of such low resistance that it takes currents which practically prevent any variation of the field. A Tesla motor with a double current may thus be made just as efficient as with a triple current. It is moreover possible to design the closed coils and magnet poles so that the variation of field produces no waste of power by Foucault currents; in fact, a machine could be made with no current in the closed coils at no load. We do not, therefore, think that there is any great need for the determination of the efficiency of such motors; the chief fault lies not in the real, but in the apparent waste of power. The magnetic circuit is excited by an alternate current, or rather by three alternate currents. The result of this is that the current taken by the motors is enormous, even when small air space machines are used.

The great want at present is an alternate motor for comparatively small powers, such for instance, as 2 horse power for use in connection with supply stations. In order to use the triple current a three-lead system of conductors must be used. This is a very serious drawback, and the difficulty of measuring currents and powers in the circuits is a great evil. If six leads are used there are, of course, three independent circuits, and instruments can be inserted in each in the ordinary way; but if the three circuits are run with only three leads the measurement becomes troublesome, and, as far as we know, impossible. To get over this difficulty Herr Dobrowolsky prefers six [illegible]. It is possible, however, to bring six leads from the dynamo, and to insert measuring instruments in the three [illegible]. The [illegible] may then be combined [illegible], for instance [illegible] transformer may then be arranged with three primary circuits and six secondary. The secondary circuits can then be measured as three independent circuits again. One triple or three ordinary transformers can be used, as desired. Closed circuit triple-current transformers will be a little more efficient than three single current closed iron circuit transformers for the same total output. We are here again at variance with Herr Dobrowolsky, but the same arguments apply to the transformers as to the dynamo. This gives the same efficiency, as far as the copper is concerned. By combining three closed circuits into one triple current transformer the weight of iron can be reduced a little, so a slightly higher efficiency is obtainable.

Schuckert & Co. exhibit a triple current transformer. They also show some very interesting machines. Imagine a direct current Gramme armature in a two-pole machine. The armature turns may be connected up to a commutator for giving direct currents in the usual way. Connections may also be made from two opposite sections to two contact rings and a single alternate current can be obtained. If three contacts are made at equal intervals, a triple current can be collected from three contact rings; and if four connections are made at equal distances, two double currents can be collected from four contact rings. Messrs. Schuckert make a machine with a direct current commutator, and several alternate current contact rings, all supplied by one armature. The result is extraordinary. The machine can be worked as a direct current dynamo, exciting itself, and giving external current. It can also be arranged to give a single, double or triple alternate current at the same time, if the necessary contact rings are supplied. In fact, such a machine can give as a dynamo or take as a motor direct currents, and single, double or any multiple alternate currents; it can act as a dynamotor, converting any of these into any other, and all this is done with one armature circuit. These machines have eight poles, so they cannot be made to give high frequencies but, of course, the same type of dynamo can be made with more poles.

We have given so much space to the discussion of the multiple current, because so much has been said about it and so much is expected from it. We have reluctantly come to the conclusion that it has no great future before it and that it is not really the solution of the problem; and as this opinion seems to be opposed to that of nearly the whole electrical engineering world, we felt obliged to give reasons to support it. The subject may be summed up from our point of view as follows: For transmission of large powers from one dynamo to one motor, or from several dynamos in parallel to several motors also coupled in parallel, the multiple current has some advantage in starting. This is small, because there is no difficulty in starting a large motor by means of cells or by starting the dynamo and motor together. The multiple current also has the advantage that a given machine will give a somewhat larger output because the whole of the available armature space is utilized. These small advantages are much more than counterbalanced by the extra cost of insulating and installing three wires, even though the weight of copper is the same in all cases. In addition to this, a single alternate current transmission may supply large motors, and may also feed lamps, etc., at the other end, without a complicated three wire system. We therefore think that the multiple current has no advantages for use in connection with large motors.

We turn now to the case of small motors on supply circuits; and we assume that they cannot be made for single currents. In order to let a supply company run motors, it has to put down a special system of triple leads, involving all sorts of complication, and puzzling consumers, who hardly understand the ways even of a single alternating current. The motors may be easily constructed, and they may work very efficiently, but the large currents taken by them will give trouble if a high-pressure system with transformers in the houses is used. For instance, if a 2 horse power motor takes 100 volts and 70 amperes, it will need a 10 horse power transformer to supply it. In addition to this it will need a special meter. Of course condensers might be used to supply the exciting currents, but 100-volt condensers are expensive to make, and this adds to the cost. There is no difficulty in supplying exciting currents by condensers at the station, but in the case of motors this demands the large transformers just mentioned. If the town is supplied by large transformers, the exciting currents do not give much trouble, as, unless a very large number of motors are used, the transformers need not cost much more. In the case of supply stations working lights, the multiple current allows us to use motors too, but the price is a complicated system of wires and transformers throughout the whole area. The probable demand for small motors is far too trifling for it to be worth while to alter a system merely to be able to supply it. It would be much cheaper to run a third circuit and use a direct current for motors and for electro-plating requirements.

We also fail to see that the triple current is any real advance beyond the double current machine, to whose development Mr. Tesla has devoted so much energy. Mr. Tesla, in America, and Messrs. Hutin and Leblanc, in France, are making progress in the direction of splitting a single into a double current by means of self-induction, capacity and resistance suitably arranged. The solution of the problem of small motors may lie in this direction, but we do not think it lies in multiple current motors, which do not fit the present systems of lighting.

In mines, especially in dangerous mines, where it is most important that there should be no sparks, and where simplicity is demanded, the multiple current will probably come into general use; but at present it does not even promise a solution of the problem of alternating motors on supply circuits. What is asked for is a small motor to suit existing alternating circuits; what is offered is a motor which demands a new and complicated system of supply to operate it.

[1] London *Industries*.

A lecture at Central Music hall, Chicago, has been announced for Oct. 24th. The lecturer is C. S. Page and the subject "What is Electricity?"

Phosphorus is now being made by electricity. The principal manufactory is in England, where, it is anticipated, fully 1,000 tons will be made annually.

Electrical Statistics and the Census Department.

The National Electric Light association at Montreal discussed the action of Superintendent Porter of the census department in ordering a discontinuance of the work inaugurated in the electrical department and took measures to signify the disapproval of the members. This action had the effect of causing the secretary of the interior to call upon Superintendent Porter for a report upon this subject. Mr. Porter has made an official report to Secretary Noble which is appended:

"The wonderful advancement of the electrical science, both in invention and successful application, occurring during the last decade, induced this office, upon the solicitation of the National Electric Light association and other interested parties, to institute preliminary inquiry—the first investigation of that subject ever made under federal authority, or by any government. For this purpose, Allen R. Foote, an electrical expert and author of national reputation, and a most worthy gentleman, was strongly indorsed by the National Electric Light association and a large number of representative firms and public men. He was appointed Dec. 4, 1889, and has been indefatigable in his efforts to push the work to completion.

"It is proper to observe, however, that when it was decided to investigate this subject, it was not contemplated that the scope of the inquiry would extend beyond certain defined limits common to the special branches of productive industry: Subsequently, however, upon consultation with gentlemen interested in this subject, the schedules were so broadened as to cover details that were regarded as necessary properly to present the condition of these important industries, and the questions contained in the schedules were approved by the National association, as well as by electrical experts and others.

"Electrical science being a newly applied industry, the cost of the investigation could not possibly be estimated with accuracy nor even approximated, but as it progressed, the expense, present and prospective, was found to be so great that I felt unwilling to divert funds from other branches of census work, and employ them in behalf of an industry, however important, which would inevitably entail larger outlay than could possibly have been anticipated.

"To meet this emergency a bill was introduced at the last congress providing an appropriation of $50,000, to be expended specifically in making inquiry into the electrical art and industries, but it failed to pass. It then became imperative to secure, if possible, the necessary returns by correspondence, and although every effort had been made in this behalf, the project did not yield satisfactory results. The reason for this failure is peculiar and anomalous. While the parties engaged in the various branches of electrical industries were entirely willing to supply information called for, they frankly admitted that they did not possess the technical knowledge incident thereto, and hence none but experts could secure the same in any other way save by personal visit to each plant.

"Hence it was determined to postpone further investigation until the Fifty-second Congress should assemble, thus relieving the census office, temporarily, of further expense in the premises, and accordingly an order issued to that effect.

"Upon the representations, however, of Special Agent Foote, concerning the non-advisability of completely suspending the work, this order has been countermanded. The inquiry will henceforth be conducted by correspondence, so far as the same may be found practicable, with the aid of one special agent in the field.

"It should be borne in mind, however, that similar action of temporary suspension was taken with reference to all other special branches of productive industry. It was also found that the outlay required to complete the collection, examination and tabulation of the manufacturing returns, was so large as to render it impracticable to assign to this branch a sufficient amount, from the funds remaining on hand, to complete any part of the statistics of manufactures. Hence I have been compelled to apply the remainder of the appropriation to the completion of the population statistics and such other branches of census investigation as could, without great expense, be immediately concluded, and meantime defer publishing the statistics of manufactures, simply maintaining the current work of that division until after the meeting of Congress, when an additional appropriation shall have been secured.

"No one, more than myself, appreciates the high importance and value of the investigation into the electrical art and industries in connection with the presentation of census statistics comprising all other productive industries of the country.

"Prior to entering upon the electrical inquiry, the division of transportation had been charged with the collection of statistics relating to telegraphs, telephones and electrical railroads, and the division of vital statistics trenched somewhat upon the electrical lighting and surgical domain. These inquiries have been eliminated from other divisions, and committed as an entirety to the division of manufactures, and assigned to the branch of special investigation into the electrical industries, thus materially adding to the cost as contemplated for the original inquiry.

"In order that some idea may be formed of the great extent and value of the work now involved in the census inquiry concerning electrical industries, it may be important to state that there have been prepared for the collection of statistics for the electrical industries for the eleventh census nineteen schedules and as many supplements, covering the following subjects:

"1. Schedules for Preliminary Information.
"2. Schedule for Educational Institutions giving a course in Electrical Engineering.
"3. Electric Light and Power Stations.
"4. Manufactures of Electrical Apparatus and Supplies.
"5. Isolated Electric Light and Power Plants.
"6. Commercial Telegraph Companies.
"7. Commercial Telephone Companies.
"8. Steamboat Electric Light and Power Plants.
"9. Municipal Electric Light and Power Stations.
"10. Uses of Electricity in Medicine and Surgery—Manufactures of Apparatus.
"11. Uses of Electricity in Medicine and Surgery—Medical Colleges.
"12. Uses of Electricity in Medicine and Surgery—Hospitals.
"13. Uses of Electricity in Medicine and Surgery—Physicians.
"14. Municipal Fire Alarm Telegraphs.
"15. Municipal Police Patrol Telegraphs.
"16. District Messenger Companies.
"17. Use of Electricity in Mining.
"18. Telegraph Lines Used by Steam Railroad Companies.
"19. Electric Street Railroads.

"There have also been issued about fifty different forms of printed letters of inquiry and transmittal, besides numerous typewritten and form letters. In addition to the statistics provided for by these schedules, statistics are to be collected by letter or by personal application on the following subjects:

"1. Scientific Electrical Instruments.
"2. Ocean Telegraphs.
"3. Electrical Distribution of Time.
"4. Uses of Electricity by the United States Government.
"5. Electrical Tabulating Machines and Registers.
"6. Electroplating.
"7. Electro-Metallurgy.
"8. Electric Welding.
"9 Special Uses of Electricity by Steam Railroads, such as:
"*a*. Telegraphing from Moving Trains.
"*b*. Special Uses of the Telephone.
"*c*. Block and Road-Crossing Signals.
"*d*. Electric Headlights.
"*e*. Electric Train Brakes.
"*f*. Electric Train-Lighting.
"*g*. Uses of Electric Motors for operating Drawbridges, Turn-tables, Traveling Cranes, Hoists and Telpherage.
"10. Electrical Patents issued by the United States.

"All advices received by me, concerning the inquiries comprised in the schedules prepared under the direction of Special Agent Foote, express the conviction that they are skillfully drawn and thoroughly adapted to the purpose. It is also indicated that those employed in the development of electrical invention and industries will interest themselves, and cheerfully make response, a consummation of supreme importance to the census office."

It is evident from this that the line of action for the electrical people to follow is in the direction of securing an appropriation from Congress which will enable the department to complete the work now in hand.

Reorganization of the Westinghouse Company.

The affairs of the Westinghouse Electric Manufacturing company have occupied considerable prominence in the electrical and financial world during the last year. The reorganization of the company which is about completed has been a topic of interest in business circles during the week. The *Daily Financial News* thus refers to the event:

"The advantageous position which the Westinghouse Electric & Manufacturing company will occupy in the electric manufacturing business upon the completion of the reorganization could not well be brought out fully by the circular of August Belmont & Co. of New York, and Lee, Higginson & Co. of Boston, asking for subscriptions to the 7 per cent. cumulative preferred stock of that company, though they call attention to the fact that the outstanding capital of the company, with its great manufacturing facilities, will be only $4,000,000 of 7 per cent. preferred stock, and about $5,000,000 assented common stock, leaving $1,000,000 for future operations.

"As reorganized, the company will be without debt, and will have a cash working capital sufficient for all its purposes when conducted on an economical basis; and this basis has been attained by the economies which have been enforced by circumstances and by a careful consideration of the future needs of the company. At no period of its existence has the company made such important advances as during the past year in the quality and character of apparatus manufactured by it; and particularly it has established a reputation for street railway apparatus second to none, and there have also been perfected during this period new and important forms of generators for both direct and alternating currents.

"From its inception, the Westinghouse company has refused to grant licenses which could prevent it from conducting business in any territory where the licensees should become unwilling or unable to supply the public demand, and in this respect the company stands alone among the large companies in its perfect freedom from troublesome obligations.

"It will be the policy of the company to cut down the cost of selling its apparatus to the lowest possible figure in order that its customers may enjoy the benefit of the lowest prices that can thereby be established; in fact, the present low cost of selling, which has been brought about by rigid economy and necessity, with the large savings that have been effected by consolidating the three companies into one, will give the company further very liberal advantages in the direction of a reduction of the cost of selling its manufactures and in the cost to its customers."

So large a part does the great Thomson-Houston factory at Lynn, Mass., play in the affairs of that city that the *Lynn Daily Press* maintains a regular department of news items gathered at the factory headed "At the Electric Works." This appears daily.

Direct Conversion of Heat into Electricity.[1]

theory of the subject, Clausius suggested in 1850 that "by the molecular motion, which is termed heat, electricity is driven from one material to the other;" and Kohlrausch's

electric current is in some way connected with the flow of heat, and vice versa. The discoveries of later years, culminating in

the electric current is merely the result of a certain vibratory motion of the luminiferous ether, and, therefore, in accordance with the principles of the conservation of energy, a certain definite quantity of heat can be converted into a certain definite quantity of electricity without either loss or gain of energy, and it is this meaning that is given to the subject of this paper, conversion by a dynamo machine being termed "indirect."

Proceeding then to calculate the absolute efficiency of the ordinary means of producing the electric current by a steam-driven dynamo, the electrical energy developed is shown to be only 6.4 per cent. of the energy existing in the coal burnt in the boiler; but even this low efficiency is eighteen times greater than the direct conversion of heat into electricity as furnished by a Noe and Clamond thermo-battery, where the efficiency works out at only 0.35 per cent. of the mechanical equivalent of the gas burnt. If the high efficiency of the dynamo and steam engine in themselves, as manufactured at the present day, be considered, it is clear that not much greater results can be expected in that direction; and the author has for some years been experimenting in other directions, therefore, for the direct conversion of heat into electricity.

The principal idea acted on at first was the heating of a certain metallic salt in a platinum crucible, which should form the positive pole of the element, and a carbon rod immersed in the molten substance the negative pole; this substance would part with its oxygen to the carbon, and then be reoxidized by contact with the air; and with this form of apparatus, a mixture of caustic soda and carbonate gave an electromotive force varying between 0.475 and 0.4 volt, the "sodium blast" generated at the carbon point burning at the surface with its characteristic yellow flame, accompanied with slight explosions. For the similar potash salts the electromotive force was between 0.4 and 0 31 volt, the flame being violet and the burning more violent, and forming a small display of fireworks. The adoption of lead oxide resulted in a momentary high electromotive force, and then a sudden collapse of the platinum crucible, owing to the metallic lead reduced falling to the bottom and eating through the platinum. The author was surprised also to find that at the junction of the platinum connection wire the crucible was also severely pitted, as the current had never been short-circuited, and he has no valid explanation to offer therefor.

After these experiments, the results of which did not promise any simple solution of the problem, the author set himself to improve, if possible, the thermo-battery, and for which purpose attention was directed to the following particulars:

1. The adoption of durable materials.
2. That the electromotive force and specific conductivity should be as high as possible.
3. Improvements in the form of the element.
4. Improvements in the application of the heat, *i. e.*, a higher efficiency in the production of the heat itself.

Subsulphide of copper, in spite of its high electromotive force, gave, on account of high specific resistance, a weaker current than materials which gave only half its electromotive force, and it was also found that, by a species of dry electrolysis, granules of metallic copper were formed throughout the body of the material, and its use was, therefore, discarded. A form of battery is described, and which was exhibited at the meeting, consisting of tubes of nickel and a special antimonial alloy, which was found to be very durable. This consisted of fifty elements in series united in one casing, and gave an electromotive force of 3.5 volt, and an internal resistance, when hot, of 0.4 ohm, with a consumption of 7¼ cubic feet of gas per hour, and the absolute efficiency is 1.08 per cent., or three times that of the existing thermo-batteries. Such a battery is almost exactly equivalent to two Bunsen elements, and though it is far below the dynamo in efficiency, still it may be suitable for various small installations, and for experimental work, owing to complete absence of polarization, as the electromotive force does not fall on short circuit. The durability is enhanced by a regulator applied to the gas supply to prevent any accidental overheating.

The author concludes by stating that he hopes to produce cells which are the outcome of still later researches, and in which the efficiency has been raised to over 5 per cent., and thus

namo. The description of the construction is withheld; but it is stated that one form is capable of continuously

consumption of 4.5 pounds of coke per hour. This success the author hopes still further to advance, and thereby exceed the efficiency of the dynamo system as a converter of heat into electrical energy.

other material to be bleached between rolls serving as

used to saturate the fabric itself. Several pairs of rolls

Academy of Sciences.

CORRESPONDENCE.

New York Notes.

NEW YORK, Oct 17, 1891.—The few mishaps which have occurred of late on electric roads seem all to have been on Long Island lines. The last accident occurred on the Flushing and Cottage Point electric road where the latter crosses the Whitestone branch of the Long Island railroad. At this point there is a sharp bend in the steam railroad track. Just before reaching this place a coupling pin on a passing freight train broke, and the electric car ran across the track directly in front of the approaching section of the freight. The car was hit about the center, lifted from the tracks and landed about fifty feet away.

It is said that the car, which was a total wreck, was valued at between $4,000 and $5,000. The sole occupants of the car were two teachers on their way to school. They were pinned down by the wreckage for some time, but were not seriously injured.

At a recent meeting of the American Society of Railroad Superintendents held at the Hotel Brunswick in this city, a committee from the Train Dispatchers' association was present and submitted a proposition suggesting changes which were deemed important in the method of telegraph despatching.

The other evening an illustrated representation of the "Passion Play" of 1890 at Ober-Ammergau was given by Marion Kerner for the benefit of the New York Telegraph club.

An electric signaling system in New York by which a policeman on post can communicate through the central office with his precinct has at last been found to be an absolute necessity. Accordingly the Police Boards in executive session last week decided to ask the Board of Estimate and Apportionment for $100,000 for an electric signaling system, and $75,000 for an improved telegraph system. The need of this system has been under discussion since 1886, when the police commissioners obtained $100,000 for the same. It was then decided to adopt the Herzog system but an objection was lodged by the Gamewell Fire Alarm Telegraph company, and the matter has dragged along until the present time. It is claimed that the $200,000 on hand will not defray the expense of more than one quarter of the signaling system.

The tower of the Madison Square Garden, which for over a year has been slowly rearing its head above the roofs of surrounding buildings, received its finishing touches last week, and has just been opened for public inspection. From the ground to the electric light on the forehead of the statue of Diana, which surmounts the tower, the distance is 341 feet. By night the tower will be a blaze of incandescent lights, 1,000 of which are used in outlining the tower's majestic proportions. The crescent in the goddess' forehead is made of prisms of cut glass, and the light is furnished by 200 incandescent lamps. In the lighting of the arcade, the roof garden, and the tower there will be used over 2,500 incandescent lamps. The search light is one of the most powerful in the country, and the current used in it is said to be over 100 amperes. Before long an illuminated clock, with chimes and having a dial 22 feet in diameter will be placed on the face of the tower.

The Edison General Electric company has declared its eighth quarterly dividend of 2 per cent. on all of the stock of the company, due and payable on Nov. 2d at the office of the company, to holders of record Oct. 12th.

The Second Avenue Electrical railway of Brooklyn, has in view the extension of its line in several directions, and plans are being prepared to this end. One line is to run from [illegible] West Brighton and Fort Hamilton [illegible] branch proposed is from [illegible] and then to Flat[illegible] bridge is also talked [illegible]

[illegible]

[illegible]

[illegible]

Milwaukee, Wis.

Reports from Washington state that Attorney-General Charles F. Tabor of this state, has filed a motion in the Supreme Court of the United States to dismiss, affirm or advance the cases of Charles McElvaine and Nicolo Trezza, the condemned murderers, who are confined in prison at Sing Sing under sentence of death by electricity. Both cases are before the Supreme Court on appeals from the decision of the circuit court of the southern district of New York, denying an application for a writ of habeas corpus.

The suit of the United States, against the Central Pacific Railroad company, the Southern Pacific company, and the Western Union Telegraph company, will receive a hearing on Nov. 2d also before the United States Supreme Court at Washington. Among other things the government asked that a certain contract between the Central Pacific Railroad company and the Western Union Telegraph company be set aside and canceled, and that the Central Pacific be directed henceforth to operate its telegraph lines without discrimination. The suit was originally brought before Justice Field, but he declined to hear it owing to the fact that two of his brothers were interested in the Western Union Telegraph company, which is a necessary party to the suit.

Cable dispatches from London say that owing to the severe storm in England the telegraph wires are prostrated and communication with the coast and between the larger cities is a matter of difficulty and is coupled with considerable delay. The wind storm, which caused serious interruption in telegraphic communication, soon developed into a furious gale, and resulted in an interruption or almost complete cessation of telegraphing throughout the southwest portions of England and the south of Ireland and in Wales

H. Ward Leonard has been obliged to postpone for one month the reading of his paper which was to be presented before the American Institute of Electrical Engineers on the evening of Oct. 27th. A paper, by A. E. Kennelly of the Edison laboratory, on "Magnetic Reluctance," has been substituted.

F. S. Hastings, secretary of the Edison Electric Light company, has issued a notice to the effect that the annual meeting of the stockholders for the election of thirteen trustees to serve for the ensuing year and for the transaction of such other business as may come before the meeting will be held at the office of the company, No 44 Broad street, New York city, on Tuesday, Oct. 27, 1891, at 12 o'clock noon. The polls will be open at 12 o'clock noon and will remain open for the reception of votes until 1 P. M. Transfer books will be closed at 3 o'clock P. M., Oct. 17th, and will reopen at 10 o'clock A. M Oct. 28th.

F. L. P.

Milwaukee, Wis.

MILWAUKEE, Oct 17.—Henry Villard spent last Saturday and Sunday in looking over his immense properties here. It was the longest visit he ever made to Milwaukee, and he seemed to be greatly pleased with his investments and the way they were turning out. In no other place in the world, he said, could be found the system which had been adopted in Milwaukee. From one common center was furnished the power with which to propel the street cars, operate machines and appliances of manufacturing plants and run sewing machines, etc., in private houses, and furnish current for incandescent lights for residences and stores throughout the city. It was the finest electrical system in the world, he declared, and the most important electrical enterprise in which he was interested. His attention was called to a statement that Edison had about perfected an electrical locomotive for him and that it would be tried between Chicago and Milwaukee. He replied that for years he had been trying to get an electrical engine made and that Edison had recently been considering plans for one. He had given Edison a time-table on a road running between Chicago and Milwaukee in order that the inventor might get an idea of what was required of him. No electrical locomotive of this character, he declared, was then in existence.

Villard and Washington Becker had a quiet talk on Monday, and it was supposed that the sale of the latter's road to the former was the subject of their conversation. Before the conference, Mr. Villard had openly stated that Mr. Becker had offered some months before to sell his street railway system, but had asked too high a price for it. He had added that he would buy the Becker line whenever he could secure it at what he considered a proper figure. Mr. Becker had likewise confessed to negotiations with Villard last spring, but had added that they found it impossible to agree upon terms, and that the deal fell through on that account. Their conference on Monday was quite a long one but both declared that they did not discuss the sale of the Becker line. There is no doubt, however, that Villard is bent upon acquiring every foot of street railway in Milwaukee. He already has the Cream City and Milwaukee City lines; he will have the Hinsey road as soon as the litigation between the owners is decided, and only the Becker line is needed to complete the list. It is generally realized, however, that he is giving Milwaukee a splendid street railway system. The Farwell avenue line, which is the first one to be completed, is said by experts to be the best piece of overhead electric railway in the world. It has worked smoothly from the start, and nothing could be more comfortable than riding in the cars. The road bed is very solid, having been built like that of a steam railway; girder rails have been used, and the motors and appliances are the very best. Between 1,200 and 1,500 men are engaged in similarly transforming the other lines of the Villard system.

The city is again in trouble about electric lights. The contract with the Badger Illuminating company will expire in December, and there is no certainty of a new contract being made in time. Some time ago the city began to take the necessary steps to secure bids, but the Badger company enjoined it, and the matter was tied up in court for about two months. A decision was finally rendered in favor of the city, and bids were advertised for as soon as possible. The Milwaukee Power & Light company, the Badger company's only rival, was the only bidder. It offered to furnish 450 or more electric lights, of 2,000 nominal candle power, at $87.50 per light per annum on a three-year contract, and $82.50 on a five-year contract, the overhead system to be used For an underground system, ornamental iron posts to be used, the bidding company asked $96.25 per lamp per annum on a three-year contract and $92.31 on a five year contract. The Western Electric system is used by the company. The company made a condition that it be allowed the use of the city's conduits for police and fire alarm telegraph wires until it could lay its own conduits. No bond accompanied the bid, so that it was purely informal, and the city is not bound by it in any way. The matter is now pending in the common council. The Badger company is still likely to secure the new contract. The city charter gives the council the right to make contracts for patented articles without going through the formality of receiving bids, and this gives the Badger company another chance. President Wall of the Badger company states that he is ready to talk business with the city at any time.

Prof. Warren S. Johnson of the Johnson Electric Service company has invented a railway system for transmitting mail and small express packages with great rapidity. The Rapid Post and Packet company, with a capital stock of $1,000,000, has been formed to introduce the system. Francis Hinton of the Illinois Steel company, H. C. Frick, the Pennsylvania coke king, and L. Norrie of New York, the Gogebic iron mining man, are interested in the enterprise. Patents have been applied for both in this country and England, Austria, France, Germany and Italy The railway, Prof. Johnson states, may be either elevated or underground. The chief principle of it is a series of impulsions, electricity playing a secondary part. Prof. Johnson states that it will convey a package from Milwaukee to Chicago in thirty five minutes, and from Chicago to New York in six hours. The railway will cost $15,000 a mile. The vehicles of transmission are small cars, which will carry 100 pounds each. One of these cars can carry 1,000 letters. The packages will be limited to twenty pounds and to from two to three feet square in size. The actual cost of sending one of these cars to Chicago will be just $1. The system has been tested at short distances, and has worked satisfactorily, Prof. Johnson says, and its nature is such that if it works all right at short distances it will work all right at any distance. Prof. Johnson declines to give away any more specific information concerning the patent. He avers, however, that it is not a pneumatic tube arrangement, and that no engines, trolleys, motors or cables are required. Several Chicago men are interested in the enterprise.

In the common council an ordinance is pending to give the Milwaukee Street Railway company the right to build over Michigan street bridge from East Water street, along Sycamore, Fifth, Clybourn and Sixth streets, and over the Sixth street and First avenue viaducts. It will form an entirely new line, and besides will permit of the running of cars directly between the two depots. The present tracks on Huron and Clybourn streets will be torn up if the new road is built.

The common council has refused to declare the Western Union overhead wire system a nuisance, and the telegraph people will be allowed to string aerial cables in alleys. The telephone wires in the territory aimed at are already underground.

Henry C. Payne, Villard's Milwaukee representative, states that some of the double-decked streets cars like those

made at Pullman will be ordered for the Milwaukee Street Railway company. They would be just the thing for some of the Milwaukee lines.

In the Superior Court the trial of the case of Fred Will against the West Side Railway company resulted in a verdict for the company. He had been injured by an electric car and sued for $5,000 damages. The court held that the plaintiff, instead of proving negligence on the part of the company, had been guilty of negligence himself.

With the roads that are being operated and those that are being rebuilt, Milwaukee has just 106 miles of electric railway, single track. The Becker system is 21 miles long and the Hinsey system 14 miles long, and both are now operated by electricity. The Villard system, which is being rebuilt, has a total length of 71 miles. In the spring all of these systems will be extended, and by next fall it is probable that Milwaukee will have 150 miles of electric railway, counting the suburban roads, of which there are now three. C.

PERSONAL.

J. W. Dickerson, editor, and Irving Washington, business manager, have both severed their connection with *Electricity*.

Thos. L. Townsend with the Partrick & Carter company, Philadelphia, is now making an extended trip through the West, taking in all the principal cities. Mr. Townsend is now in Omaha and from there will go through the Southwest.

C. E. L. Brown, one of the most widely known electrical engineers of Europe, will retire, it is said, from the Oerlikon Works, near Zurich, in Switzerland, at the end of the present month. Mr. Brown's future movements will be watched with interest by electricians in this country and abroad.

L. Knowles Perot, electrical engineer with the Equitable Engineering & Construction company of Philadelphia, has been appointed assistant engineer of the company. Mr. Perot is an energetic and pushing man, and those who know him will agree that the Equitable company showed good judgment in making this appointment. He is a college graduate, but in addition to a thorough theoretical training he has the advantage of having taken the expert course at the Thomson-Houston factory at Lynn. Mr. Perot and Chief Engineer W. A. Stadelman will look after the interests of their company at the Pittsburg convention.

NEW INCORPORATIONS.

Cataract Electric company of Buffalo, N. Y.; capital stock, $40,000; manufacturing and using electricity for light, heat and power.

Granite City Electric company, Barre, Vt.; capital stock $50,000; generating electricity for light and power; E. D. Blackwell, Montpelier, Vt.

Alexander-Chamberlain Electric company, New York city, N. Y.; capital stock, $1,000; electrical engineering, construction of electrical works, etc.

A. C. Seibold company, New York City, N. Y.; capital stock $5,000; to manufacture and sell electrodes for arc lamps and other devices used in electric lamps.

Glenwood Heights company, Charleston, W. Va.; capital stock, $52,000; to maintain and operate electric lights and furnish the same for light, heat and power; J. B. Floyd, Charleston, W. Va.

Cumberland Electric company (incorporated in W. Va), Pittsburg, Pa.; capital stock, $100,000; manufacturing, constructing and operating all kinds of electrical apparatus for light and power, and all other business for which electricity may be applied; J. F. Brown, Charlestown, W. Va.

Bates & Blake Electric Railway Conduit company, Waterloo, Iowa; capital stock, $1,000,000; to manufacture and sell "Bates and Blake's electric railway conduit and trolley," also railway supplies in general; F. C. Platt, Waterloo, Iowa.

Hydro Electro Vacuum company, Chicago, Ill.; capital stock, $500,000; to manufacture and sell the Haughawont Hydro Electro Vacuum depurators, rectal, vaginal and nasal douches; Briggs & May, room 705, 85 Dearborn street, Chicago, Ill.

Butler Electric Light & Gas company, Butler, Mo.; capital stock, $15,000; to buy, own, operate and control the material, machinery, devices and appliances for manufacturing gas and electricity for lights, illumination, etc.; Geo. M. Canterbury, Butler, Mo.

Franklin Electric company (incorporated in W. Va.), New York, N.Y.; capital stock, $5,000,000; to manufacture, sell, lease, use, maintain and license primary and secondary batteries, motors and machines for supplying light, heat and power by electricity, contracting for same; H. M. Mansell, 45 Broadway, New York.

Crouch-Houston Electric & Manufacturing company, Eugene, Ore.; capital stock, $1,000 000; to purchase, own, hold, use, sell, rent and dispose of any and all letters patent and inventions of whatever name and nature heretofore patented to Frank J. Crouch, and especially the invention of Frank J. Crouch called the Crouch safety dynamo; Frank J. Crouch, Eugene, Ore.

ELECTRIC LIGHT.

An electric light plant is proposed for St. Elmo, Tenn.

The council at Greenville, O., has rejected all the bids for the proposed electric light plant, and will advertise anew.

The Thomson-Houston Electric Light and Power company, of Sharon, Pa., has been formed with $30,000 capital.

The lighting of a mine by electricity has been such a success at Leisenring No. 1 in the Connellsville coke region that the Frick Coke company will light all its shafts by the same means.

The Manufacturers' Investment company at Madison, Me., is said to be installing one of the finest electric light plants in Maine. The installation embraces both incandescent and arc dynamos, and is being erected by the Thomson-Houston company.

Articles of incorporation were filed October 15th with the secretary of state of Indiana by the Logansport Electric Light & Power company of Logansport, Indiana; capital stock, $60,000; directors, R. T. McDonald, Joseph Seiter, Victor E. Seiter, Brainard Rorison and Edward J. Hathorne.

The Bath & Hammondsport Railroad company is negotiating with the Thomson-Houston Electric Light company for a plant to light its docks, yards, shops and depots in Hammondsport, N. Y. The business men at that place are also agitating the question of electric light, and if the railroad company decides to put in a plant, it will probably be done in connection with the one for the village.

ELECTRIC RAILWAYS.

A new electric line is building at Santa Rosa, Cal. It will run from the railroad station to the Pacific Methodist college.

A franchise has been granted to the Hammond, Ind., City Railway company by the city council to operate an electric street railway on the principal streets. The Pullmans are said to be backing the venture.

Eight of the nine generators for the power house of the Rochester, N. Y., Railway company have already been installed. At present the company has 100 motor cars. Of this number 71 are in daily operation. Eleven other cars are mounted on trucks, and will be fitted for extra use as fast as workmen can adjust the necessary machinery. The eleven remaining cars of the 100 will be mounted as soon as the trucks arrive.

A contract has just been closed by the Short Electric Railway company, covering the equipment of four of five street railways in and around Wilkesbarre, Pa. The Wilkesbarre & Wyoming Valley Traction company has been formed to consolidate the railways in Wilkesbarre and the long, narrow valley containing a number of prosperous townships. The system is to be equipped electrically at a cost of over $200,000.

TRADE NOTES.

The offices of the Hunt Engineering company have been removed from Brooklyn, N. Y., to 126 Liberty street, New York city.

The Ferracute Machine company, manufacturers of presses, dies, etc., of Bridgeton, N. J., are getting out some new lines of presses for electrical work, and have just issued catalogues describing them.

The Stock Quotation company of New York is to employ storage batteries in place of primary cells to supply current for its system. Truax & Vail of New York have secured the contract to supply accumulators.

The Central Electric company feels happy over the fact that its sales of Packard high grade incandescent lamps are constantly increasing, and reports that there is a great tendency towards using better material in electric light construction.

Okonite tubing, which is being introduced for special insulating purposes, is composed of a tough and almost indestructible compound, and has all the high insulating qualities that the Okonite wires possess. It is not in any way affected by exposure, or by the action of the elements.

L. J. Wing & Co. of 126 Liberty street, New York, have taken the general agency of the Barriett motor and dynamo. A number of valuable improvements on these machines have been made. Wing & Co. report having a number of sales in the short time in which they have had the agency.

George Cutter has further improved his magnetic cut-out by adding a lightning arrester attachment, thus making a double safeguard in one very simple instrument. His new station cut-out is put up on a neat slate base, and will impress the visitors at the street railway convention.

The Jackson-Cornish Electric company has opened a factory at 203-207 South Canal street, Chicago, where it will deal in electrical supplies, and do a general construction and repair business. Mr. Jackson had been with the Northwest Thomson-Houston company, St. Paul, as superintendent four years.

The Crocker-Wheeler Motor company, New York city, has placed D. Herbert Jeffery, formerly general manager of Jeffery & Co., Jersey City, N. J., in charge of its offices, handling its large correspondence, management of records, etc. This step has been found necessary to relieve the other officers of the company of these duties, and to enable [illegible] departments.

The Knapp Electrical Works, Chicago, have just put [illegible] will send a descriptive pamphlet to those interested. The wire handled by the Knapp Electrical Works, Chicago, is [illegible] claimed, is in great demand for street railway work.

The Delaware Hard Fibre company of Wilmington, Del., is enlarging its plant with the object of doing special work in making up fibre into the various forms in which it is used. The company has a well-equipped machine shop where dies are made and fibre cut, and pressed into almost any form desired. This [illegible] business, and electricians will undoubtedly be glad to know that they can get fibre cut and finished as described.

The Williams Engine company was incorporated last week at Baltimore. The capital stock is $50,000, in shares of $10.00 each. The stock is to be fully paid up at par before any work is done. The directors are James B. Macneal, W. S. Williams, Samuel T. Williams, Edward L. Torsch, Thos. D. Hooper, C. P. Lawrenson, J. Vernon Campbell. The company has considerable work ahead, and as soon as the plant is all in, it expects to build engines up to 250 horse power.

As claimed in a recent circular issued by the Elektron Manufacturing company of Springfield, Mass., the principal points of excellence of the Perret electric motor are high efficiency, low speed, full power, perfect automatic regulation, no sparking under changing load, extreme simplicity, unequalled durability and greatest economy. The advantages of electric power are set forth, and the Perret motor described in detail, with illustrations. A number of testimonials are added at the back of the pamphlet.

The Duplex Rotary Engine company is showing one of its engines at the exposition at Chicago, coupled directly to a Thomson-Houston dynamo, which is furnishing light for a real estate display. The engine occupies but little space and appears to have a very steady motion, a requisite for electric light use. These engines are being built at 215 E. Superior street, Chicago, and, if the claims made for them, are supported by experience in practice, they will, undoubtedly, come into general use for the running of generators.

The Franklin Electric company of New York city was incorporated last week to manufacture, sell, lease, use and maintain primary and secondary batteries, motors and machines supplying for light heat and power by electricity. The incorporators are George B. Waterhouse, Passaic, N. J., Frank K. Irwing, Brooklyn, N. Y., Henry M. Munsell, New York, A. Scott, Brooklyn, N. Y., Henry B. Key, New York. This company, it is believed, will endeavor to develop the storage battery car business. Much is expected of this corporation.

The Roessler & Hasslacher Chemical company, New York, reports increased demand for Isolatine paint which it is introducing in the market for insulating purposes. It is claimed for this paint that it combines the meritorious features of asphalt and metal paints and that it always remains pliable, never cracks or peels off; is of the highest electrical resistance and is not affected by solutions of acids, alkalies and salts; is not changed by natural temperatures, and produces a fine glossy black surface; in short, that it is an excellent protector of iron and wood under all circumstances.

The Electric Merchandise company, Chicago, reports sales of Burton electric heaters last week to the following companies: Spokane Street railway, Spokane, Wash.; Danville Electric railway, Danville, Ill.; Stillwater Electric railway, Stillwater, Minn.; Terre Haute Street Railway company, Terre Haute, Ind.; Burlington electric railway, Burlington, Ia.; Reading & Southwestern railway, Reading, Pa.; Eau Claire Street railway, Eau Claire, Wis.; People's street railway, Springfield, Ill.; Salt Lake Rapid Transit company, Salt Lake City, Utah; Minneapolis Street Railway company, Minneapolis, Minn; Electrical Supply & Construction company, Pittsburg, Pa.; Pullman Palace Car company, Pullman, Ill.; Windsor & Sandwich railway, Windsor, Canada. The success of electric heating is fully demonstrated, and the advantages of the Burton company's method seem to be realized by managers of electric roads.

H. Ward Leonard announces that he has perfected his new method of operating electric motors to such an extent that, by a slight modification in a central station plant which will not in any way affect the operation of existing devices, he will be able to control any motor upon the circuit so that it will operate in either direction and automatically at any desired speed and torque, and with perfect efficiency under all conditions. Mr. Leonard's first development of this method made it necessary when using a motor on a central station circuit to use the equivalent of a transformer of the energy. In his latest development no transforming of the energy is required, it is claimed. The first cost, he says, will be no higher than that for shunt motors in use to-day, and yet all the advantages of the perfect control will be secured. No change in the generators, motors or translating devices of the present stations will be required in order to accomplish this result.

The Patton motor Manufacturing company of Chicago announces that it has secured several contracts for the type of motor cars now being built at Pullman for the Patton company. These motor cars do not depend on any outside source for their supply of energy. There are neither overhead lines requiring poles nor underground conduits, but the energy for each car is generated by a small plant carried on the car. This plant is composed of a gasoline engine, dynamo, motor and accumulator and is housed

[illegible] The engine is geared direct to the dynamo by means of a friction pulley. The normal pressure to operate the car is derived from the dynamo. There exists a constant generating power, and when the car is descending a grade, carrying a light load, or standing still, the surplus current is utilized to charge accumulators, which are used when an excess of the normal power is needed. These accumulators always ready to take up the surplus current when the motor is doing but little work, and return it when more power is needed. The engine is automatically supplied with gasoline. Only one man stationed upon the platform is required to operate the car, as the mechanism may be controlled from either platform.

On October 6th the successful firm of Alexander, Barney & Chapin, of New York, completed the first year of its business life. The business has grown with great rapidity. On October 6, 1890, the firm opened a store at 20 Cortlandt street, occupying a space about 30 feet front by 130 feet in depth; the entire force consisted of seven men. On the first day, which was given up largely to the hospitalities of house warming, twenty-five orders were booked, and those twenty-five customers still remain on the books of the firm. The number of employes has now increased to twenty-eight, while the number of customers has reached the astonishing figure of about 2,000, and the floor space occupied has been doubled. When it is considered that the business of this firm has come almost entirely from central electric lighting stations, isolated plants, bell hangers and construction companies, the volume of trade with the house of "A., B. & C," is amazing. The electric railway supply business, which has, with some electrical supply companies, compensated for the present competition in the electric lighting field, has not heretofore been sought after by this firm, but encouraged by the support it has received from their present customers, it is about to open a department for the manufacture and sale of electric specialities, which, as it will be the only one of its kind in the East, will assuredly be as profitable as the departments for household goods and electric light supplies.

BUSINESS.

The New York salesrooms of the Phœnix Glass company will be located at 42 Murray street after November 1st.

W. C. Sterling has recently landed at Monroe, Mich., a raft made up of 17,000 cedar poles and a large amount of cedar timber which will be converted into ties for electric street railway use. These poles have been selected for city use. Mr. Sterling is prepared to fill orders for poles or ties on short notice.

Dry batteries have become a leading and staple article in the electrical business, and electricians and others interested in that class of work find them possessing many advantages for certain uses over the old form of liquid cells. One of the most successful of dry batteries is the Ajax, made by the Electrical Supply company. It seems to answer all conditions satisfactorily to consumers.

The Pond Engineering company reports a large demand for Armington & Sims engines for driving dynamos. It is now furnishing engines for the State Insane Asylum, San Antonio, Tex.; Pacific Branch National Soldiers' Home, Santa Monica, Cal.; Traverse City Asylum, Traverse City, Mich; Waterloo, Ill., Electric Light company; Provident Life Assurance building, Waco, Tex.

H. Ward Leonard & Co. now have on exhibition at their offices in the Electrical Exchange building, No. 136 Liberty street, New York, a Crocker-Wheeler motor, operating under Mr. Leonard's new principle for controlling the speed, torque and direction of rotation of electric motors. The motor is made to perform various tasks in such a manner as to clearly show the principle used and the facility with which either the speed or torque is controlled.

The Fontaine Crossing company, Detroit, manufacturer of high speed engines and low speed dynamos, is making a class of apparatus that is claimed to be specially adapted for steamboats and isolated plants in general, and is meeting with most satisfactory results. While comparatively a new company, quite a number of installations have already been made, and the outlook for the future is very bright. C. F. Dunderdale, 356 Rookery, is the Chicago [illegible]

[illegible] Kansas City, Mo., [illegible] company of New York values the following extract from one of Mr. Grimes' letters relative to an electric elevator installed for [illegible]

[illegible]

It has been said that to be able to appreciate anything one should see it, and so it is in the case of the Ries regulating socket. A representative of the WESTERN ELECTRICIAN, while in Baltimore recently, called at the office of the Ries Electric Specialty company and found the company busily engaged filling orders for its specialty. It was asserted by Vice-President and Assistant General Manager Lewis S. Greensfelder that inquiries and orders for the socket are coming in at the rate of about fifty per day. Mention must be made, too, of an incident illustrative of this company's generous appreciation of its officers' efforts at the Montreal convention. In the Baltimore office of the company there now hangs a magnificent set of resolutions, elaborately framed, which was presented to President Elias E. Ries and Vice-President Greensfelder by the board of directors. These resolutions were presented to the above named gentlemen for their untiring efforts in the introduction of the new regulating socket at the Montreal convention. On each side of these resolutions hang the photographs of the members of the convention, taken in front of the Windsor Hotel. The company looks upon the resolutions as valuable souvenirs of the convention, at which its socket received its most successful introduction.

C. M. Barclay and Wm. Sharpe, both well known to the electrical and business interests of Chicago, have formed a co-partnership under the name of Barclay & Sharpe, 549 Rookery, to operate as general contractors and western agents for Woodbury automatic engines, the Gill water tube boilers and the Radway heater, made by the Stearns Manufacturing company of Erie, Pa. Mr. Barclay was for many years Chicago manager for the Sprague Electric company, having formed an acquaintance at that time that will be of great value to him in his new undertaking. Mr. Sharpe is a thorough and experienced mechanical engineer, having served a five years' apprenticeship in a leading establishment in England. Many of the earlier street railways in the west were built under Mr. Sharpe's supervision, he having held for an extended period the position of superintendent of construction for the Sprague company, since which time he has had charge of several important works in California. The new firm will make a specialty of building complete steam plants, using the engines and other apparatus made by the Stearns company at Erie. This company employs 450 men and is in every way equipped to turn out the highest class of work. The capacity is to be largely increased at an early day.

ELECTRICAL PATENTS.

Issued Oct. 13, 1891.

460,862. Electro Magnetic Separator. Gustave M. Gouyard, Leadville, Colo.

460,942. Trolley Catcher for Electric Cars. William L. Brown, Boston, Mass.

460,958. Electric Signal for Railway Trains. Lawrence Dunn, Fort Smith, Ark.

460,963. Combined Electric Clock and Thermoscope System. Henry J. Haight, New York, N. Y.

460,967. Track Rail for Electric Street Railways. John T. Hill and Bernard Meiring, Cleveland, O.

460,968. Fuse Box for Electric Lamps. Arnold B. Holmes, Boston, and Geo F. Gale, Winthrop, Mass.

460,972. Rheostat. Otto A. Kessner, Newark, N. J.

460,978. Electric Soldering Iron. Willis Mitchell Malden, Mass.

460,979. Electric Soda Fountain. Willis Mitchell, Malden, Mass.

460,980. Electric Heating Core for Smoothing Irons. Willis Mitchell of Malden, Mass.

This invention consists mainly in a block or solid piece of soapstone or other insulating material, having grooves for the wire cut in its sides or ends or both.

460,991. Incandescent Electric Lamp. Albert L. Reinmann, New York, N. Y.

461,023. Electric Battery. Daniel M. Lamb, Boston, Mass.

This invention consists in a method of preparing active material for electric batteries, which consists in enveloping the individual granules or particles thereof with a water repellent substance, such as resin.

461,024. Composition for Electric Batteries. Daniel M. Lamb, Boston, Mass.

461,025. Electric Battery. Daniel M. Lamb, Boston, Mass.

Of the two claims the first follows:

"The composition, substantially as and in about the proportions [illegible] gypsum, sal ammoniac, bichromate [illegible] sulphate of copper, black oxide of manganese and resin, all pulverized and mixed together, each granule of the composition being enveloped with water repellent material."

461,026. Compound for Electric Batteries and Method of Preparing the Same. Daniel M. Lamb, Boston, Mass.

461,027. Electric Battery. Daniel M. Lamb, Boston, Mass.

461,052. Electro Magnetic Brake. Alton J. Shaw, Milwaukee, Wis.

461,0[illegible]. Electric Railway. Barton R. Shover and William C. Dickson, Indianapolis, Ind.

[illegible]

[illegible] for Electric Signaling Apparatus. [illegible] Springfield, Mass.

[illegible] Gates, Springfield, Mass.

[illegible] Fire Extinguisher for Buildings. [illegible] Philadelphia, Pa.

[illegible] Wolstencroft and William H. Soley, Philadelphia, Pa.

461,104. Electric Signaling Apparatus. Eugene G. Mettler, Indianapolis, Ind.

This invention relates to improvements in the construction of electric signaling apparatus, and is especially intended to give notice of the breaking of wires arising from over-heating or burning out of any of the wires of a series of dynamos in an electric station.

Of the two claims the first is presented:

"An electric signaling apparatus comprising an electro magnet set in the main circuit between the dynamo and the mechanism to be operated upon, the core of such magnet weighted and provided with a numbering tag at its lower end, its upper end connected to a steam whistle, the latter suitably connected to the steam supply.

461,105. Commutator Oiler. Fred L. McGahan, Indianapolis, Ind.

461,122. Electric Door Operating Device. Robertus F. Troy, Madison, Wis.

461,135. Electric Inductional Transformer. William Stanley, Jr., Pittsfield, Mass.

The general object of this invention is to construct the transformer in such a manner as to render the plates capable of independent adjustment under the pressure of the clamping devices by which the groups of plates are held together and secured.

Of the five claims the third is given:

"A transformer plate in the form of an arch or bridge spanning the magnetizing coil, having oblique bearings at each end, and fitted with a saddle forming a third bearing at the center of the bridge."

461,139. System of Distributing Electric Energy. Rankin Kennedy, Glasgow, Scotland.

This invention is designed to combine all the essential advantages of the so-called direct or continuous and alternating systems of distribution, being capable of supplying electrical energy in any required form, and for any purpose from one group of main conductors.

461,140. Dynamo Electric Machine. Rankin Kennedy, Kilmarnock, Scotland.

The first claim follows:

"In a dynamo electric machine or motor the combination of a field magnet having multiple poles disposed in two groups of opposite polarities, each of said groups being composed of a plurality of radial polar extensions, two annular laminated armatures having a radial thickness not less than half the breadth of the faces of the radial poles, and a cylindrical iron shell inclosing and supporting said armatures and serving to concentrate the magnetic lines.

461,144. Electric Arc Lamp. Elihu Thomson, Swampscott, Mass.

Of the four claims we give the last:

"The combination with the worm wheel and pivoted frame carrying the same of the screw shaft, and a movable bearing therefor, engaged by said frame, and a spring tending to hold the shaft and wheel in engagement."

461,152. Telautograph. Max Soblik, Berlin, Germany.

This invention relates to devices whereby drawings, plans, manuscripts, printed matter, and the like may be exactly reproduced at a distance.

Of the four claims the first follows:

"In a telautograph the combination, with the revoluble shaft of the reprocatory carriage and intermediate mechanism operatively connecting said carriage with shaft, a style carried by the said carriage and adapted to cause variations in the main circuit, a second style carried by the said carriage, an electro magnet also carried by the said carriage, and included in the local circuit, and a circuit closer adapted to be operated by the said variations in the main circuit, and thereby to cause the electro magnet to operate the said second style."

461,169. Non-Interfering Fire Alarm Box. Frank F. Loomis, Akron, O.

Of the nine claims the eighth follows:

"The combination with the rocking armature and the disk wheel bearing a pawl to engage and raise the armature, and having a projecting tow of a hub arranged to be rocked by opening and closing the box door and provided with pins to engage the toe of and partially rotate said disk wheel."

461,178. Electric Boiler Alarm. Mathias Beckers, Langerwehe, Germany.

461,228. Electric Car Motor. George Willett, Englewood, Ill.

Of the ten claims the first follows:

"The shaft of a motor with a worm rigidly attached thereto, in combination with a hub loosely mounted on a propelling axle or shaft, said hub being provided with disks on the faces of which are rolls revolvable by said worms, and having a bearing on studs, said rolls being at such a distance from each other as to conform to the pitch of the threads of the worm."

461,229. Electric Meter. George R. Baldwin, New York, N. Y.

461,239. Switch Box. Horatio A. Foster. New York, N. Y.

461,240. Dynamo Electric Machine. Ezra T. Gilliland, New York, N. Y.

This invention consists in an improved frame of a dynamo electric machine, and in an improved provision for assembling the parts within the frame.

461,262. Galvanic Battery. Philipp Hieronymus, New York, N. Y.

461,272. Electric Conductor. Frank A. Perret, Brooklyn, N. Y.

461,279. Watchman's Electric Time Recorder. Fred W. Schiefer, Buffalo, N. Y.

461,294. Automatic Electric Pump. Charles J. Van Depoele, Lynn, Mass.

461,295. Electrically Actuated Pump. Charles J. Van Depoele, Lynn, Mass.

461,296. Armature for Electric Motors. Charles J. Van Depoele, Chicago, Ill.

461,297. Actuating Device for Moving Commutator Brushes. Charles J. Van Depoele, Lynn, Mass.

Of the eight claims the first is given:

"The combination with a sectional commutator, of a contact carrying device concentric therewith, frictional connections between the commutator and contact devices, a detent holding the contact carrier, and means for periodically retracting the detent."

461,298. Electric Switch. Sterling P. Van Nort, St. Louis, Mo.

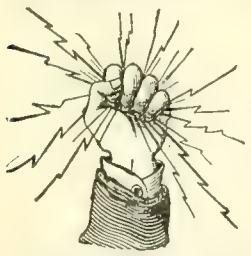
461,3[illegible]. Electrical Drop Bar for Doorways. Benjamin Lyons, Kansas City, Mo.

461,371. Fire Alarm Apparatus. William C. Shaffer Milwaukee, Wis.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., **Brooklyn, N. Y.**

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain [illegible] weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and specials, parts, fixtures, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are [illegible] to furnish our Clark Wire with a white outside finish for ceiling clear work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible cables with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager

HERBERT H. EUSTIS, President and Electrician.

CHICAGO AGENTS: The Electrical Engineering Co., 320 Dearborn St. **TORONTO, ONT. AGENTS:** The Toronto Electrical Works.

A GENTLEMAN With extensive business experience and ability, also all the capital necessary, is desirous of engaging in the manufacture of some ELECTRICAL SPECIALTIES.

Address **"CAPITAL,"**

Care of WESTERN ELECTRICIAN.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

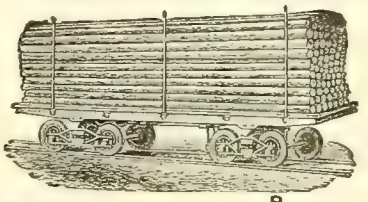
BRASS CASTINGS.

THE TURNER BRASS WORKS.

4 LaSalle Avenue, Chicago.

☞Write us for Prices.

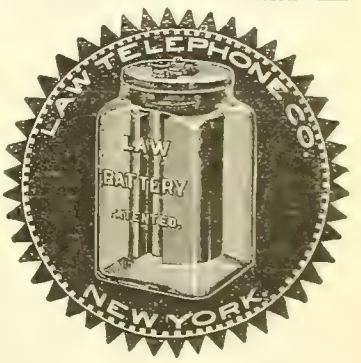
ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.



The Winner of 1890 will win again in 1891.

Eleventh year.

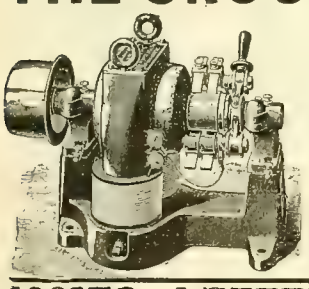
SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

FOR SALE.

One 3 Horse Power Electric Motor.

One 6 Horse Power Electric Motor.

Both in excellent condition, having been used but little.

ERIE ELECTRICAL SUPPLY CO.,

ERIE, PA.

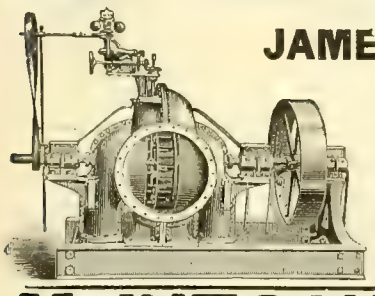
JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL, FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.



Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

Standard Laboratory Photometer.

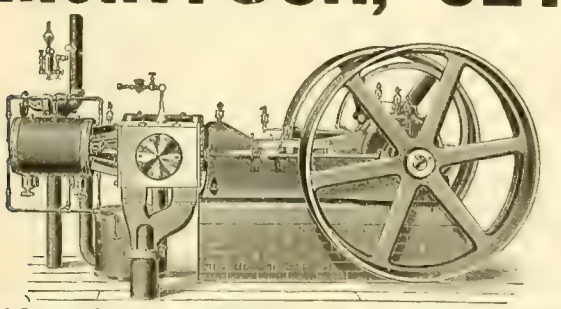
For illustrations see WESTERN ELECTRICIAN of September 12th, Page 150.

This outfit is designed to measure accurately the candle power of Incandescent Lamps, and will be found of great value by Manufacturing Companies. Price for the complete set or separate parts furnished upon application. Correspondence solicited.

Send for Illustrated Descriptive Catalogue 1-66.

QUEEN & CO., PHILADELPHIA.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION
One	12½x12	80	Edison General Electric Co., Groton, N. Y.
Two	18½x17	200	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rio Janeiro, Brazil.
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 18x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 18x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 18x15	150	G. A. Rollins & Co., Chicago, Ill.
One	15 and 21x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Leeds, England.
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 18x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One	11 and 18x15	150	Fritz Wilen, Helsingfors, Finland.
One	16x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 28x17	400	Baltimore Electric Refining Co., Baltimore, Md.
One	14½ and 28x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS,

339 Rookery Bldg., CHICAGO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

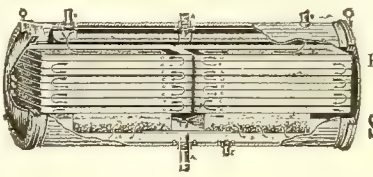
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

ELEMENTS OF ELECTRIC LIGHTING.

BY PHILIP ATKINSON, Ph. D.

260 Pages Cloth Binding, Illustrated, Price $1.50.

This book is an elaboration and revision of the popular series of articles which ran through the WESTERN ELECTRICIAN under the same title. It treats of: Principles of the Dynamo; Alternate Current Dynamos; Direct Current Dynamos; Electric Terms and Units; Electric Measurements The Arc Lamp; The Incandescent Lamp; The Storage Battery; Electric Distribution.
Sent, postage prepaid, on receipt of price.

ELECTRICIAN PUBLISHING CO.,
6 Lakeside Building, Chicago.

EVERYTHING IN

WIRE—FUSE— STRIPS.

MANUFACTURED BY

The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingots, Slabs, Sheet Wire and Castings at lowest market rates.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.

73-75 W. Jackson St. **RELIABLE**

WE ARE FITTED WITH RELIABLE Machinery and Tools, And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

PATENTS.

For applications filed during the remainder of 1891 my fees will be due only on allowance, if desired. Write for particulars **WM. H. BABCOCK,** Attorney at law and solicitor of Patents, 709 G St. N. W., Washington, D. C. P. O. Box 229. Formerly examiner in U. S. Patent Office. FIFTEEN YEARS' PRACTICE.

HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, **Rods, Tubing, Washers, Discs** and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.

Binders

FOR THE **Western Electrician**

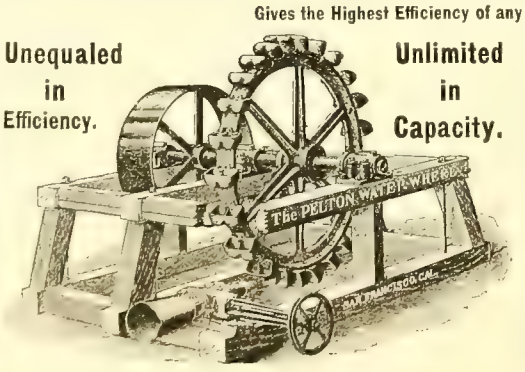
$1.00.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 10 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,
121-123 Main St., San Francisco, Cal., U. S. A.
143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

Gleason & Bailey Mfg. Co.,

(LIMITED.)

GENERAL WESTERN AGENTS FOR THE

STEUBEN INCANDESCENT LAMPS,

The best in the Market,

Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.

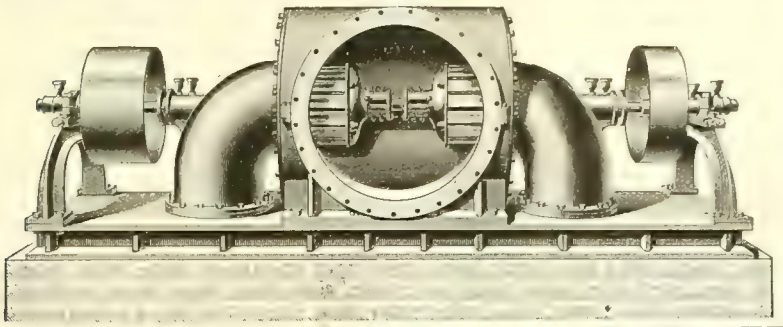
Rubber Covered, Weather-Proof Wires and Lamp Cords.

233 Lake Street, **CHICAGO, ILL.**

It will pay you to get our prices and catalogues.

BRANCHES: 104 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 50 W. Monroe St. Chicago. | **St. Louis, Mo.**

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES ... CELEBRATED WATER WHEEL, ... on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** ... diameter, being **double** the **Power** of ... by a number of the leading electric ... economical use of water it is without an ... of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended ... and it can be belted directly to dynamo.

The accompanying engraving represents a pair of **VICTOR TURBINES** arranged on a horizontal ... Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

COMPLETED TO DEADWOOD

The Burlington Route, C., B. & Q. R. R., from Chicago, Peoria and St. Louis, is now completed and daily passenger trains are running through Lincoln, Neb., and Custer, S. D., to Deadwood. Also to Newcastle, Wyoming. Sleeping cars to Deadwood

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. **136 Liberty St.,** NEW YORK

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

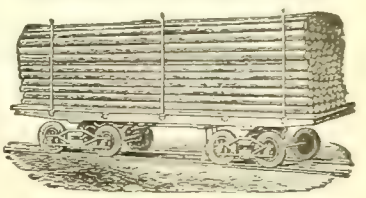
FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing. Will carry two different kinds of material in opposite directions at the same time.

Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

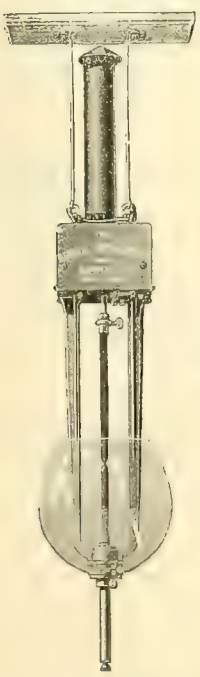
VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 44 DEY ST., N. Y.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building, **CHICAGO, ILL.**

Established 1881.

Telephone Building, **NEW YORK CITY.**

C. & C. ELECTRIC MOTORS AND DYNAMOS.

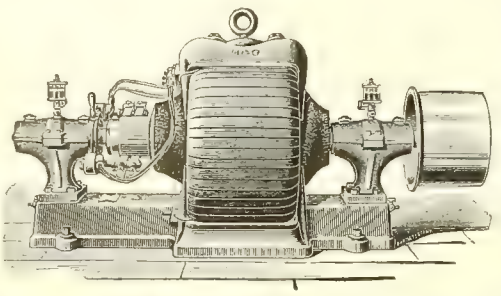
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHŒNIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.

MORE WORDS ARE NEEDED
TO DO JUSTICE TO THE
PERRET ELECTRIC MOTOR.

OFFICE OF CURTIS MANUFACTURING CO., Manufacturers of Carriage Robes,
Fifth Avenue and 16th Street, New York City, September 16, 1891.

The Elektron Manufacturing Co.—

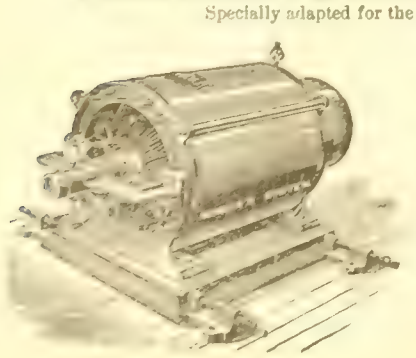
GENTLEMEN.—If there were words enough in the English language to express my admiration of the Perret Motor I might do justice to its good qualities; but there are not. We have used it every working day since it was put in, and not one cent has been expended on it except for oil. It drives our six heavy machines as steadily as a clock. I consider it the very best power we could get, and would not part with it unless I could get its equal. I take special pride in showing it to my friends. It's not a plaything, but business every day. If any one wants to know what it can do, just send them up to me. Yours truly, CURTIS MANUFACTURING CO.

THE ELEKTRON MANUFACTURING CO., SPRINGFIELD, MASS.,
New York Office, 89 Liberty Street.

Selling Agents: WASHINGTON, D. C.—J. U. Burkett & Co., 1409 New York Ave. NEW ORLEANS, LA.—George Baquie, 140 Gravier St.
CHICAGO, ILL.—The Electrical Engineering Co., 320 Dearborn St. ST. PAUL, MINN.—F. J. Renz, 95 East Fourth St.
PHILADELPHIA, PA. Pennsylvania Machine Co., 29 North Seventh St.

The Heisler System Long Distance Incandescent Lighting.

A practical subdivision of the electric light. Cheap to install and perfectly automatic regulation.
Specially adapted for the lighting of Public Halls, Railroad Depots, Pleasure Resorts, Streets, Stores and General Illumination.



Noted for the Brilliancy of the Light and Greatest Production of Candle Power per H. P.

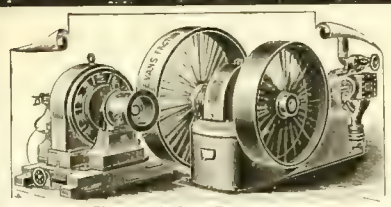
NO TRANSFORMERS USED UPON THE CIRCUITS.

We manufacture and carry in stock, dynamos of the following capacity, in 32 C. P. lights: 160, 200, 250, 300, 350, 400, 450, which will operate their rated capacity in 16, 20, 32, 45, 60, 100 and 150 C. P. Lamps. The output of any of the above sized dynamos can be distributed from a circuit composed of No. 8 B. & S. wire; and there will be no drop in candle power of the lights at any point upon the circuit.

Full guarantee given with our apparatus, and special fixtures for indoor and outdoor lighting.
Series Lamps and Sockets for any current or candle power. Send for descriptive matter and price lists.

HEISLER ELECTRIC LIGHT CO., DREXEL BUILDING, PHILADELPHIA.

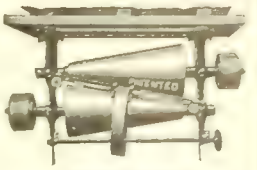
AGENCIES—Inter State Complete Electric Construction Co., St. Louis, Mo; Belton Electric Co., Belton, Texas; Howe Construction Co., Norwalk, O.


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.


Evans' Cones, For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES
OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." PATENT "K.K." LINE WIRE TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus, Electric Motors and Generators,
Alternating Current Apparatus, Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

CUT-OUTS,
JOINTS,
DISTRIBUTING
BOXES,
ELBOWS
ETC., ETC.
CORRESPONDENCE SOLICITED.

THE NEW
SAFE-DUCT
AND
COMPLETE METHOD
OF
WIRING FOR ALL
ELECTRIC LIGHTING SYSTEMS.

"VULCA"

NEW YORK INSULATED WIRE CO. NEW YORK
MOISTURE-PROOF
VULCA
ELECTRICAL
WIRE-DUCT
NON-INFLAMMABLE
TRADE MARK

ELECTRICAL WIRE DUCTS.

AND CHICAGO.

GRIMSHAW
TRADE MARK
WHITE CORE
INSULATED WIRE

THE NATION'S CHOICE.

Grimshaw White Core Wire.

B. D. WIRE, TAPES AND COMPOUNDS.

ALL SUPPLY STORES KEEP THEM.

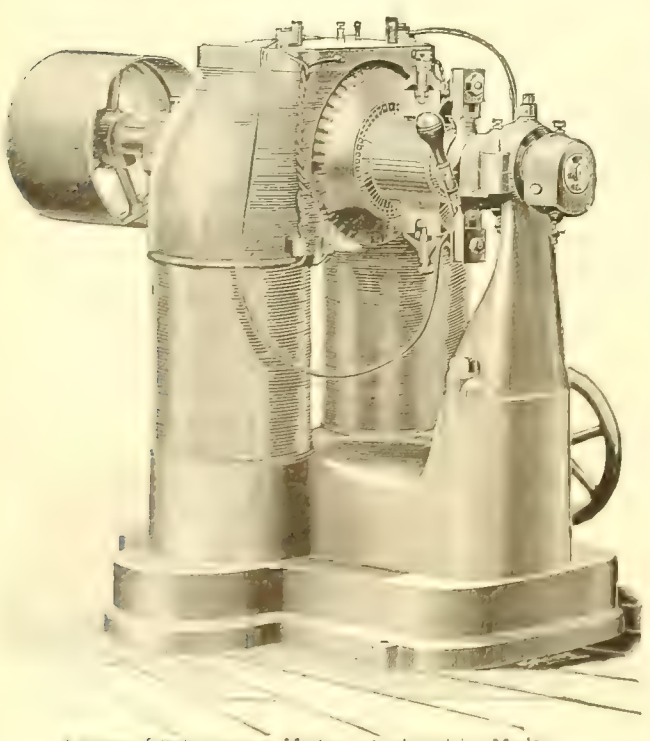
NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street, CHICAGO,

MAIN OFFICE: 649-651 Broadway, New York. GEO. H. MEEKER, Western Manager.

COLUMBIA ELECTRIC CO.,

MANUFACTURERS OF



Large Stationary Motor, Columbia Make.

MOTORS, GENERATORS,
DYNAMOS, LAMPS,
SUPPLIES AND SPECIALTIES.

ALL GUARANTEED MECHANICALLY, ELECTRICALLY AND LEGALLY.

ST. PAUL, - - MINN.

BUY

THE JEWEL INCANDESCENT LAMP.

THE

WITH HOOKED FILAMENT.

"JEWEL"

ANY VOLTAGE, ANY SOCKET.

LAMP.

ESPECIALLY ADAPTED TO STREET CAR USE.

ADDRESS,

WM. HOOD, 239 La Salle St., CHICAGO.

ELECTRICIAN PUBLISHING COMPANY'S

HAND-BOOK SERIES.

22,000 Copies published to date. An Astonishing Record.

Dynamo-Tenders' Hand-Book.

By Lieut. F. B. Badt.

Fourth Edition, Eighth Thousand.

94 Pages, 70 Illustrations, Flexible Cloth Binding, Type Page 6x3 inches.

The only PRACTICAL Dynamo Tenders' Instruction Book in the English language. Just the book for Dynamo-Tenders, Linemen, Stationary and Marine Engineers who wish to learn how to operate and care for electric light or power plants. Moonlight schedule for 1891.

Bell-Hangers' Hand-Book.

By Lieut. F. B. Badt.

Second Edition, Fourth Thousand.

106 Pages, 97 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches.

Designed for those engaged in selling, installing or handling electric batteries, electric bells, elevators, house or hotel annunciators, burglar or fire alarms, electric gas lighting apparatus, electric heat regulating apparatus, etc. The only book of the kind published.

Incandescent Wiring Hand-Book.

By Lieut. F. B. Badt.

Third Edition, Seventh Thousand.

72 Pages, 42 Illustrations, Flexible Cloth Binding. Type Page 6x3 Inches. Five Tables, 12x18 Inches.

These tables give *at once* and without any calculation the size of wire required in each case for any percentage of loss.

It is a book for practical wiremen and learners, and does not require any previous knowledge of wiring. It differs in this respect from other wiring tables, or computers.

The book contains full illustrations and complete information concerning methods of running wires, location of safety devices, splices, insulation, testing for faults, wire gauges, wiring of fixtures, elevators, buildings, etc. The only book of the kind published.

Electric Transmission Hand-Book.

By Lieut. F. B. Badt.

First Edition, Three Thousand Copies.

97 Pages, 22 Illustrations, and 27 Tables. Flexible Cloth Binding. Type Page 6x3 Inches.

This book contains all practical information for power producers, capitalists, agents of hydraulic and electric companies, engineers, motor inspectors and other persons interested in electric power transmission. By means of the tables anybody can find at once cost of plant for least operating expenses, or for minimum first cost of installation.

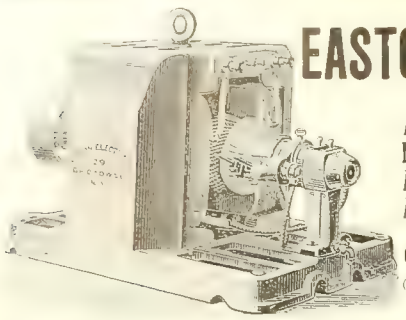
The book gives all necessary information concerning motors, and rules for ascertaining horse power of motors, driving various classes of machinery, as hoists, pumps, street or tram cars, fans, etc.

Twenty-seven new and original tables give more information on the subject in a small space than any book heretofore published on the same subject.

Each Work Sent Postpaid on Receipt of One Dollar.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.



THE
EASTON ELECTRIC CO.,

MANUFACTURERS OF

Arc and Incandescent Dynamos, Motors, Generators and Separators, And Arc Lamps adapted for use on Arc or Incandescent Circuits.

ADDRESS:

643 Kent Ave., Brooklyn, N. Y.

(Near Roosevelt, Grand and East 23d Street, Ferries from N. Y.),

For Circulars, Prices and Information.

REMOVAL NOTICE.

On and after *November 1,* our *New York Salesrooms* will be located at

42 MURRAY ST.

YOURS TRULY,

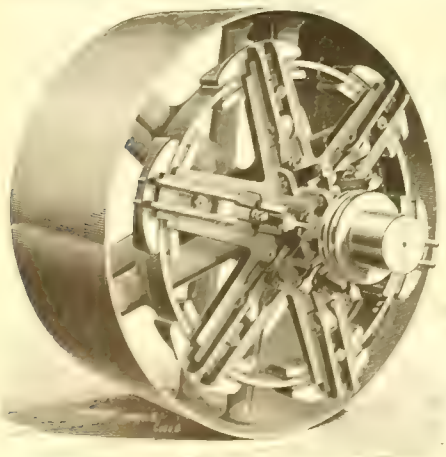
PHŒNIX GLASS CO.

THE ELEMENTS OF DYNAMIC ELECTRICITY AND MAGNETISM.

A Book For Learners. **JUST OUT!** Price, $2. Postage Free.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
11 Cortlandt St., - NEW YORK.

Engineering Offices: 116 Franklin St., BOSTON.

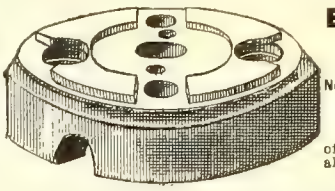
CHICAGO: 250 Canal St. MINNEAPOLIS: 508 Kasota Building.

KANSAS CITY: 122 and 123 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

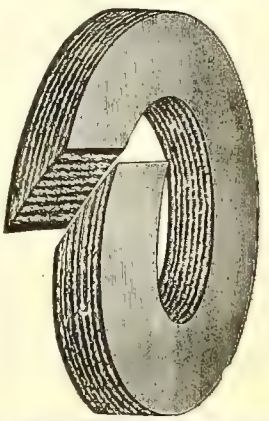
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.



Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.

FITCHBURG, MASS, U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

FOR SALE:

(IN GOOD ORDER.)

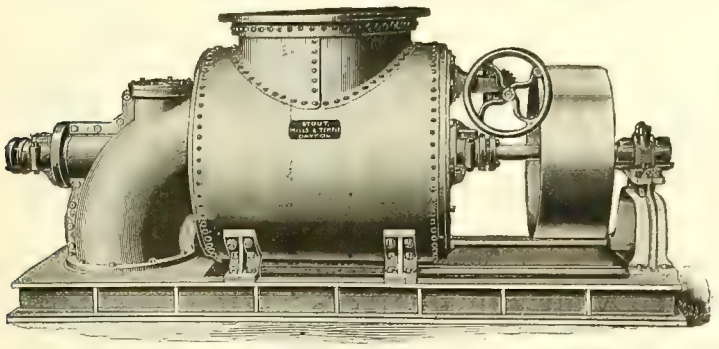
One Edison 150 Light Dynamo, good as new	$275 00
One U. S., New Style, 110 Volt, 200 Light Incandescent Dynamo, Rheostat, Ammeter and 200 Key Sockets, has not been used three months, good as new	375 00
One Manchester 50 Volt, 200 Light Compound Dynamo	180 00
One Manchester 50 Volt, 150 Light Dynamo	150 00
One Daft 110 Volt Shunt, 200 Light Dynamo, New Armature	250 00
One C. & C. 15 H. P., 110 Volt Motor	260 00
One T.-H. 500 Volt Compound Dynamo, 50 H. P., New	1,200 00
One T.-H., 15 H. P., 500 Volt Motor, New	400 00
One Sperry Arc Dynamo and ten Arc Lamps	350 00
One 600 Volt, 25 Ampere, U. S. Shunt Dynamo	400 00

FOREE BAIN,

47 and 49 South Jefferson Street,

CHICAGO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

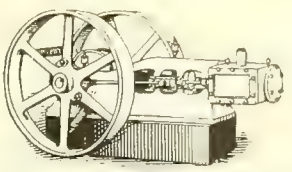
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North Street, BALTIMORE, MD.

YOU WILL OBLIGE

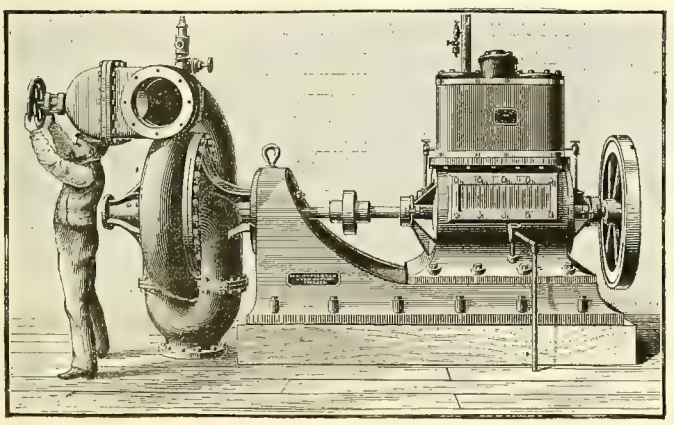
Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES

A SAMPLE INSTALLATION.

Standard Automatic Engine coupled direct to a Centrifugal Pump. Speed 280 Revolutions.

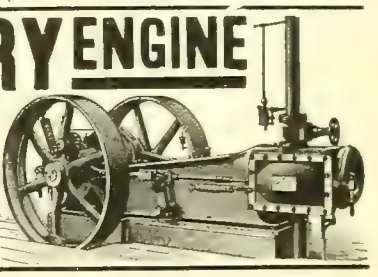


Over 4000 Westinghouse Standard Engines in use.

THE WESTINGHOUSE MACHINE COMPANY.
BUILT AT PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
—Catalogue sent on application.—
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. HALF TONE PLATE SPECIALTY. CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

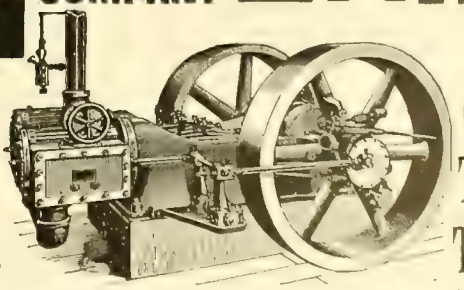
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,
ST. LOUIS. CHICAGO. KANSAS CITY.
OMAHA. DALLAS. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER & CO., 38 South Fourth Street Philadelphia, Pa.; DRAYO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY Co., Tacoma, Wash.; CROOK, HORNER & CO., Baltimore, Md.; E. G. GILBERT, Atchison, Kan.
BRANCH OFFICE, Room 506 Rookery Building, CHICAGO, ILL. ALBERT FISHER, Manager.

VISITORS TO THE

STREET RAILWAY CONVENTION

Are cordially invited and requested to visit the quarters of the

THOMSON-HOUSTON ELECTRIC CO.,

To examine its latest improved

Electric Railway Equipment and Devices

FOR OVERHEAD CONSTRUCTION.

DON'T FAIL TO SEE THE NEW

COMBINED SNOW PLOW AND SWEEPER.

BOSTON OFFICE, 620 Atlantic Avenue.

CHICAGO OFFICE, 148 Michigan Avenue.

RAILWAY SUPPLIES.

ESTIMATES FURNISHED FOR COMPLETE EQUIPMENTS.

WRITE FOR DESCRIPTIVE
PAMPHLET OF OUR

NEW TROLLEY WHEEL,
NEW TROLLEY LINE HANGER,
NEW PULL-OFF BRACKET,
NEW SPAN WIRE INSULATOR.

ALL OF THESE ARE NEW, AND VASTLY
SUPERIOR TO ANYTHING ON THE MARKET.

PERKINS LAMPS

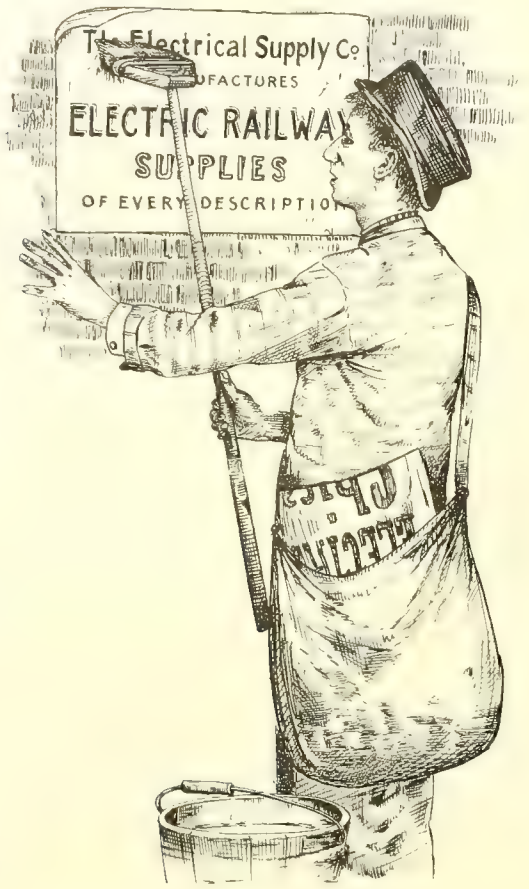
FOR STREET RAILWAY USE,

Have a double filament which the jar of the car will not break.

THE KNAPP ELECTRICAL WORKS,

Manufacturers and Dealers,

54 and 56 FRANKLIN ST., CHICAGO, ILL., U. S. A.



WE KEEP POSTED

On all matters relating to the best appliances and methods obtained in ***Electric Railway*** practice. With the aid of our Engineering Department we have been able to invent and perfect many devices, which, owing to their simplicity and merit, have received instant recognition from construction contractors and operating companies.

WE MANUFACTURE

A full line of ***Electric Railway*** materials, following those patterns which experience has proved to be best suited for the work, and the most practical. Cheap goods are rarely safe and economical. Safe and economical goods are always cheap, price hardly considered. The worth of such materials to you is almost inestimable; they are profitable in the saving of repairs, delays and costly accidents.

Send for our **Electric Railway Catalogue No. 31.**

THE ELECTRICAL SUPPLY CO.,

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

Factories: Ansonia, Conn.

THE WIRT AMPERE INDICATOR.

(PATENTED.)

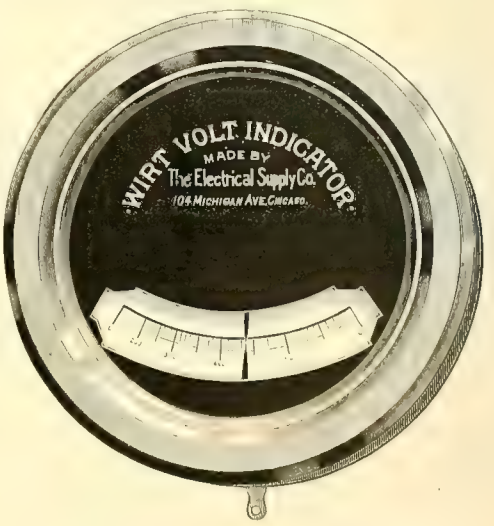
This instrument is designed for the practical work of Station Electricians and answers the conditions more perfectly than any instrument yet sold.

The working parts being simple and well made, will stand handling, shipping and all ordinary use.

Made in any size from 10 to 1,000 Amperes.

THE WIRT VOLT INDICATOR.

(PATENTED.)



Is intended to be left in circuit continuously and can be relied upon for constancy and accuracy under the most trying conditions. The resistance of the instrument is high—making the consumption of energy small. An adjustable index permits *reading at a distance*, indicating variations from normal pressure.

Correspondence invited regarding these or special Instruments,

THE ELECTRICAL SUPPLY CO.,

RANDOLPH ST. AND MICHIGAN AVE.,

CHICAGO.

Factories: Ansonia, Conn.

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.,

—MANUFACTURERS OF—

VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES.

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES and CABLES, very pliable. Every variety of INCANDESCENT CORES.

HABIRSHAW

RUBBER COVERED

WIRES.

CABLES AND CORES.

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High Insulation and Long Life, all milage

If you are not acquainted with the merits of Habirshaw Insulation we shall be pleased to send you samples upon application.

W. M. HABIRSHAW, Gen'l Mgr. OFFICE: 315 Madison Ave., Cor. 42d St., New York.

FACTORY: Glenwood, Yonkers, N. Y.

Western Agents: THE ELECTRICAL SUPPLY CO., Corner of Randolph St. and Michigan Ave., CHICAGO, ILL.

TAKING THE LEAD.

THOUGH ONLY

ON THE

MARKET

—FOR—

SIX MONTHS,

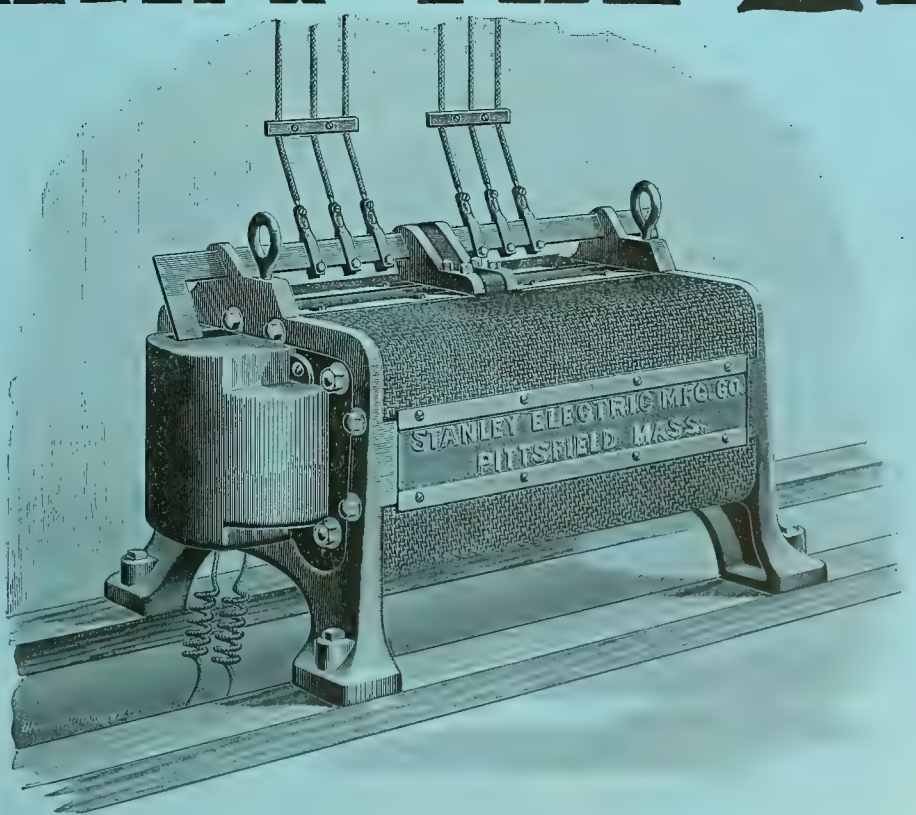
THE

STANLEY

—IS—

NOW KNOWN

—AS—



THE

BEST

Transformer.

CORRESPONDENCE

SOLICITED.

CUT OF 300 LIGHT TRANSFORMER.

STANLEY ELECTRIC MFG. COMPANY, PITTSFIELD, MASS.

WESTERN AGENTS: The Electrical Supply Co., Corner Randolph St. and Michigan Ave, Chicago, Ill.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

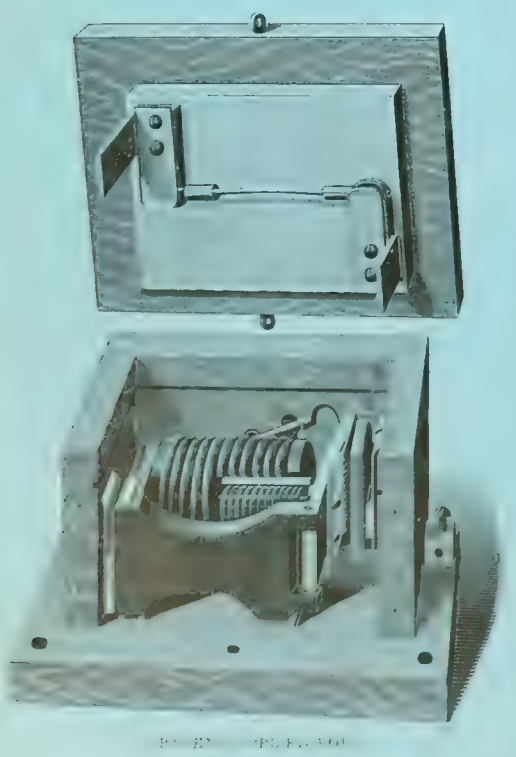
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

GEORGE CUTTER,

ELECTRIC SPECIALTIES,

333 "The Rookery," CHICAGO.



Cutter's Magnetic Cut-out.

LIGHTNING ARRESTER

—AND—

CUT-OUT COMBINED.

Built on correct scientific principles.
Gives perfect protection to the motor.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, OCTOBER 31, 1891. No. 18

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building, - - CHICAGO.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE
Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

New York & Ohio Company
WARREN, OHIO.
MANUFACTURERS OF
THE Packard HIGH GRADE
INCANDESCENT LAMP

AGENTS
J. W. Peale, - - No. 1 Broadway, New York.
Electric Eng. & Supply Co., - - Syracuse, N. Y.
Central Electric Co., - - - - - - Chicago.
The Electrical Eng. & Supply Co., St. Paul, Minn.
St. Louis Electrical Supply Co., - - St. Louis.

CLOWER, HARRIS & CO.,
CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.
The largest Electrical Supply House west of the Mississippi River.
Everything Electrical
289 ELM STREET. - - DALLAS, TEXAS.

FOR SALE.
One 3 Horse Power Electric Motor.
One 6 Horse Power Electric Motor.
Both in excellent condition, having been used but little.
ERIE ELECTRICAL SUPPLY CO.,
ERIE, PA.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.

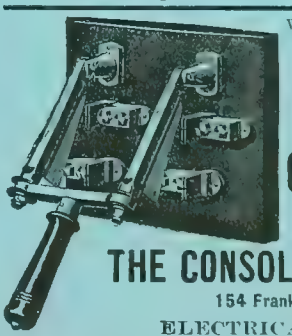
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.

OKONITE TRADE MARK

INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

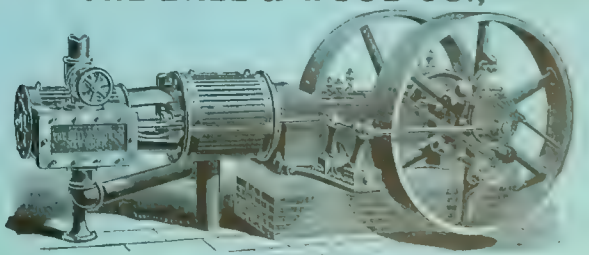
WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.



WM. ROTCH, Prest. CHAS. G. WINTER, Treas.
CHAS. E. BIBBER, Gen'l Manager.

DO NOT
Equip your Switch-board with cheap Switches.
BUY THE
C. E. M. Jack-Knife Switch.
It is a Record Breaker and a reliable Circuit Breaker.
Manufactured Solely By
THE CONSOLIDATED ELECTRIC MFG. CO.,
154 Franklin St. and 355 Congress St., BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS.

IMPROVED BALL ENGINES,
BUILT BY THE BALL & WOOD CO., NEW YORK.



AGENTS
W. B. Pearson & Co., Home Insurance Building, Chicago, Ill.
Thos. G. Smith, Jr., 11 Hammond Building, Cincinnati, Ohio.
W. A. Day, 128 Oliver Street, Boston, Mass.
A. M. Morse & Co., St. Louis, Mo.
Cooley & Vater, Minneapolis, Minn.
Mead & Stringham, 321 Hammond Building, Detroit, Mich.

The Thomson-Houston ELECTRIC CO.,

MANUFACIURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000 Thomson-Houston Arc Lamps,

750,000 Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co....xiii
Alexander, Barney & Chapin.....i
American Electrical Works.... xiii
Andrews & Co., A. H..... ... xxi
Babcock, W. H..... xiii
Baggot, E xiv
Bain Electric Mfg. Co..... ix
Ball Engine Co..... xxi
Ball & Wood Co., The i
Beckerleg, Jas. G xiv
Beggs, J. E., Mfg. & Supply Co. iv
Bernstein Electric Co..... xiv
Blatz, L..... xiii
Borden & Selleck Co..... xv
Braun Illustrating Co xxi
Brownlee & Co..... xii
Brookfield, Wm..... ... xii
Brush Electric Co..... ...xvii
Butler Hard Rubber Co ix
Buxton, Geo. B xx
C. B. & Q. R. R..... xv
C. & C. Electric Motor Co.....xvi
Card E. Motor & Dynamo Co..xviii
Central Electric Co..... ... v
Chicago Electric Mfg. Co..... xiv
Chicago Electric Motor Co.....——
City of Big Rapids, Mich..... xii
Clower, Harris & Co..... i
Chicago Insulated Wire Co... xvii
Colburn Electric Mfg. Co..... xx
Columbia Electric Co.....xviii
Coolidge, Fuel & Supply Co..... x
Consol. Elec. Mfg. Co., The.... i
Cowles Elec. Smelt & Alum. Co.xiv
Crocker-Wheeler Elec. Mo. Co. xiii
Cutter, Geo..... xxvi
Day's Kerite Insulation..... i
Dayton Globe Iron Works Co..xxi
Delaware Hard Fibre Co..... xii
Detroit Electrical Works.....viii
Densmore Typewriter Co..... ——
Eastern Electric Cable Co..... xiii
Easton Electric Co..... ——
Edison General Electric Co..... vi
Edison General Electric Co., Cable and Wire Department..... vi
Electric Construction & Sup. Co.. xx
Electric Merchandise Co..... x
Electric Secret Service Co..... x
Electrician Pub. Co..... xviii, xx
Elec. Construction Co., The.... xiii
Electrical Engineering Co..... xii
Elec. Eng. & Supply Co., The..xiii
Electrical Supply Co., The... xxiv
Elektron Mfg. Co..... xvi
Empire China Works..... xviii
Erie Electrical Supply Co..... i
Evans Friction Cone Co..... xvii
For Sale ..... i, iv, ix
Foster, O. A..... ——
Fort Wayne Electric Co..... xxvi
Freeman, Coleman & Co..... ——
Gleason & Bailey Mfg. Co. Ltd. xiv
Globe Carbon Co..... xv
Great Western Elec. Supply Co.. ix
Greeley & Co., The E. S..... i
Hale Elevator Co..... ——
Heisler Electric Light Co..... ——
Hill Clutch Works..... ——
Hine Eliminator Co..... xii
Holmes, C. H..... xiii
Holmes, Booth & Haydens... .xvii
Hood, Wm..... x
India Rubber & Gutta Percha Insulating Co..... ——
Interior Conduit & Insulation Co. x
International Okonite Co..... i
Kartavert Mfg. Co..... ix
Keller & Degenhardt..... xii
Knapp Electrical Works..... xxiii
La Roche Electric Works..... iv
Law Telephone Co..... xiii
Leonard & Co., H. Ward..... xiv
Leffel & Co., Jas..... xiii
Loud, H. M. & Sons Lumber Co..xiv
McLaughlin, James xiv
Mason, James H..... xiii
Milliken Bros..... iv
Minneapolis Street Railway Co. xxv
Monitor Electric Co..... x
Mosher Arc Lamp Co..... xii
Munsell & Co., Eugene..... xiii
Murphy, T. J..... xv
National Carbon Co..... iv
National Electric Mfg. Co..... xix
N. Y. Belting & Packing Co..... xii
New York Insulated Wire Co.. xxi
New York & Ohio Co..... i
N. W. Elec. Specialty Co..... xvi
Nuttall Company, R. D i
Ostrander & Co., W. R..... xviii
Palste, H. T..... xiii
Page Belting Co..... ——
Partrick & Carter Co..... iv
Payne & Co., Geo. W..... ——
Pearson & Co., W. B..... xxi
Pelton Water Wheel Co xiv
Phœnix Glass Co..... ——
Pond Engineering Co xxi
Powell Co., The Wm..... xviii
Queen & Co..... xiii
Ries Elec. Specialty Co., The... x
Rockford Electric Mfg. Co..... ——
Royal Electric Co..... xii
Samson Cordage Works xii
Sargent & Lundy..... i
Sawyer-Man Electric Co..... xv
Schawel & Co., Jas..... xiii
Schieren & Co. Chas. A..... xii
Schoonmaker, A. O xii
Schuyler Electric Co..... iv
Short Electric Railway Co xii
Schultz Belting Co..... ——
Sperry Elec. Mining Mach. Co.. xiv
Standard Underground Cable Co.... i
Stanley Electric Mfg. Co..... ——
Star Iron Tower Co..... xviii
Stearns Mfg. Co..... xxi
Sterling, W. C..... xv
Steuben Elec. Mfg. Co., The.... ix
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co vii
Taussig, S..... iv
Temple, J. C..... xv
Thomson-Houston Elec. Co.ii, xxii
Union Electric Mfg. Co., The....xx
Union Electric Works..... ——
Union Hardware Co..... .. xii
U. S. Electric Lighting Co.. ——
Van Nuis C. S..... ——
Vulcanized Fibre Co..... xv
Western Electric Co xvi
Westinghouse Elec. and Mfg Co..xi
Westinghouse Machine Co..... xxi
Weston Electrical Instrum't Co.——
Williams Engine Works..... .xxi
Woodbridge & Turner Eng. Co..xv
Woodhouse & Rawson, Ltd....——
Worthington, Henry R.....——

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelt. & Alum. Co.
Freeman, Coleman & Co.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Union Electric Works.
Western Electric Co.

Anti-Friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg & Supply Co.
Brush Electric Co.
Columbia Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Samson Cordage Works.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Franklin Electric Co., The.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric. (See Wire Insulated, **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co. The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Cars, Railway.
Minneapolis St. Ry. Co.

Castings, Brass.
Blatz, L.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Detroit Electrical Works.
Edison General Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Keller & Degenhardt.
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Steuben Electric Mfg. Co.
Temple, J. C.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Electrical Supply Co., The.
Palste, H. T.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg & Supply Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Columbia Electric Co.
Detroit Electrical Works.
Easton Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Light Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The
Cutter, Geo.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt
Leonard & Co., H. Ward.

Electrical Specialties.
Columbia Electric Co
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co. The.
Turner Brass Works.

Electric Railways
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Elevators, Electric and Hydraulic.
Hale Elevator Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E., Mfg & Supply Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Columbia Electric Co.
Cutter, Geo.
Detroit Electrical Works.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co. The.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Cutter, Geo.
Delaware Hard Fibre Co
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Journal Bearings.
Turner Brass Works.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Columbia Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Light Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Steuben Electric Mfg. Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Columbia Electric Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Elektron Manufacturing Co.
Erie Electrical Supply Co.
Foster, O. A.
La Roche Electric Works.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Freeman, Coleman & Co.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Babcock, W. H.
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Coolidge Fuel & Supply Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Star Iron Tower Co.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Street Ry. Equipment.
Minneapolis Street Ry. Co.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.
Roessler & Hasslacher Chemical Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James.
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Type Writer Co.

Valves
Packing, Insertion.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. THE NATIONAL CARBON CO. CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

NOW THEN! FOR SALE CHEAP!!

[illegible] Light Thomson-Houston Incandescent [illegible] volts.
Two extra Armatures for same
Four American Arc Machines, 25 lights, 2000 candle power.
60 miles No. 10 American Elect. Wire used about one year.
One 100 H. P. Horizontal Boiler, full front.
One 65 H. P. Westinghouse Automatic Engine.
High Speed Engines, Pumps and Equipments for Electrical Stations on hand.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

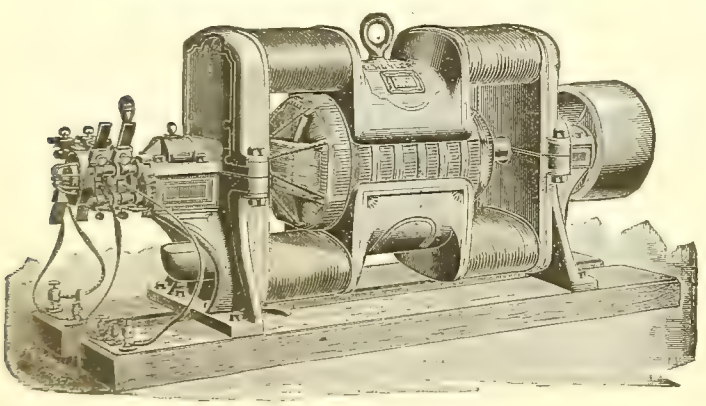
Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

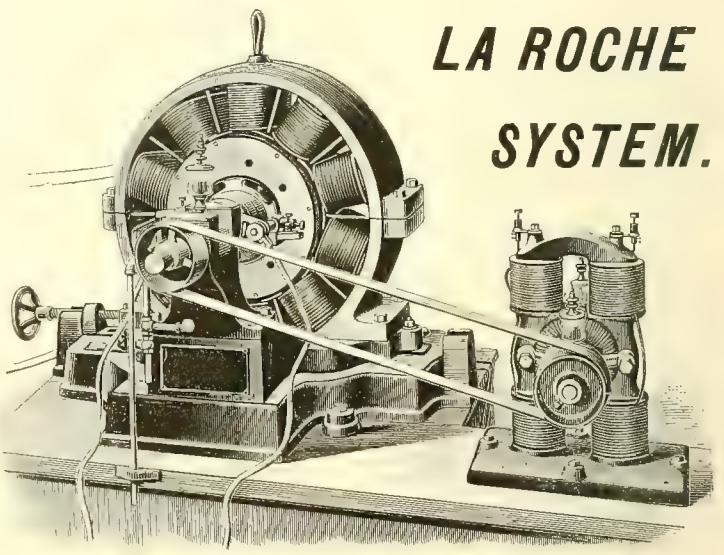
Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

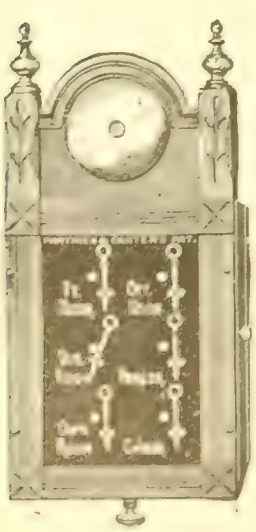
FOR LONG DISTANCE LIGHTING,

FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.



ESTABLISHED 1867.

FRANKLIN S. CARTER CHARLES M. WILKINS. E. WARD WILKINS.

—TRADING AS—

PARTRICK & CARTER CO.,

125 South Second Street, PHILADELPHIA, PA.

SOLE PROPRIETORS OF THE PATENT NEEDLE ANNUNCIATORS.

Manufacturers of and Dealers in all Kinds of

ELECTRICAL SUPPLIES.

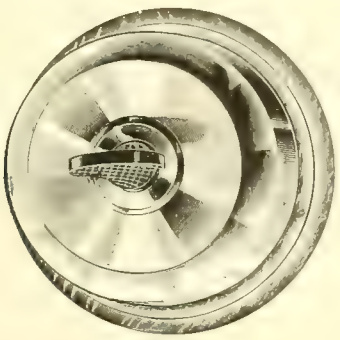
—WE MAKE A SPECIALTY OF—

Bells, Disque Leclanche Batteries, Gas Lighting Apparatus, Bronze goods and a full line of supplies for hotel and house work.

Agents for Canada: The Toronto Construction and Electrical Supply Co., Toronto.

[illegible] trade upon receipt of Application and Business Card.

PAISTE SWITCHES.



5 Ampere Paiste Switches, Porcelain Bases, 30c.
10 do. do. do. do. do. 35c.

OUR ST. LOUIS BRANCH.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

OUR KANSAS CITY BRANCH.

OKONITE
TRADE MARK.

GATE CITY ELECTRIC COMPANY.
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OUR OMAHA BRANCH.

OKONITE
TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

OUR DENVER BRANCH.

OKONITE
TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., Denver, Colo.

We haven't much on our page this week,
but we want you to READ IT ALL.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

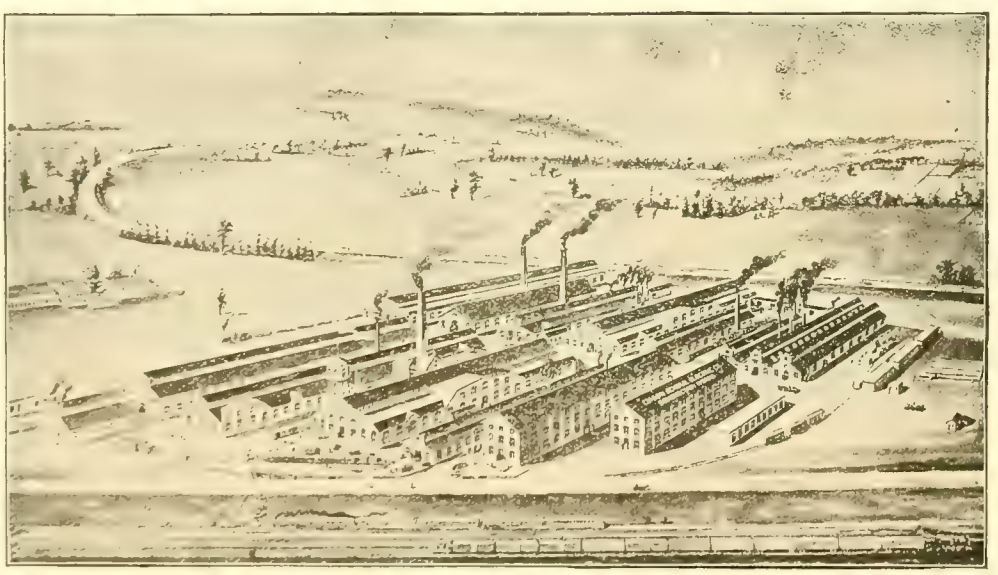
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE THOMSON-HOUSTON COMPANY'S LAMP EXPERT PRONOUNCES THE THOMSON-HOUSTON INCANDESCENT LAMP "WORTHLESS."

Look at this Statement

(We copy below from the Thomson-Houston Company's advertisement, running in the WESTERN ELECTRICIAN from September 12 to October 17.)

SEE WHAT PURCHASERS SAY:

B. B. Burley, Proprietor Burley House, Belle Plaine, Iowa.

STATE OF IOWA, } ss.
Benton County, }

I, B. B. Burley, being duly sworn, upon oath depose and say, that I am a resident of Belle Plaine, Benton County, Iowa, and proprietor of the "Burley House" in said city; that September 20, 1889, the Wm. A. Hunter Electric Company placed a 32 candle power, 52 volt Incandescent Lamp of the Thomson-Houston system, on the porch at my said hotel; that said lamp burned continuously for 4,620 hours, burning out July 15, 1891. B. B. BURLEY.

Subscribed in my presence and sworn to before me, August 10, 1891.
TOM. H. MILLER, Notary Public,
In and for Benton County, Iowa.

{ SEAL. }

Burley House, Belle Plaine, Iowa.

Extract of letter from Manitou Electric Co., Manitou Springs, Colo., Dated August 23, 1891.

"We have got T. & H. lamps burning and giving good light, that I can figure up over 10,000 hours. We have probably 200 Thomson-Houston lamps burning that have burned 5,000 hours. The lamps were all I could ask. Have tried "Sunbeam", ..., and other lamps made in Chicago, and the ....., all of which are no good on earth." MANITOU ELECTRIC CO.,
By C. F. Tingley, Manager.

(We copy below from our advertisement in the WESTERN ELECTRICIAN of October 17.)

QUERY. Why do the Thomson-Houston Company mention in their advertisement the length of life of their lamps as if it were an evidence of superiority? Is it because they are unable to make "good" lamps of high efficiency; because they are presuming upon the ignorance of their customers; or because the *individual* who wrote the advertisement did not know any better?

And then at this.

(We quote below from page 17 of "A Treatise on the Incandescent Lamp" by J. E. Randall, Electrician of the Incandescent Lamp Department of the Thomson-Houston Co.)

"It is probable that in the future the length of time a lamp will be allowed to remain upon its socket will be reduced rather than increased. The reason is to be found in the lamp itself. While numerous reports have been published in which phenomenal records for life have appeared, two very important factors in such tests have been carefully omitted. They are: The efficiency or the horse power consumed per candle, and the ratio of the illuminating power at the start to that after a run of 1,000 hours. No published tests which have given the items mentioned have shown that the lamps were of any value for illumination after a run of 800 or 1,000 hours. The writer has yet to see a lamp whose candle power after 1,000 hours' run was not so much reduced as to make it worthless. This limit to life by the decrease in illuminating power will be more fully appreciated and more definitely settled the more the incandescent lamp is used for domestic illumination. The various manufacturers will then guarantee that their lamps will retain their candle power for a certain number of hours, instead of guaranteeing, as at present, that the lamps will run 600 to 1,000 hours before breaking, a guarantee which any well made lamp will fulfill."

The admission that Thomson-Houston lamps are "worthless," coming from so good a source as the electrician of the lamp department of the Thomson-Houston Company himself, must be accepted as correct.

We would also call attention to our advertisements in the WESTERN ELECTRICIAN of September 26, October 3, 10, 17 and 24.

A SUGGESTION. The next time that the Thomson-Houston Company wish to show the superiority of their goods and assume the responsibility for a statement made by one of their customers directly reflecting on goods made by their competitors, it might first be well for them to make sure that they are on the right side of the fence themselves.

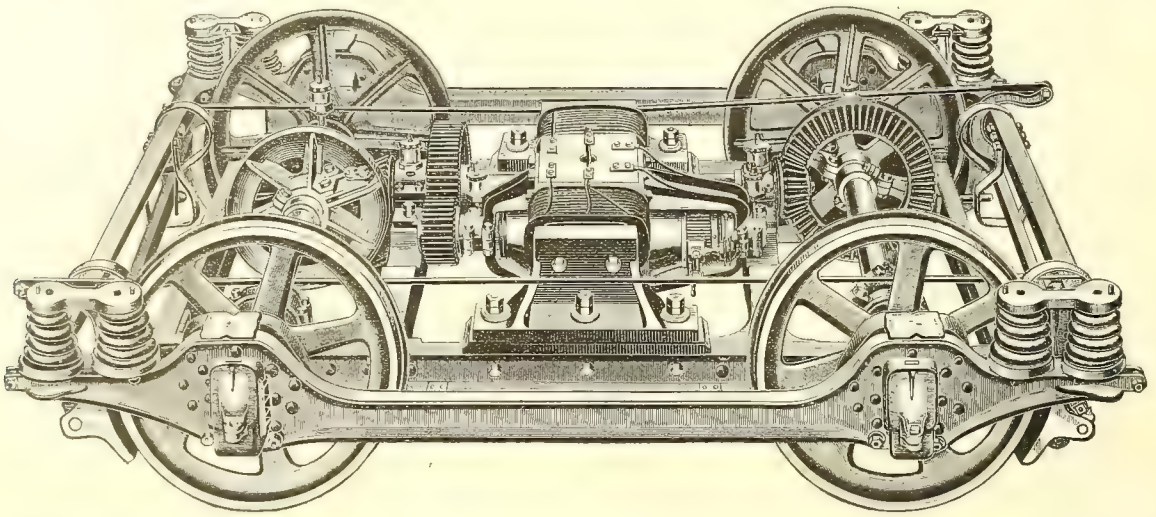
WE CAN furnish a lamp of high efficiency or a long-lived lamp as our customers may desire. Each style will be found to give a whiter light and more light per dollar of expenditure in current than similar lamps made by other manufacturers.

THE SUNBEAM INCANDESCENT LAMP CO., 805 Chamber of Commerce Bldg., CHICAGO.

FACTS, STREET RAILWAY MEN SHOULD KNOW ABOUT

The Detroit Electrical Works'

STANDARD RAILWAY SYSTEM.



Our *latest type "B"*, standard equipments have been ordered by street railway companies at Gloucester, Mass., 10 cars; Salem, Mass., 5 cars; Aurora, Ill., 15 cars; and by J. N. Beckley, President of the Rochester Railway Company, for his railway at Lawrence, Mass., 15 cars, after thorough *trial* and *experience* with the *latest styles* of equipments put on the market by the *other leading electric companies.*

Our equipments will operate with *less current* to do the same work, with less noise and with *less risk* to *burn-outs* of *armatures, fields* and *switches,* than any other equipment on the market, whether double or single reduction.

The advantages over two motors, of having but *one motor* to drive the car, are:

1.—*One-half* the number of electrical parts.

2.—*Uniform wear* on the system throughout.

3.—*Single Absorption* of the *current*, thus eliminating *losses incidental* to *dividing power* into *two* or more units.

4.—*Impossibility* of having one motor working against another, which often happens to the *destruction* of some one or more parts.

5.—*Ability* to *reverse motion* at *speed* in case of *danger,* where prompt action may save personal injury and subsequent damage.

6.—*Accessibility* of *motor parts* to *inspection* from the *car floor*, everything being in the *center*, under *one* trap door.

7.—The *indisputable fact* that *four wheels* of a truck, all *driven simultaneously* from *one source* of *power*, *give all* the *traction* on the rails due to the weight of the *car* complete, *regardless* of the *distribution* of the load in the car.

This is an *important consideration*, especially in *work* on *grades* where *all* the *traction* of the car is *needed* and where *slipping* of the *wheels* is *objectionable* and *expensive.*

In the *new style*, type "*B*", 30 and 40 H. P. equipments, the details throughout have been redesigned to meet hard service at a *low cost* for *maintenance* and *repairs.*

The *switches,* recently patented, are *strong*, *durable* and *safe* from *arcing*, or *burning* by breaking heavy currents.

The *rheostats* are made of German silver wire, and arranged in an improved casing for protection and durability.

These statements are facts, and we will furnish the means for any intending purchaser to verify them, both by inspection of the apparatus at our Works and by inquiry into the results of operation on the roads that we have equipped.

Full information and detail estimates furnished upon application.

DETROIT ELECTRICAL WORKS, - DETROIT, MICH.

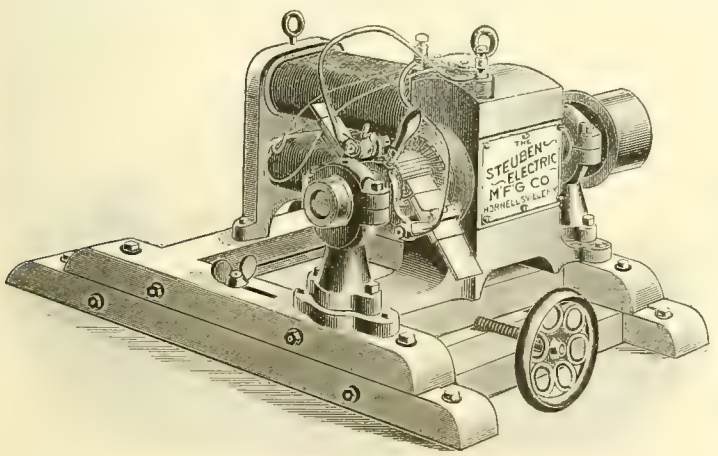
CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

DO YOU want a first-class DYNAMO with which to DRIVE your competition? If so, DIRECT your inquiries to us.



KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

FOR SALE:

(IN GOOD ORDER.)

One Edison 150 Light Dynamo, good as new	$275 00
One U. S., New Style, 110 Volt, 200 Light Incandescent Dynamo, Rheostat, Ammeter and 200 Key Sockets, has not been used three months, good as new	375 00
One Manchester 50 Volt, 200 Light Compound Dynamo	180 00
One Manchester 50 Volt, 150 Light Dynamo	150 00
One Daft 110 Volt Shunt, 200 Light Dynamo, New Armature	250 00
One C. & C. 15 H. P., 110 Volt Motor	260 00
One T.-H. 500 Volt Compound Dynamo, 50 H. P., New	1,200 00
One T.-H., 15 H. P., 500 Volt Motor, New	400 00
One Sperry Arc Dynamo and ten Arc Lamps	350 00
One 600 Volt, 25 Ampere, U. S. Shunt Dynamo	400 00

FOREE BAIN,

47 and 49 South Jefferson Street,

CHICAGO.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

Something Entirely New. NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED. **Simple, Efficient, Economical.**

Indorsed by the Electrical Press, and Prominent Electrical Engineers and Electricians. For Particulars and Prices write to

THE RIES ELECTRIC SPECIALTY COMPANY, Baltimore and Eutaw Sts., BALTIMORE, MD.

PATENTEES AND SOLE MANUFACTURERS REGULATING SOCKETS.

COOLIDGE FUEL & SUPPLY CO.,

RAILROAD CROSS TIES AND PILING.

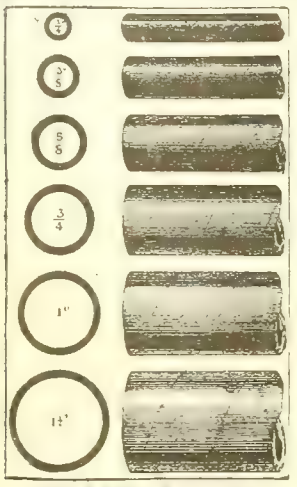
CEDAR AND OCTAGONAL PINE POLES.

CROSS ARMS, PINS AND BRACKETS.

—MANUFACTURED BY—

J. R. CLARK CO., Minneapolis, Minn.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 226 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

16 C. P. Less than 100 lots, 55 Cents.
" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

ELECTRIC RAILWAY SUPPLIES

For All Systems.

EXCLUSIVELY.

SEND FOR CATALOGUE.

ELECTRIC MERCHANDISE CO.,

11 ADAMS STREET, CHICAGO.

W. R. MASON, General Manager.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

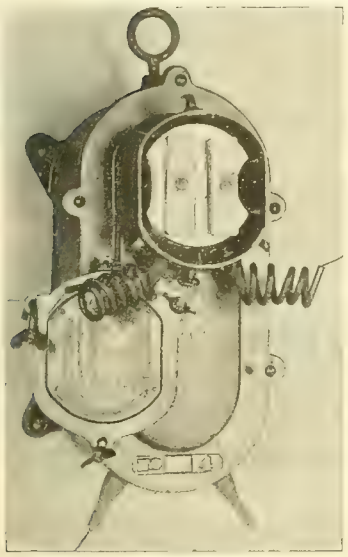
The Street Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

Westinghouse Electric & Mfg. COMPANY,

Pittsburg, Pa., U. S. A.

Makers of Electric Light and Power Apparatus for all Purposes.

PIONEERS OF THE ALTERNATING SYSTEM.



CONVERTER.

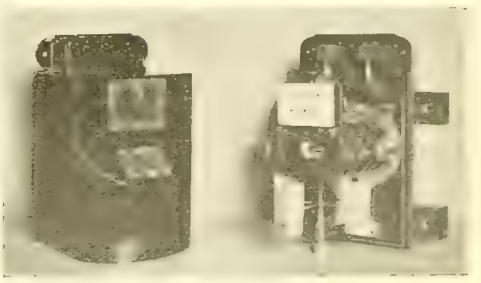
OUR **Converters** COMBINE

HIGHEST EFFICIENCY,
ABSOLUTE SAFETY,
PERFECT REGULATION,
LOW PRICES.

OUR **Meters** ARE

SIMPLE,
ACCURATE,
RELIABLE,
DURABLE.

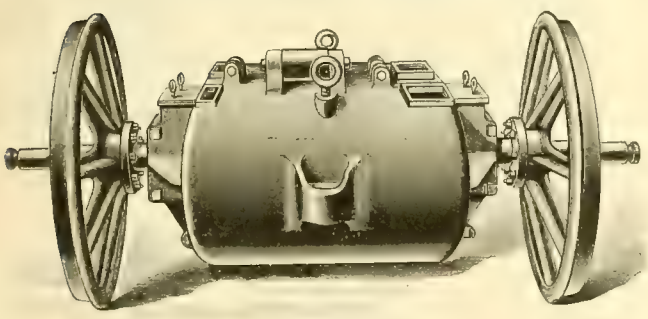
OVER **700,000** 16 C.P. Lights' Capacity of METERS IN USE.



METER.

The Westinghouse Meter is the only A. C. Meter which has been adopted as standard by the London (England) Board of Trade. Synchronous System for the Long Distance Transmission of Power in large units claims the attention of every one having available Water Power within twenty-five miles of a market.

RAILWAY DEPARTMENT.



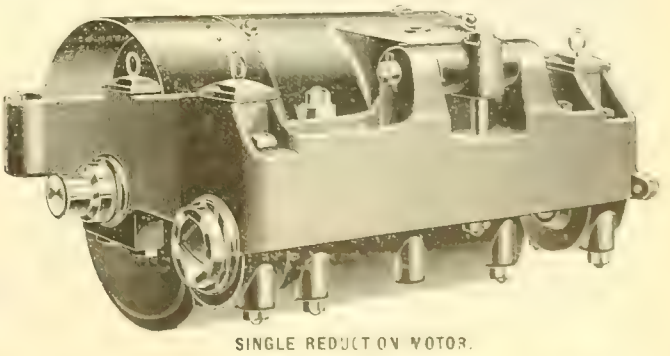
IRON-CLAD GEARLESS MOTOR.

YES, WE MANUFACTURE AND SELL GEARLESS and SINGLE REDUCTION

RAILWAY MOTORS,

MULTIPOLAR AND 2-POLE GENERATORS,

and all Station Appliances for Street Railway Work.



SINGLE REDUCTION MOTOR.

Percentage of increase in roads using our apparatus greater than that of any other company.

Send for Latest Catalogue.

OFFICES IN ALL OF THE LEADING CITIES. Correspondence Solicited.

Address,

WESTINGHOUSE ELECTRIC & MFG. CO.,

Pittsburg, Pa., U. S. A.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

BUY THE BEST!

The Mosher Arc Lamp.

DIRECT INCANDESCENT CIRCUITS.

READ THE FOLLOWING TESTIMONIAL:

NATIONAL ELECTRIC MFG CO., EAU CLAIRE, WIS., October 5, 1891.

Mosher Arc Lamp Co., Chicago, Ill.

GENTLEMEN:—Replying to your inquiry of the 3d inst. we beg to state that the lamps you sent us some time ago are giving us better satisfaction than any other lamp we have ever tried to burn on an incandescent circuit. We inclose herewith an order for 10 of them to be shipped to Elgin, Ill. Yours very truly,

NATIONAL ELECTRIC MFG. CO.

Noted for Simplicity and Steadiness.

500 to 2,000 candle power, making superior lamp for photo-engraving purposes. Write for price, circular, and sample lamp.

MOSHER ARC LAMP CO., 125 Ontario St., CHICAGO.

Or to F. P. Little & Co., Buffalo, N. Y.; Creaghead Engineering Co., Cincinnati, O.; Chas. F. Lindner, San Francisco, Cal.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

WANTED

ELECTRIC LIGHTING.

Bids will be received at the City Recorder's Office, until Monday evening November 16, 1891, for lighting the city of Big Rapids, Mich., with 32 to 40 2,000 candle power electric lights, according to the following plans.

FIRST: For lights running from dusk until 12 o'clock every night in the year.

SECOND: For lights running from dusk until daylight every night in the year.

THIRD: Running from dusk until 12 o'clock upon what is known as a moonlight schedule.

FOURTH: Running from dusk until daylight upon a moonlight schedule.

Bids upon each of these propositions to be made for contract running from January 1, 1892 to January 1, 1893, also from January 1, 1892 for a term of three years. The Common Council reserve the right to reject any and all bids.

W. A. FOSTER, Recorder.

KNOW WHAT YOU'RE GETTING!

HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

In a test of the best known "Separators" recently made at Cornell University this ELIMINATOR demonstrated percentages of efficiency over ALL competitors ranging from 11 to 59 per cent. The full report of test with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street. NEW YORK.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

Royal Electric Co.,

911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURERS OF

Alternating and Continuous Current Dynamos and Motors,

AND ELECTRIC MACHINERY.

THE MOST COMPLETE ALTERNATING SYSTEM NOW ON THE MARKET.

Agents Wanted for Exclusive Territory.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

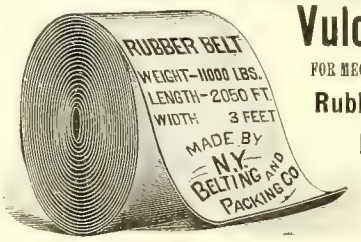
NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of

Vulcanized Rubber Fabrics



FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.

SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 160 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 16-20 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, Rods, Tubing, Washers, Discs and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

THE ELECTRICAL ENGINEERING CO.,

322 DEARBORN ST., CHICAGO.

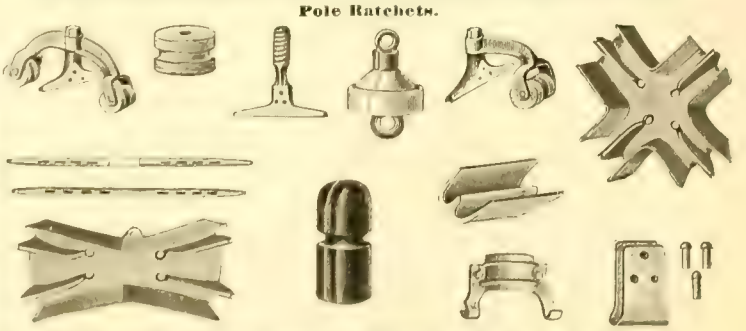
Contractors for all kinds of ELECTRICAL WORK.

GENERAL WESTERN AGENTS FOR

The Clark Wire.
The Interior Conduit and Insulation Co. of New York.
The Elektron Manufacturing Co.
Perret Motors.
The Standard Dynamo, Manufactured by the Fairbanks Scale Co.

STANDARD LINE APPLIANCES.

Trolley Wire Splicing Tubes, Pull-off Brackets, Curve Insulators, Pole Ratchets.



Crossing Frogs, Rail Connector Clips, Trolley Wire Insulators.

THE **SHORT ELECTRIC RAILWAY COMPANY,**

Main Offices, Cleveland, Ohio.

Western Electrician.

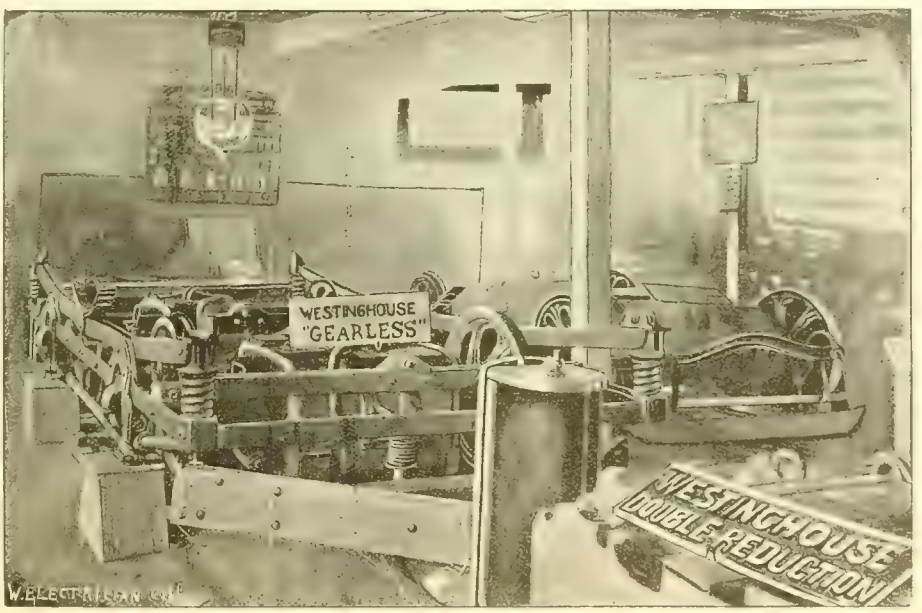
EVERY SATURDAY.

Vol. IX. CHICAGO, OCTOBER 31, 1891. No. 18

Street Railway Exhibits at the Pittsburg Convention.

The exhibits at the Pittsburg convention were far more extensive than those of former years; in fact they were so extensive that the arrangements for them were far from meeting the demands. It was found necessary to place many of the displays in out-of-the-way places and they therefore did not make as imposing an appearance as they otherwise would. It was found in the first place that the plan of dividing the displays was one that should not be followed in the future, and it is quite probable that the association will hereafter adopt the plan of securing a large hall conveniently situated, where all the displays can be accommodated. The fact that the exhibits were scattered about did not, nevertheless, lessen the interest in them. Everybody in Pittsburg and Allegheny knew there was a convention, and they knew the street railway men were holding it. A better advertised gathering could not be found. Nearly every street car in the two cities carried signs announcing the convention and exhibition, and also informed all beholders of the particular type of apparatus that the car and line upon which it was operated were equipped with. The electric railways, of course, monopolized the attention of the public generally and the delegates as well. There were all kinds of apparatus and devices displayed. The Thomson-Houston, Edison, Short, Westinghouse and Detroit systems were shown in actual operation. There were gearless motors and single reduction and double reduction motors shown, and the visitors had excellent opportunities to compare the merits of the several systems. The builders of electric cars and trucks as well as the manufacturers of electrical apparatus showed what advances had been made in the line of car building.

In the accompanying cuts are shown several views of the machinary exhibited on board the barge which was tied up behind the convention headquarters. These illustrations include special views of exhibits of motors, trucks and specialties which are explained in detail.



STREET RAILWAY EXHIBITS AT THE PITTSBURG CONVENTION.

The Short system was thoroughly displayed on the barge as well as on the regular passenger lines equipped by the Short company in Pittsburg. Its special display occupied a prominent position at the entrance of the barge. There was a gearless motor, mounted on a car axle, showing the operation in detail. There were also single reduction motors and one of the Short company's new power generators for street railway work. This latter machine excited much favorable comment. It is substantially constructed and is certainly a handsome piece of work. This type of machine was recently illustrated in the WESTERN ELECTRICIAN. A handsomely finished switch-board equipped with a full quota of measuring instruments was also a feature of interest.

The Westinghouse company's display on the boat was a practical exhibition of the method of mounting the motors on a car truck. There were also several motors for street railway work shown, and a fine switch-board. The special features of the Westinghouse company's motor were displayed to advantage.

The Thomson-Houston company's exhibit in the boat was not so elaborate but it was nevertheless one of the special attractions. Several types of motors were shown and their advantages under different conditions pointed out. There was also a complete display of measuring instruments arranged on a switch-board, giving the display a business-like air. The company's most attractive display and one which was examined by the practical members with much interest was a new combined snow plow and sweeper, which was run about the streets day and night. It is a handsomely built machine, and attracted as much interest among the residents of Pittsburg as in railway circles.

One of the prettiest displays in the exhibition was a working model of the motor and truck of the Detroit Electrical Works. This was shown on the Mayflower and was constantly surrounded by visitors.

The display was brilliantly illuminated during the evening. Several Ward arc lamps were arranged in different parts of the boat and showed the exhibits to advantage.

The Edison company's display was made in its parlor at the Monongahela House. Here a street railway truck was placed in the center of the room and the operation of the Edison system displayed. Above the truck and arranged on one of the walls of the parlor was a cluster of incandescent lamps forming the initial letters of the company's name. There was another cluster over the door, and these served to draw thousands of spectators to the exhibit.

The construction and supply companies occupied as much space and attracted as much attention as the large manufacturing concerns. Throughout the halls of the convention headquarters and on the boats moored at the wharfs the displays of these companies were attractively arranged.

Electricity at the World's Fair.

In a letter dated October 6th the Frankfort correspondent of the WESTERN ELECTRICIAN says:

"Mr. Hornsby of Chicago, assistant to Prof. Barrett in the electrical department of the World's Fair, arrived in Frankfort a few days ago and has been looking up electrical matters at the exposition. The German exhibitors at Frankfort are very enthusiastic over the World's Fair, and it is believed that a large number will exhibit. Siemens & Halske of Berlin will without doubt exhibit on a large scale, as well as W. Laymeyer & Co. of Frankfort, Schuckert & Co. and many others.

"In a conversation between Mr. Hornsby and Mr. Dobrowolsky, who designed machinery used in the Lauffen-Frankfort electrical transmission, Mr. Hornsby asked whether it would be possible to transmit power from Niagara Falls to Chicago, a distance of about [illegible] miles, with any reasonable [illegible]. Mr. Dobrowolsky said that he, directly or indirectly, would undertake the transmission of [illegible] from Niagara to Chicago at the [illegible] such a contract were opportunity offered. He stated that he would probably transform directly to 40,000 or 50,000 volts at Niagara Falls, and transform down one or more times at Chicago to 50 volts; and would expect to obtain an efficiency of [illegible]. [illegible] horse power generated at Niagara, 3,000 or more horse power could be utilized at the World's Fair in Chicago."

This good news is confirmed by reports from Secretary Hornsby himself. A recent letter from him, written in Frankfort, states that he left there for Nuremberg on the 7th inst. to visit Schuckert & Co. From there he went to Berlin, Cologne, Breslau, Dresden, Vienna, Buda Pesth, Paris and London to visit the works of the most prominent manufacturers met at the exposition. He has been sufficiently encouraged there to visit these places. He is already assured of extensive and complete exhibits. Hartman & Braun of Bockenheim promise a fine display of their electrical instruments, etc. Dr. Hoepfner, the well-known electro chemist of Giessen, was visited and promised a complete exhibit of his method of electrolytic extraction and purification of copper and other metals. Dr. Werner Siemens has expressed a willingness to make a fine exhibit. Prof. Ferraris of Turin, Italy, wishes to visit the fair and the electrical congress especially. He says that he hopes the date for the congress will be fixed for August, 1893, as all of the professors of Europe have their vacation during that month, and a better attendance could be had. Frederick August Haselwander, so prominently connected with the Lauffen transmission scheme, promises to exhibit a new street railway conduit. The Ganz people of Vienna talk of running an electric road from the exposition grounds to St. Louis, making trips every half hour.

Referring to the prospect of English electrical manufacturers making exhibits at Chicago the London *Electrical Review* says: "The McKinley tariff will doubtless be a great drawback to English manufacturers wishing to exhibit, but we believe this will only apply to a few small firms, and that the larger manufacturers will have something worth exhibiting, but it is of course useless to attempt to forecast anything on the matter at the present moment. It is to be hoped, however, that the exhibition will be a successful one." It may be remarked that this is the first encouraging word for the exposition from any purely electrical English paper.

Plans have been prepared for the lighting of several of the great buildings. As stated last week, that for Machinery Hall contemplates the use of no less than 672 arc lamps of 2,000 candle power each. This plan was suggested submitted to the committee on electricity by Engineer Sargent, but [illegible] merely a [illegible].

The classification of the electrical department has been finally completed and is now in the hands of the printers. It has been changed but slightly from the classification published in this paper on March [illegible]. [illegible] department [illegible] by Engineer Keller, under Chief Barrett's supervision, and are now in the hands of the director-general for his approval. The prospectus of the department has been completed, and is also in the hands of the director-general for ap-

[illegible] committee on electricity. It contains all information that it is thought anyone could desire, and will aid intending exhibitors in determining the probable cost of their exhibits.

By an advertence a few articles were omitted from the first part of the alphabetical freight classification of electrical supplies which was published in the WESTERN [illegible] is the missing [illegible]

[illegible table]

A letter written by Secretary [illegible] on Oct. 11th showed that he was in Berlin at that time. The agent of the department of electricity will visit Paris and London, and it is expected that he will return home about the middle of November.

THE CONVENTION

Of the American Street Railway Association at Pittsburg, Pa.

The ninth annual meeting of the American Street Railway association was held Oct. 21st and 22d at the Monongahela House, Pittsburg, Pa. In addition to the delegates there was an unusually large number of supply and construction men present, and the merits of the several systems of street railway propulsion were thoroughly discussed and illustrated in actual operation. The meetings and displays were almost entirely devoted to electrical matters, and the gathering presented the appearance of a purely electrical convention.

President Watson made the following address:

THE PRESIDENT'S ADDRESS.

The warmth of our reception, even in the preliminaries of this convention, proves that we made no mistake when we selected Pittsburg as the place of our tenth annual meeting. The city is famous for its hospitality. The glow of a thousand furnace fires is reflected in the hearts of her people. Most of us learned this long ago. We are no strangers in Pittsburg. For years we have depended upon Western Pennsylvania for [illegible] cable power very many of us [illegible] therefore, presents itself why we should cultivate the most cordial relations with the people [illegible] underlies our liking for this city—the bonds of fraternity. Six of the companies whose horse car, cable and electric lines thread the valleys and climb the hills, which forms the ups and downs of Pittsburg, are earnest and zealous members of our associa[illegible]

[illegible] electricity to street railway traffic. It is a source of no lit[illegible]

[illegible] time [illegible]

The following statistics have been compiled from returns made by street railway companies in the United States and Canada to the middle of September, and are believed to be as reliable as it is possible to make them:

Total number of [illegible]	11,030
Number of miles operated by animal power	[illegible]
" " " " " electricity	[illegible]
" " " " " steam motors	[illegible]
" " " " " cable	[illegible]
Total number of cars [illegible] street railway [illegible]	[illegible]
Number of cars operated by animal power	[illegible]
" " " " " electricity	[illegible]
" " " " " cable	[illegible]
" " " " " steam motors	[illegible]
The number of horses employed	[illegible]
" " " mules "	[illegible]
" " " steam motors	[illegible]
Number of companies operating street railway lines	[illegible]
" " " " by animal power	[illegible]
" " " " " electricity	[illegible]
" " " " " cable	[illegible]
" " " engaged in building new lines, about	[illegible]

It is interesting to note that since November, 1890, the number of horses employed on street railway lines has fallen from 116,795 to 88,114; that is, 28,681 in one year. At this rate, it will not take long to emancipate the horse from street railway business.

According to the official figures taken from one of the street railway journals for the month of October, 1891, Philadelphia leads, with 510 miles of single track; and after the Quaker City comes Chicago with 452 miles, New York with 289 miles, Brooklyn 285, Boston with 283, St. Louis 275, Baltimore 207, San Francisco 205, Cleveland 192, Cincinnati 180, Pittsburg 10[illegible], Kansas City 141, New Orleans 130, Louisville 132, Buffalo 110, Minneapolis 101, Los Angeles 99, Detroit 94, Birmingham (Ala.) 92, St. Paul 90, Washington [illegible].

[illegible] RAILWAY EXHIBIT AT THE PITTSBURG CONVENTION.

The official figures of the census just completed show that in December, 1889, 476 cities and towns possessed rapid transit facilities; and it is now difficult to find any town of 5,000 inhabitants without one or more street railways.

While a large majority of us are interested in electric street railways, electricity will not be permitted to monopolize this convention. One of the features prepared for us will be the report of a special committee on "A Year's Progress in Cable Motive Power." This is well. We should not become so deeply interested in any one form of rapid transit as to lose sight of the good points of all others.

Where streets are straight, and grades are steep, and the traffic is limited only by the number of cars that can be operated, a well constructed cable system may have economic advantages that should be better understood. In our boyhood days a galvanic battery could always draw us away from the grindstone, and now, later in life, most of us find the dynamo, the engine and the switchboard of an electric power house far more attractive than the heavy machinery of a cable plant. But, if under any conditions, the cable system will give the best possible service to the [illegible] than electricity on the balance sheets, we want to know it.

This convention is to be favored also with the third paper on the "Public Treatment of Corporations," by the [illegible] saying that corporations have no souls. Perhaps that is [illegible] seem to have no conception of what a corporation is or why corporations are formed.

No doubt we would all be more than pleased if the ripe wisdom and sound common sense contained in these admirable papers by Mr. Scribner, preserved in book or pamphlet form, should be placed in every public library, and laid upon the table of every editorial room where to promote justice is deemed an end more worthy than to nurse a prejudice.

The reports of the four special committees on electrical topics will certainly receive your closest attention, and should be discussed with the greatest freedom. If you have any well digested opinions, which do not accord with the conclusions of the committees, let us have the benefit of your thought and experience.

Since the introduction of cable and electric transit, the government, in its wisdom, has found a new use for the street cars. Some of our lines have been elevated to the dignity of United States mail routes. The plan, in bold outlines, is to place on all the cars convenient little boxes for the collection of mail, which is taken up and sorted at some central point, and the city letters sent to the substations without any of the delays incident to the handling of the mails at the general post office. As an illustration of the workings of such a system there is on record a well authenticated instance of the travels of two letters, one of which was dropped into a letter box on a lamp post in a large city, and the other sent from the same point at the same time to the general post office on an electric car. A comparison of the envelopes, subsequently made, shows that the last named letter actually reached Washington, 400 miles away, at almost the same time that the letter dropped into the box was received at the general post office, only two miles away. In a city where all the cars come to a common center the plan seems most feasable, and companies who have not given this matter due consideration will do well to consult their local postal authorities at an early day.

No doubt we shall all derive much pleasure and reap great benefit from the Columbian Exposition in Chicago in 1893. It will be learned with no little regret that Charles B. Holmes has resigned from the World's Fair committee. John B Parsons of the West Chicago street railway has been asked to fill the vacancy, and happily for us, he has accepted the appointment. But we shall not have to wait two years yet to learn what the inventors and manufacturers are doing. They are here with us in large numbers, and their exhibits are well worthy of a large share of your time and attention in the intervals of our business meetings.

Only those of us who at some time in the history of this organization have held the presidential office can have a clear conception of the large amount of dull routine work devolving upon the secretary and treasurer in the course of a year. If this association grows and flourishes like a green bay tree, it is because he keeps the roots well watered. If our meetings prove rich feasts of good and wholesome things it is because he is the caterer. We have been most fortunate in being able to continue in office for a term of years a gentleman so earnest and efficient in the discharge of all the duties of this important position as William J. Richardson.

This convention ought not to adjourn without expressing in some manner its appreciation of the able work of the street railway press. Never more eagerly than now have we watched for the coming of these ever-welcome monthly visitors. The development of new forms of rapid transit has sent us back to school again, and these are our text books. From title page to back cover we scan them through, advertisements and all, in our eagerness to learn the very latest advances in electric, cable and other forms of motive power. Their digests of the important decisions of the courts, their carefully tabulated statistics, their superb illustrations, their detailed descriptions of the power plants and equipments of the most progressive street railways of the world, and their portraits and biographies of prominent street railway men, and their intelligent discussions of all the problems which confront us as a class—are all features which commend them to our heartiest support. They would do splendid missionary work in the editorial rooms of some of our leading daily papers, and the local companies would be acting wisely should they arrange to secure, at whatever cost, the exchange of their city papers with the several journals devoted to the street railway industry.

And now, in conclusion, let me thank you most heartily for your attention, and allow me to express the wish that you may enjoy, to the utmost, the good things prepared for you by the several committees having in charge the arrangement for this meeting.

[illegible] COMMITTEE.

The report of the [illegible] committee was next presented [illegible] follows:

At the opening of the meeting in the city of Buffalo the membership numbered 169 companies. At that meeting and during the year the following named companies have become members:

Asheville, N. C., Street Railway company; Attleboro, Mass., North Attleboro & W. Street Railway company; Baltimore, Md., City Passenger Railway company; Denver, Col., Tramway company; Erie, Pa., Electric Motor company; Evansville, Ind., Street Railroad company; Lancaster, Pa., City Street Railway company; Merrimac Valley Street Railway company, Lawrence, Mass; Lexington, Ky., Passenger and Belt Railway company; Black Rock and Salisbury Beech Street Railway company, Newburyport, Mass; Newton, Mass., Street Railway company; Paterson, N. J., Railway company. Schenley Park and Highlands Railway company, Pittsburg, Pa; Willamette Bridge Railway company, Portland, Ore; Raleigh, N. C., Street Railway company; San Antonio, Tex., Street Railway company; St. Joseph, Mich., & Benton Harbor Street Railway company; Metropolitan Electric Railway company, Springfield, Mo; Toledo, O., Electric Street Railway company: Utica, N. Y., Belt Line Railway company; Douglas County Street Railway company, West Superior, Wis; Wheeling, W. Va., Railway company; Milwaukee, Wis., Street Railway company, in place of the Cream City Railway company, and the Milwaukee City Railroad company, both the latter companies having been members.

The following companies, being operated and controlled by other companies in the same cities, have withdrawn:

New Williamsburg and Flatbush Railroad company, Brooklyn, N. Y. Minneapolis, Lyndale and Minnetonka Railroad company, Minneapolis, Minn. Providence Cable Tramway company, Providence, R. I.

The following changes of names of members have taken place:

Atlanta, Ga., Consolidated Street Railway company, in place of the Atlanta Street Railway company; Augusta, Ga., Railway company, in place of the Augusta and Summerville Railroad company, Buffalo, N. Y., Railway company, in place of the Buffalo Street Railroad company. Consolidated Street Railway company, in place of Street Railway company of Grand Rapids; Lowell, Mass., and Suburban Railway company;, in place of Lowell Horse Railroad company; Toronto, Can., Railway company, in place of Toronto Street Railroad company.

The following named members have withdrawn:

Sea Shore Electric Railway company, Asbury, Park, N. J. Saginaw Union Street Railway company, East Saginaw, Mich. Ottawa, Ill., Electric Street Railway company. Richmond, Va., Railway and Electric company.

As the result of these changes the membership is now 180 companies. At the close of this meeting, the membership will, doubtless, exceed 200 companies.

Committees have been appointed to report on the following subjects, namely: "A Perfect Electric Motor," "A Year's Progress of Cable Motive Power;" "Public and State Treatment of Corporations, No. 3;" "The Dependent—Overhead or Underground—System of Electric Motive Power," and "The Independent—Storage or Primary Battery—System of Electric Motive Power."

It will be seen that unusual prominence has been given to the subject of electricity; indeed, so much so, that this meeting may be fairly called an "electric meeting." The committee considered that electricity had rightly earned the consideration which has been accorded it in the several subjects devoted to its consideration along different lines; and the development of the business during the current year has only tended to strengthen the committee in the wisdom of its allotment of so large a part of the time of this meeting to electrical consideration. The preparation of the reports covering the two distinctive systems—dependent and independent—were placed in the hands of men who were thoroughly competent to deal therewith by reason of their intimate connection in each case with the respective systems. No limit whatever was placed upon the authors as to their treatment of the subjects; and it is believed that the consideration given thereto will be exhaustive. The gentleman to whom was referred the subject, "A Perfect Electric Motor," by reason of his long continued and varied experience with electric traction, as well as his extensive knowledge of the street railway business, was considered to be eminently qualified to tell this association what were the requirements necessary in a perfect electric motor.

All the traffic associations in the country but one have for the past two years generously accorded to the delegates and others in attendance at the meetings of this association the courtesy of a fare and a third for the round trip. We regret that this exception is made, and shall continue our efforts to obtain the concession until it becomes co-extensive with territory which includes our membership.

Your committee desires to call attention to the fact that a hearty invitation has been tendered the association by the Rochester Railway company of Rochester, N. Y., to hold its next annual meeting in that city.

In this connection the committee feels called upon to comment upon the fact that the association, with its attendant friends and business acquaintances, has become so large in numbers as to tax to the utmost the hotel accommodations of most cities. It has occurred to your committee that it might be advisable to refer each year the question of the selection of the next place of meeting to a special committee, whose duty it shall be to take under advisement the question of hotel accommodation and special rates, as an inducement for the association to go to any certain city.

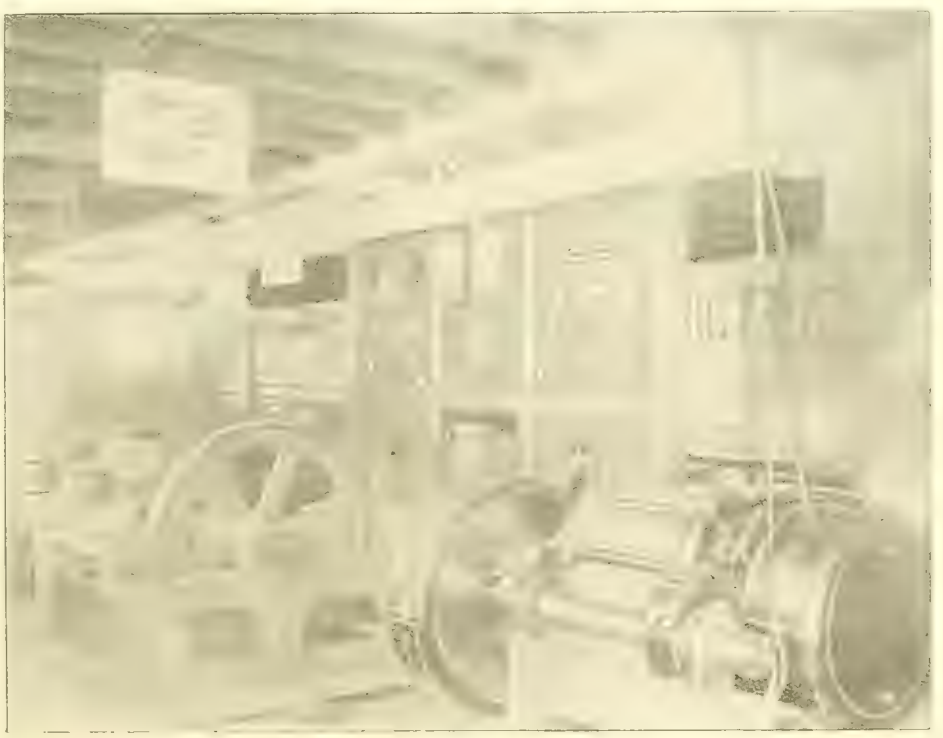
The committee takes occasion to express its grateful recognition of the efforts that have been made by the Pittsburg street railway companies, and especially by their local committee, to have all the arrangements relative to meeting as complete as possible—in the matter of the street railway exposition as well as in the entertainment of the delegates and their friends.

In closing this report, we are glad to call attention to the fact that, although the year has been one of unusual mortality, we have not been called upon to mourn the loss by death of any of our representatives.

Treasurer's Report.

A summary of the treasurer's report, which was next presented, is given:

Receipts.....	$7,122.70
Expenses.....	5,380.64
Balance on hand.....	$1,742.06



SHORT COMPANY'S STREET RAILWAY EXHIBIT AT THE PITTSBURG CONVENTION.

Perfect Street Railway Motor.

The report of the committee on "A Perfect Street Railway Motor" was presented. It follows:

A Perfect Electric Motor.

BY H. A. EVERITT.

For the past eight years the writer has been very intensely interested in the perfection of electric motors. The first experiments were made in the summer of 1883, but during the previous winter we had been carefully watching the operation of an electric system in the private premises of one of the large manufacturing companies, and had seen the motor operate under all conditions of weather—though, of course, experimentally. We had come to the conclusion that it was just the thing, and had hopes that it would revolutionize travel the world over. On application to the city government, we were given the right to build one and a half miles of railway, with an electric conduit. The troubles and vexations we experienced with the conduit are not covered by the title of my paper, and I will endeavor to confine myself to explaining the changes that were required in the motor.

The first fundamental error made by the electricians was in the idea of increasing the voltage in proportion to the number of cars run, which, of course, would be impracticable in a system of any size, but we did not know that then. We got out our experimental car, and quite frequently, for a few hours, it would work magnificently, giving a speed of twenty-two miles per hour with the utmost ease, and running forward or backward with one or two loaded trailers in fine shape. We were quite well satisfied with the experiment with the one car, but insisted on having a second and third car placed on the line before adopting it generally. We finally got the second car running, and were very much disgusted to find that the unsuccessful. After these various trials, the late Richard permission to put in the gearing, and [this style of gearing has been practically adopted by all the prominent electrical companies in the country] after trying to operate this line for about a year and three months, we gave the matter up for the time being, believing that it was impracticable either to operate a conduit, or to operate by the system as suggested at that time, though never losing faith in the final outcome of electric propulsion. We examined a great many motors and traveled over a large part of the United States to observe tests made of storage batteries of various kinds, but we were not at all satisfied as to their successful practical operation, and, until we saw the road operating at Richmond with overhead wires, we had no desire to again enter into the matter of electrical propulsion, although it must be admitted that some of our people were willing to put in a system similar to the one at Scranton, even before the Richmond system was in operation. An electrical motor of three years ago should hardly be compared with the motors manufactured at the present time, and, on the other hand, a motor that is considered perfect, or nearly so now, might be considered old-fasioned and obsolete within a much shorter period. We have made several tests of storage battery systems, and have the many tests made in that branch, and, candidly, we must admit that the practical, successful application of storage batteries for street railway propulsion seems as far in the future as it did five years ago. Almost all street railway men admit that the storage system, if successful, would be the ideal system, and all hope for its ultimate achievement; and in this age of progress it would be very short sighted and bigoted to say that it will never come.

All of the prominent companies are eager to perfect their motors in the matter of details, and have cheerfully co-operated with the practical men running electric roads to bring about the improvement of their machinery. All the well-known systems of the day have some special points of advantage, but these I will not refer to as it is not within my province to do so.

The motors when first constructed were altogether too light both mechanically and electrically, but these difficulties are being overcome very rapidly, as well as the serious difficulty of too rapid motion, which swelled the operating expenses very largely in maintaining the parts and replacing the gearing. The best motors manufactured hereafter will be the most simple in the matter of the construction of the parts, and at the same time not consuming too great a quantity of electricity, so that in addition to being simple they will also be economical. The principle of winding armatures is, of course, a pretty old one now, and each company is anxious to give its patrons the most efficient and best armature. I think it would be an improvement if in all machines made, a better insulated wire were used, in both armatures and fields. A more reliable and positive fuse wire application, one that would always burn out while still under the capacity of the motor would also be a great improvement.

A great many corporations in operating motors do not appear to be willing to give them proper attention or inspection, with the result that weak points are very soon apparent; but this is in no way the fault of the manufacturer.

The writer expects within a very few years, as the motors are perfected and their armature speed reduced, to see a line of [illegible] of not more than a two hour time table for the through trip, and giving a transportation rate considered impossible with the present motive power. A great diversity of opinion exists as to the proper size of motor cars, a good many [illegible] car is desirable and practicable. From our experience in [illegible] opinion that on routes having a small patronage, where the [illegible] and undesirable to have a car exceeding 21 feet in length [illegible] daily expense of hauling a very large car of great weight.

[illegible] wonderfully perfected within the past year, and if as much [illegible] desirable that the mechanical application should be more

[illegible] after. I do not think it was the intention [illegible] in any way the special weak points of any system, but simply to refer to the whole question in a general way. If you will pardon a short divergence from the subject, I will relate an incident which occurred last spring. A gentleman largely interested in street railways made the remark that in the city of New York they would never permit of the use of electric motor cars if accompanied with unsightly overhead wires. I asked him if it were quite consistent that so much objection should be made to a system which required but one copper wire, not exceeding three-eighths of an inch in diameter, with posts on either side of the street, 150 feet apart, with a diameter not greater than an ordinary hitching-post, after allowing on the street that beautiful structure, the New York elevated railway, with its perfect (?), odorless, smokeless, noiseless steam locomotives, and shutting out both light and air to the people on the street where the railway is operated. He candidly admitted that he did not know but that the elevated road was about as bad as the overhead wires.

To resume my subject, at the present time all of the prominent companies are devoting the time and intellects of their best men to the perfection of a gearless motor. They all now have the single reduction motor in the market, which is certainly a wonderful achievement in advance of the late countershaft machines, and which ought to make a splendid exhibit when compared in the matter of operating expenses. But I have noticed one matter which the electrical companies seemed to have entirely overlooked in the manufacture of their apparatus, and I must say that this failure is universal.

All of the prominent companies seem to have fallen into the same error, and seem to persistently and maliciously continue in their evil ways. I do not think that any one subject connected with electrical propulsion has received so much attention from the railways as this one, and with so little co-operation and assistance from the electric companies. I, of course, refer to the price of their equipment. It appears to me that the companies, instead of operating 4,000 motor cars, could be operating 40,000 within a very short time, if they would bring the price down to a reasonable figure so that all companies could afford to purchase an equipment. I think it would also be desirable if the electric companies would supply all the extra parts from their shops, at a price allowing a reasonable margin for profit.

Before closing this paper, I desire to extend my sincere thanks to all the gentlemen connected with street railways who have so kindly given me the benefit of their experience on this subject.

In summing up my idea of a perfect street railway motor at the present time, I would say:

Taking the trolley wheel, [illegible] I think it desirable to have a wheel that is capable of following the wire at any angle, with a trolley pole brittle enough to break should it become entangled in the wires, without pulling them down, and a trolley spring rigid enough to give good, steady pressure on the trolley wire, and so constructed that when the car is in the car house or going under a low bridge, the pole could come very close to the roof of the car, also flexible enough to give good pressure when the trolley has to be 21 or 22 feet high at railway [illegible].

The car should have a lamp circuit, with plenty of lamps distributed properly.

The perfect motor ought to have, as hereinbefore suggested, a reliable fuse plug that will invariably blow before [illegible]

Have on each car the best lightning arrester that can be [illegible]

[illegible] desirable to use a controlling switch that is easily operated and readily re- [illegible]

[illegible]

diameter, making a small number of revolutions per minute, with the bearings made of extreme width, with proper grease-cups, and in such a condition that they can be readily rehabited when slightly worn.

The diameter of the commutator should also be large, and to have the brushes easy of access is very desirable. The winding of the armature ought to be of the simplest kind, and the size of the wire and insulation of same should be carefully looked after. I think the insulation of wires in armatures is at present one of the weakest points in the motor.

The armature gears should have a wide face, and run in oil. The armature shaft ought to be of ample diameter, and there is nothing gained by having the keyway too small for the securing of the commutator to the shaft. The commutator should be carefully insulated, so that there will be no grounds between it and the case. The box in which this gear runs ought to be constructed of copper, or some light material that is somewhat flexible, so that if struck from the outside it will bend rather than break. The fields should also be wound with a wire of better insulation, and of ample size to take the current. Of course, in this particular, I do not intend that the wire of either the field or armature should be great enough to take more horse power than ought to be used by the machine. To my mind it is very desirable to have the armature in such a condition that it can be readily taken out from the machine and put in again.

One of the serious disadvantages to operators of electric roads is the expensive labor necessary in winding the armatures and fields, also in regard to high priced mechanics who ought to be employed to attend to the machines. There is nothing gained in employing a cheap class of labor to handle an electric equipment, either as electricians, armature or field men or mechanics. This proposition is a self-evident truth, as can readily be observed in many roads now in operation.

STREET RAILWAY EXHIBIT AT THE PITTSBURG CONVENTION.

At present, I think the single reduction motor is the nearest perfection of any on the market.

I think it very desirable that the electric companies should devote some time to the perfection of an electric brake to stop the car with the same power that runs it. This could be readily done and would be a satisfactory improvement.

Electric heaters are now used in quite a number of places and I think will prove quite satisfactory.

I have noticed electric signal bells on some of the cars, and they seem to work very well.

For a dasher gong on a motor car, I am in favor of a foot tread, as in testing an electric gong we found that our men used it altogether too freely.

I am in favor of an oil head-light, one that can be removed easily, so that in the event of a trolley being broken or anything happening to the electric part of the car, or a light is desired underneath the car, the oil head-light can be used to better advantage than the electric. There ought also to be one oil light in every car for the same purpose. There is no reason why an electric fare register cannot be made to work successfully.

The durability of the motor is a question which requires very careful attention. The single reduction motor when properly looked after ought to last for many years. We [illegible] operation for over ten months, and it appears to be in as good condition as when it first went on the road. The car should be of moderate size, constructed [illegible] without fancy decora[illegible] display.

[illegible] on frequent headway, and at all [illegible] day and night, at as high a rate of speed as the civic authorities will permit. The noise of the motors has been very largely done away with, and by careful attention the old counter shaft machines can be used until worn out by simply covering the gearing with an oil box, and by not attempting to run them too many miles without inspection.

The report was received and ordered filed and the thanks of the association extended to Mr. Everett.

Discussion.

W. J. Stephenson, Washington: In the city of Washington we are prohibited by an act of Congress, from using any other power than some conveyed underground, or horses. By a recent act of Congress the two principal lines were required to change their motive power within two years. One of these lines has entered into the construction of a cable road, a part of which is completed and in successful operation. The other line I believe is operated, or will be operated, by the storage battery system. I believe matters are in an experimental stage. This appears to be the only method of operation that we can have in the District of Columbia, in the way of an electric road, as the system of overhead wires for the present is out of the question. I would like some expression of opinion as to whether or not any more danger to the life and limb of passengers is attended in operating overhead wires than an underground wire. I believe there is nothing in the way of a successful underground or storage battery system in operation. I would like also to get some opinion in regard to the comparative cost in operating electric roads and horse railroads.

Charles Cleminshaw, Troy: I understand a paper has been prepared by an electric company showing the cost in detail of the two systems, the horse and the electric. Statistics from seven standard roads are given and I have no doubt the information will be given to the convention before we adjourn.

Mr. Charlton, Hamilton, Ont.: There is one other point that would be of interest to many companies still employing horse power and contemplating the use of electric power. It is Whether the revenue derived from a change from horse power to electric power has been as great as anticipated, or has it been so great as to warrant the change; whether the change has paid in cities of moderate dimensions with small populations.

Mr. Owen, Reading: Mr. McCarthy in his report last year went into this question very fully. The conditions are not the same in every city. Mr. McCarthy arrived at the conclusion that there was a point up to which horses could be operated more cheaply than electricity; and that in some instances the cable could be operated more economically than electricity.

Mr. Hasbrouch, New York: As the gentleman is in pursuit of knowledge I will refer him to a paper read at the annual meeting of the New York state association. Mr. Beckley, the president, made a very interesting report on this subject. He is up to his eyes in electricity in Rochester.

Mr. Henry, Pittsburg: I have in my hand a copy of my last annual report. Our total cost including conductors and motormen, all repairs, mainteance of way, general expenses, and all other charges, amounted to 20 26 cents per mile. Separating this into strictly operating expenses and fixed charges, we have operating expenses of 12.74 cents per car mile, and in comparing the same with the cost of operating the horse line, which was 10 cents per car mile, we must remember that we then paid but one man on a car where we now pay four, or three cents per mile against 6.8 cents now. This increased cost per mile for conductors and motor men is a necessary adjunct of rapid transit, and is not peculiar to the system. Allowing for this, we have a difference of 1 04 cents per car mile in favor of electricity as against animal power.

Mr. Bickford, Salem: We have equipped our lines and run twelve cars. Formerly it took eighteen cars to do the work twelve cars now do. On one line where we ran twelve cars by horses, we run eight electric cars and carry more passengers.

Mr. Stephenson: That is the general information that I get. We have about twenty cars on our road, and I am satisfied that when we put on electricity twelve or fourteen cars will carry the same number of people as the twenty do now. I am also satisfied that we shall have an increase in our travel of twenty-five to fifty per cent. The point we want to know is, the relative cost between the electric cars and the horse cars. How much we are going to make by the change or how much we are going to lose. In the last report of the United States Census Bureau, the statistics of fifty roads were given. No roads were mentioned by name or even the cities in which they were located. I think there were three roads operated by cable, thirty-six by electricity and the remainder by horses. The

horse and cable road were the only ones that paid dividends. The electric roads had not paid a dividend from the time of their organization. We are fortunate enough with our little horse railroad to give the stockholders and ourselves a little money in the shape of dividends. I do not want to put an electric road there and not give them anything.

MR. PEARSON of Boston. I think I can give some information on this subject. Our road has about three hundred and fifty cars equipped with electric motors. The expense of operation with horses is about twenty five cents per car mile, including everything connected with the operation, fixed charges and track repairs. In Boston the cost of operation is quite high as compared with some other cities. You will find in many cities the cost of operation of horse cars is below twenty-five cents, but we pay a good price for labor, on account of the running of our lines in the congested parts of the city, where we cannot get as much work out of a man as you can in other cities. This makes a greater cost of operation. The cost of operation with electric motors up to the present has been about twenty cents per car mile. The increased cost of operation in our city is also true to a great extent with electricity. We pay twenty-five cents a day more for motormen and electric car conductors than we do for horse conductors and drivers. That has been our experience up to this time; we save about twenty-five per cent. Our men are really expected to work ten hours a day, but we really get any where from seven and a half to nine and a half hours a day. The amount of power consumed is considerably more, on account of the slow speed with which the motors have to operate in the down-town sections of the city. There the streets are crowded with teams and cars, and I suppose that the cars run at an average of perhaps one or two miles an hour for a distance of from one-half to one mile, which of course decreases the profits very materially. We expect to get the cost of operation down to sixteen or seventeen cents per car mile. Another item of expense to us is the high cost of power, as we have been obliged to hire power from an electric light company and pay it a good price, of course much more than it would cost a street railway company if it had its own power house. As I said before, the saving of electric cars, compared with the horse system, is about twenty-five per cent.; being about twenty cents per car mile for the electric cars and twenty-five cents per car mile for horse cars.

MR. RICHARDSON: I would like to ask Mr. Pearson, before he takes his seat, what size of cars his company has operated in its electrical propulsion and what size he thinks, from his experience, would be the best and most economically operated, all things considered.

MR PEARSON: We began with a sixteen foot motor car very similar to the old horse cars. We have changed from that to a long car, which is twenty-six or twenty-eight feet long in the body and thirty-five feet over all; that is the car we have adopted as our standard. For our purpose we find a decided improvement in earnings, and saving in operating expenses per passenger, with the long car I imagine that the conditions in Boston determine that for us, and in other cities it may be that the short car would be more profitable for operation. We find the long car earns a great deal more per car mile, and we have only the same number of men to operate it as with the short one. From our test we find that the amount of power consumed on a level track is very little more for the long car than with the short one; in fact, the weight which we have in the car seems to have little to do with the current consumed as long as the car is on a level track. From tests we found that a long empty car weighing perhaps eighteen thousand pounds and using a certain average amount of current would when loaded with fifteen thousand pounds of weight, require very little additional power until it came to a grade. We have experimented in this matter, and could hardly tell from the reading which was the empty and which was the loaded car. That being the case it does not cost much more to operate long cars than short cars. Again, they carry nearly double the people and do it with the same expense for conductors and drivers Just how much more heavy cars will increase the track repairs, of course we cannot tell at present. Our experience has been that the long cars are the best for our purpose.

MR. BALLARD, San Antonio: The gentlemen from Washington told us of certain statistics he had seen, and that while certain cable and horse railroads have paid dividends, thirty-six electric roads have not paid any dividends. I happen to know from having seen the figures of a good many roads that the profits they made were absorbed in paying for new equipment. The shareholders, instead of advancing more money, allow the profits to be used for that purpose. As to the advantage of the electric road over a horse road, I do not think sufficient allowance is made for the natural increase of travel and for the fact that people prefer to ride on an electric car. In the city of San Antonio, the entire line has been equipped within the last year. The total gross revenue of the old horse line running regularly was about $6 500 a month. We are now running at an average gross income of $12 000 a month with only an increase of the population of about 2,000. Our increased receipts are nearly one hundred per cent.

MR. SAGE: Have you increased your mileage?

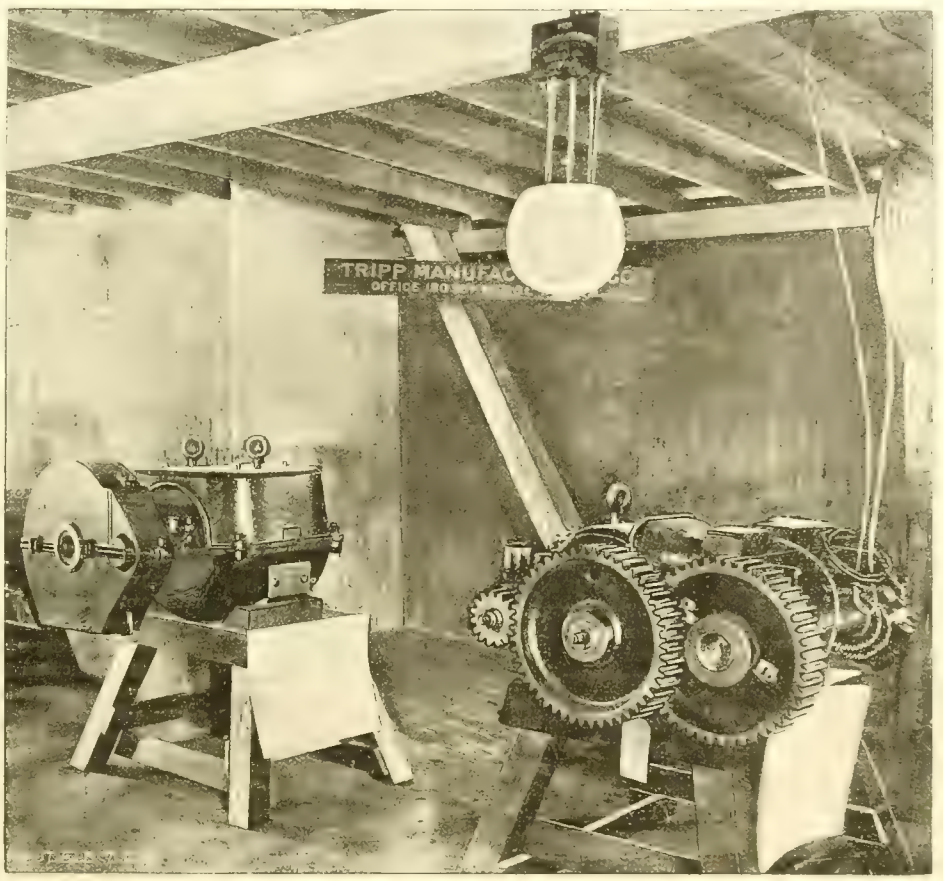
MR. BALLARD: Very little The increase in traffic is enormous.

WM. RICHARDSON: Will the gentlemen kindly state how much the cost of operation in the aggregate has been increased.

MR. BALLARD: The increase is only twelve per cent. Our total outlay for operating expenses, in earning a revenue of $12,000 a month against $6,500 a month, is only an increase of twelve per cent. I would also like the gentlemen to bear in mind that we have to pay $5 50 for every ton of coal that we burn.

D. F. HENRY, Pittsburg: At the convention in Buffalo one year ago, on behalf of this city, I extended an invitation for the next meeting to be held here. I now give you all a hearty welcome At that time we promised to show you in operation one hundred miles of electric road, thirty miles of cable road and possibly still have left a few miles of the old horse railroads. In addition to this, we promised to show you the largest iron and steel and glass factories in the world. Now that you have so honored us we shall leave it to your judgment whether our promise has been made good. On our several lines you will find the various types of electrical equipment The double and single gear and the gearless motor, all of the standard manufacturers being represented; and you will have an opportunity to examine them in successful operation before leaving the city. On Friday we shall have a steamboat excursion for all, including ladies and gentlemen, for the purpose of visiting some of the great mills and workshops, which we hope will prove pleasing to all.

A vote of thanks was tendered the officers of the Pittsburg railway companies and the local committee for the entertainment provided.



THOMSON HOUSTON STREET RAILWAY EXHIBIT AT THE PITTSBURG CONVENTION.

EVENING SESSION.

An evening session was held Wednesday, the convention being called to order at 8:30 P. M. by the president. The first paper presented was a report of the committee on "A Year's Progress of Cable Motive Power," by James C. Robinson. The report was filed.

OVERHEAD AND UNDERGROUND ELECTRIC RAILWAYS.

The next order of business announced was the reading of the report of the committee on the dependent systems of electric motive power—the overhead and underground. This report consisted of a paper, prepared by Mr. Mansfield, which follows:

[illegible] undoubtedly meant by its selection that all systems [illegible] devices to the moving cars, should be included under one head. A moment's thought will, I think, convince any one [illegible] somewhat [illegible] an underlying [illegible]

In looking over the field, therefore, I concluded that as there had been a great many specific papers within a year or two upon this very subject, I must in a broad and general way treat of the various "dependent" systems as they are to day. Having decided this, I prepared a series of questions and [illegible] country using the overhead system. I also undertook to examine into all other methods whereby the electric current is directly transmitted to the moving car.

In treating of the "dependent system" I have arranged the various applications of electricity to railroading under four headings, or I might say into four methods: First, the underground; second, the surface; third, the overhead and fourth, the storage battery. The first three are arranged in reference to the locality of the electric conductor, or transmitting devices. I am aware that one or two of these methods may in some particulars merge closely into other, but I do not see that any more distinctive lines can be drawn, and will now proceed with the discussion.

[illegible]

Under this heading I have classified all methods of conducting or transmitting electricity to the car by means of any conductors or devices placed underground I might possibly divide into two classes: First, continuous bare conductors placed in an open slotted conduit; and second, all other divices of automatic character which enable the contact piece or device on the car to take its electric current from sectional bare conductor or from bare metallic points, automatically made alive. There have been in this country at least four practical experiments with the first class, several hundred thousand dollars have been expended in testing it, and thousands additional in perfecting it, particular attention being given to the protection and insulation of the bare conductor. In spite, however, of all this refinement and study, practically nothing has been accomplished, and I have no hesitation in asserting that the continuous live conductor in an open slotted conduit is to-day a failure, and that it cannot be made a success throughout our cities of to-day, its fatal weakness being our inability to prevent the conduit from becoming filled with water, mud, etc. The time may come when our sewerage systems will be perfect enough to enable us to overcome this fatal weakness. To day, however, they are not, and even an optimistic view puts this time a long way distant.

No large practical experiments have been made with this second class, but a large number of patents have been issued, and evidently there has been a great deal of careful thought and study bestowed upon it. I have seen a number of models and elaborate drawings in various cities of the country exemplifying this class. I, however, have no hesitancy in asserting that this class also will never prove a success, nor can it be made to work successfully throughout any of our cities to-day. The reason for this is obvious. It is immaterial whether the automatic devices prevent the sections or contact points from being alive all of the time or not, if the conduit is filled with water or mud, and the points are made alive just as the car passes, there is bound to be a momentary grounding from these points. In other words, a point made alive [illegible] the other side of the circuit grounded, is just about as dangerous and bad as if it remained alive [illegible] grounding may not be as severe, but still it will occur, and with a large number of cars throughout the city moving at the same time [illegible] points to be alive, [illegible] through water, it would cause a tremendous loss upon the central power station, and in all probability a complete grounding or short circuiting of the entire system. Numerous ingenious schemes have been devised [illegible] the fatal weakness. None [illegible] to trial. I have seen many [illegible] this direction.

[illegible]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, Editor and Publisher.
[illegible] O'HARA, } Associate Editors
[illegible] L. PERRY,
W. E. KEILY,
[illegible] L. BAKER. Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

Street Railway Exhibits at the Pittsburg Convention. Illustrated 255, 256, 257, 258, 259, 262
Electricity at the World's Fair 255, 256
American Street Railway Association. Report of the Annual Convention.
President's Address 256
Report of the Executive Committee 256, 257
Treasurer's Report 257
Perfect Electric Motor, by H. A. Everett, and discussion 257, 258, 259
The Dependent—Overhead and Underground—Electric Motive Power, by George W. Mansfield, and discussion. 259, 260, 262, 263
The Independent Storage or Primary Battery—System of Electric Traction, by Knight Neftel, and discussion 263, 264
[illegible] 264, 266
Standards in Electric Railway Practice, by O. T. Crosby, and discussion 264, 265, 266
[illegible] 266
The New President 266
Delegates in Attendance 266, 267
[illegible] for Membership 267
The [illegible] 267
[illegible] Entertainments 267
[illegible] Illustrated 268
[illegible] Notes, Events and Personals 268
[illegible] ....26[illegible]
[illegible] Congress [illegible] (Chicago Electric Club) 268, 269, 270
[illegible] New York and Chicago ....27[illegible]

DEPARTMENTS.

[illegible] ....[illegible]
[illegible] ....[illegible]
[illegible] 270

THE stenographic report of the proceedings of the convention of the Street Railway association at Pittsburg last week, to which a considerable portion of the space of this week's issue is devoted, contains much information that [illegible] interest to the electric railway men [illegible].

[illegible] should be [illegible] the American Street Railway [illegible] of street [illegible] should be determined largely by the ability of respective [illegible] port for this suggestion. The only thing to mar the pleas- [illegible]

The local street railway companies and the people of Pittsburg generally did all in their power to make the meeting an enjoyable affair and had it not been for the treatment of visitors at the hotel, which was designated the headquarters of the association during the meeting, the Pittsburg gathering would have been considered an ideal convention.

THE importance which is attached to the exhibits of apparatus at street railway conventions was shown at Pittsburg, where the displays were so large that they could not be accomodated in the space which was originally provided for them. This made it necessary to have them cut up and parceled out and, of course, lessened the imposing effect which a united display would have. It is probable that the committee having charge of the arrangements for the next meeting will profit by the experience of the Pittsburg gathering and provide much more space for the exhibition of street railway machinery and special devices. The tendency toward displaying specialties at these conventions as well as standard apparatus is increasing each year. In the exhibition at Pittsburg all the prominent companies were represented and nearly all the smaller specialty concerns had displays.

MUCH interest was shown in the discussion of Prof. Gray's paper on "The World's Congress of Electricians of 1893," at the Chicago Electric club at last week's meeting. A number of valuable suggestions were made by the several speakers, and it can be safely asserted that the gathering successfully accomplished its object, which was to arouse the interest and enlist the support of the electrical men in and about Chicago in the proposed international congress of electricians. Mr. Sunny, in a thoughtful speech, pointed out the great advantages that would result from an authoritative assemblage of the world's electricians in 1893. The benefits that would accrue from a universal, complete and well-settled system of practical electrical units are so apparent that no argument is needed to demonstrate them. There is no such comprehensive system in vogue in Europe and America today, and no doubt the Chicago congress would leave an enduring monument to its labors in the shape of a carefully defined set of standards, with a universally acceptable nomenclature. The progress of the science since the Paris convention of 1881 alone makes the proposed congress a necessity, even if the standards were left in a satisfactory state at that time, which was not the case. As Mr. Sunny remarks, "In the absence of the determination of these units there must necessarily be much confusion, and if a remedy is not speedily applied the embarrassment must be of a serious character." Mr. Sunny cordially commended the idea, and pledged the sincere and hearty co-operation of the National Electric Light association. The other speakers were also enthusiastic in advocacy of the project, and, so far as Chicago is concerned, the work of preparation has been begun with every indication of success.

Of course the convention will not be a success without the active co-operation of foreign nations. The benefits will be equally shared by all, and we shall look for a hearty response to the invitation of the world's congress auxiliary.

MR. CROSBY'S paper on "Standards in Electric Street Railway Practice," read at the Pittsburg convention, contains much that is of practical value mingled with not a little that must be considered as purely theoretical. His remarks on the varying methods of rating street car motors adopted by different manufacturers are correct in the main, and a standard whereby all manufacturers would rate their machines on a uniform basis of work accomplished would certainly be a great desideratum. We doubt, however, if the "horizontal effort" system proposed by Mr. Crosby is practically adapted for use as a substitute. One prime objection is that it is too complicated and too radical a departure from existing standards. Long usage has familiarized the public with the term "horse power" in connection with all machinery used to generate or convert power, and the attempt to substitute any other term for popular use would be so difficult as to be well nigh impossible. If all the several conditions that affect the efficiency of electric motors were likewise standardized, then, indeed, a uniformity of expression might be obtained by Mr. Crosby's method that would be comprehensible to electrical and [illegible] engineers. But the men who buy street car motors, whose money keeps the factories busy, are, in nine [illegible] of ten, neither the one nor the other. Of what [illegible] to inform the proprietor of some street car [illegible] for instance, that he could procure [illegible] motor on [illegible] would not know what [illegible] expressed to him in language with which he was familiar, which would cause more or less confusion and a considerable loss of time. We think, on the whole, that any successful effort to standardize the rating of electric motors must be made on the basis of the existing nomenclature and that it will be found to consist in an agreement as to the conditions under which the given horse power shall be computed.

Many excellent suggestions are given in the remainder of Mr. Crosby's paper, which, as an intelligent and earnest effort toward improvement, is a welcome addition to the literature of the subject. The list of electric railway terms, with definitions, is compact and, no doubt, of considerable value, although many will doubtless look upon it as a work of supererogation.

IN his paper on the dependent systems of electric traction George W. Mansfield uses vigorous language in relation to the employment of storage batteries as the motive power on street cars. After reading it no one need be in doubt as to the author's position, as will be seen by the following extract:

"There is not to my knowledge to-day a single railroad corporation owning and operating storage batteries solely for what there is in them, nor do I believe there ever will be. It is now claimed that litigation has interfered with their development. This is absurd. With ideality written all over the system, do you think that powerful corporations who have spent hundreds of thousands of dollars in experiment would finally abandon them and devote their energies to a system on which they have had to spend almost an equal amount in introducing and exploiting, fighting their way inch by inch throughout the country? Had there been the slightest promise or intrinsic merit in the system, it would ere this have been in every city in the land, litigation or no litigation. No, gentlemen, such sophistries are for the blind and unthinking. For years I have believed that the storage battery car should be relegated to where it belongs, a position with the air, gas and wind motors. I have no faith in them nor hope for them."

We hardly think that the general electrical public will indorse Mr. Mansfield's extreme views. It is true that the storage battery is far from being a commercial success, but that is no reason why it should not be given a chance. He is a bold man indeed who, after viewing the electrical achievements of the last twenty years, ventures the absolute assertion that the accumulator can never be made of practical utility.

THE Pittsburg convention of the American Street Railway association was one of the most important gatherings of the year from an electrical standpoint. While all methods of street railway traction are represented in this association, the prominence which the electric railway has earned, has made the organization's meetings assume the appearance of electrical conventions.

At Pittsburg the overhead trolley system occupied the greatest part of the attention of the delegates, the discussion of the most approved methods of construction occupying most of the time. An excellent opportunity was afforded the visitors to study and compare the merits of the several overhead systems as they were all in practical operation in Pittsburg. The local companies afforded every facility for a thorough inspection of the details of these systems. In the address of the president, and the report of the executive committee mention was made of the remarkable progress that had been made in the substitution of electricity for other methods of street railway propulsion. The prominence which the electric system had assumed warrented them, they said, in devoting so much time to the discussion of electrical subjects. The electric railway had proved its superiority, its merits had been recognized by the members of the association, and had been acknowledged by them in the most emphatic manner. They had signified their faith in the electric system by investing their money in it, and equipping their lines. Further evidence was not required to show their interest in the new system, and therefore the committee felt justified in practically devoting the meeting to the consideration of this subject.

It seemed to be the general impression that the overhead trolley system would continue for some time, as the leading commercially successful method of electric railway work. The storage battery system, however, was not entirely neglected, and it was evident from the expressions of the street railway managers, as well as the manufacturers of electric railway apparatus, that much would be expected of the accumulator in future electric railway development. The underground or conduit system was considered, but it seems to be the impression among the representatives of the railway companies that little of practical value has been done in this direction. The discussions were practical and valuable, and will no doubt prove interesting [illegible] to street railways contemplating the introduction of electric equipment.

[*Continued from page 259.*]

rubber tube made something like a hose pipe. Arranged upon the upper side of this tube are the contact points, which might be likened to rivets punched or tapped through the tubing. The contact wheel or device rolls along the top of this tube, and is sufficiently heavy as it proceeds to press the tube together so that the contact points or rivets come in contact with the conductor inside the tube. By this means the current is transmitted to the motors. Obviously, as the car proceeds, the tube behind the contact wheel springs back into its original position. Plainly, however, if the conduit was filled with water, there would be an inevitable grounding of the points made alive, with consequent trouble and disaster.

Another arrangement was to have inside the conduit a large elastic tube, with a bare conductor inside, this tube to be slit along its upper side. Attached to the car is a plow with a contact device at its lower end inside the tube, and in contact with the conductor. This plow moves along with the car, and slides through the slit. With this arrangement it is apparent that if the conduit were filled with water, it would run in just before and behind the plow. Should this occur, the old fatal trouble would be bound to follow. Furthermore, it would be exceedingly difficult to arrange the tube sufficiently rigid in position to withstand the action of the plow, and the sides of the slit sufficiently tough to withstand the friction. The question of turnouts would also be serious and troublesome.

Another inventor arranged on each side of his conduit slot rubber flaps shod with steel, and held together by means of springs. Attached to the car is the plow as usual. As the plow passes along in the conduit it presses back the flaps. The objection to this is, of course, the liability of the water getting into the slit before and behind the plow. To obviate this, the inventor ingeniously suggested that the whole conduit be kept under an air pressure, which air pressure would be sufficient to blow the water out of any of these open places where it tended to run in I do not consider that any of these plans can ever be successful. We now come to the

Second, or Surface Method.

The inventions covered by this method are somewhat similar to those employed in the conduit system, only in place of being in a conduit, they are placed upon the surface of the street. By far, however, the larger number of arrangements are based upon what might be called the "interval" or "point" system. Primarily this arrangement consists of an underground insulated conductor connected by means of taps to contact points on the surface of the ground, held in place by means of iron boxes, and insulated therefrom by means of rubber, wood, fibre or other similar substance. Upon the car is swung a long contact plate, extending practically from one end to the other. This plate is carried close to the ground, and is arranged to touch the points as it passes along. It is plainly apparent that if these contact points are always alive, then every time the street is covered with water, short circuits are inevitable. To overcome this, many automatic arrangements have been devised to cut these contact points into circuit by the car as it passes along. One inventor had electro magnets on his car, which imparted their magnetism to the iron contact pins or points. These becoming magnetized would lift a little armature inside the iron casing, which in turn moved a switch and cut the iron contact points into circuit. Another inventor arranged a slot between his tracks, in which the plow passed. As this plow passed the contact points, it would tip a lever or some other automatic device, which would throw a switch and put the iron contact points into circuit. Obviously, all these arrangements have the same fatal weakness—a liability to ground or short circuits. I do not consider any of them practically possible. There is one more system which practically combines all these methods, and which obviates many of the objections. The inventor has a slot between his rails and boxes with a contact device within, placed at proper intervals. Upon his car is a plow which passes along through the slot, and also a long contact plate or arrangement extending its entire length. The operation of the invention is as follows: The plow as it passes through the slot strikes a lever placed in connection with each box, which lifts for a distance of six or eight inches above the ground a piston carrying the contact piece proper. This is made in the shape of a right angled hook placed within a vertically moving piston, and thoroughly insulated from it. As this is raised up, the long contact plate under the car passes beneath the hook, and holds it up. The current is taken into the car as the plate slides along under the live hook.

Naturally as the car passes along, the hook slides off from the end of the contact bar and drops back into place. To protect this hook, or contact piece proper, it is covered with an extension of the cylinder, so that, as far as the street is concerned, the surface is perfectly smooth, and one sees nothing but a small round cover in the center of each of these boxes. The contact hook is alive only when it is resting on the contact plate of the car. Certainly in so far as getting rid of all the troubles due to the street being covered with water, this is successful. The fatal weakness whereby the contact points remain permanently on the street surface is obviated here by the contact point being practically lifted six or eight inches above the surface. In regard to the permanence and reliability of this system, I can say nothing, as no trials have been made. The inventor claims to have overcome every objection.

Summing up the general results of the underground and surface methods, it certainly looks as if we could not expect very much from them in the immediate future. Much perseverance and money must be expended before as practical and certain a method as our present overhead method is attained. We surely are all anxiously and hopefully waiting for it. In behalf of the struggling inventors and our common good, I beg that you, gentlemen, will expend all of the above two items you possibly can.

Our rival is the cable. It certainly does look as if for the enormous sums they expend in making their system feasible, we ought, for an equal sum, to make ours perfect. Mechanically it is an assured success, but electrically it has not so proven.

Is it not possible for some bright inventor to devise a scheme whereby the insulation of the live parts can be maintained? This is the sum of all the difficulties. A simple transposition of parts and the problem may be solved. Picture the result! No wires overhead. A welcome boon to millions of pent up suffering people in the great cities of our country; the almost complete annihilation of our rival, and electricity forever established as the great transportation agent throughout the length and breadth of our land. Personally, gentlemen, I have large holdings of a ten per cent., cumulative, preferred hope, and I sincerely trust you all will subscribe liberally, if you have not already done so. We now come to the

Third, Overhead Work.

It is, I suppose, somewhat conceited for me to suppose that I can give you practical gentlemen any information on this subject. I have had, however, somewhat extended experience, and many opportunities for observation. I also addressed to all of the electric street railroads throughout the country a circular letter, asking for certain detailed information. The results of my own experience, and the summary of the answers to these questions, I have the temerity to lay before you.

There are two general methods of operating the overhead system. One is by having a continuous trolley wire wherever the track runs, and the second is to have this trolley wire divided into sections. For towns and for suburban traffic, the former is almost invariably adopted and carried out. Practice would seem to indicate that but little trouble is experienced, and that there is practically no advantage in dividing the trolley wire into sections. In fact, a disadvantage, since you lose its conductive capacity.

The sectional trolley wire surely must be used for all city work. It would be practically impossible to operate in Boston without proper divisions. It is, however, almost impossible to originally fix all these divisions once for all, as the topography of the city, the grades, location of the power houses, routes, lines of traffic, etc., all have to be taken into consideration. It is bound to be a gradual growth to a large extent.

Obviously the methods of feeding the trolley wire vary with the method of arranging the trolley wire. With the first method mentioned (using a continuous trolley wire) the feeders are either extended from the station the entire length of the route, tapping into the line at intervals, or else separate feeders are run out from the station to certain pre-determined distances, and there tapped into the trolley wire. When more than one feeder wire is needed in either case a repetition of the scheme is carried out from feeder wire to feeder wire. There is little to choose between the two methods. Both are good.

With the second method (the divided trolley wire) there are two ways of accomplishing the feeding. First, to extend a feeder the entire length of the line and tap into the center of each section of the trolley wire, or, second, to extend the feeder the entire length of the line and tap into both ends of each section. The advantage of the former is that in time of trouble a man has to run to only one box to cut out a section, or the whole arrangement could be made automatic by putting a fuse or mechanical circuit-breaker in the box. The disadvantage is that you lose the value of the trolley wire as a conducting medium, which in the case of hard drawn copper wire is considerable.

In the latter method (tapping into the section at each end) obviously a man has to go to each end of the section to entirely cut out that section, and two sets of automatic devices would have to be arranged to operate in case of trouble. You have, however, the advantage of utilizing the trolley wire as a conductor.

It is undeniably true that the question of feeder wires is one of great importance, and a difficult one to always economically solve for all conditions. The point, however, which the railroad corporations should watch above all others is that they have enough. I have visited many roads where I found that the larger part of the trouble which they were complaining of lay in the fact that they did not have either sufficient trolley wire or track feeders. Railroad officials are very apt to object to feeders, because of, first, their cost, and, second, the placing of so many wires overhead, which is liable to bring them in conflict with the municipalities and the public. The question of having a sufficient number of feeders underground for the track is one which they can have no valid or reasonable excuse for. To illustrate how important a part the ground wires or ground plates play in a system, I would mention that not long ago I was told that in the city of Cambridge (Mass.) the superintendent often telephoned to the electrician that he could not get sufficient current, and that his cars would not run well. The message would be transmitted to the proper official and he would hasten over. By the time he could get there, however, possibly an hour or two would elapse, and when he did arrive he would find everything working all right, the potential having increased. After a great deal of careful searching the trouble was found. One of the principal ground plates at the station had been thrown over the embankment into the Charles River. At times of very low tide this plate would become exposed, rendering valueless its functions as a ground plate. As soon as the ground plate was thrown farther out into the river the trouble ceased.

I strongly recommend as many of these ground plates as it is possible to have, not only at the station, but also along the line; brooks, bog land, water pipes, everything should be utilized for this ground circuit wherever possible. The plates can be made of sheet copper or iron, preferably the latter, and should have a superficial area of several hundred square feet. The wire connecting them to the track should be of sufficient size and very solidly attached to the plates and the rails. The continuous supplementary wire should in all instances be employed, and the [illegible] If this plan is adopted and carried out, and proper connections [illegible] companies will ever have any trouble with loss of power on their ground circuits.

[illegible] should be placed underground. The cities in which this underground work has been adopted are Buffalo, Minneapolis and St. Paul. [illegible] railway corporations.

I firmly believe that the trolley wire system is here to stay for many decades, and although I hope for a successful underground system, it may never come.

[illegible] thing can be done to advance the interests of the overhead system, it should be done. [illegible] assisting if you, when you go before your local municipal boards and the public, petition for only the trolley wires, agreeing to place all other wires under ground?

It is perfectly safe and sure. There is no reason whatever but the cost why all other wires should not be underground to-day. Science or practice has not demonstrated as yet that this can be done with the trolley wire.

For railway companies the question is one almost entirely of construction. The cables alone will cost to all probability less than the overhead wires. This construction work can be done simultaneously with the track reconstruction, for it is my experience that whenever a large city railway adopts electric power, it is almost absolutely necessary to rebuild its tracks. Under these circumstances I doubt if the cost of the conduits or ducts would be more than a few thousand dollars additional per mile.

In regard to the overhead devices and material used, I can only urge the advice that the most substantial and perfect apparatus that can be secured be used. Too much care and attention cannot be bestowed upon these devices. It does not pay to put in some little cheap fifteen cent arrangement, when for fifty or sixty cents a substantial, reliable and standard device can be obtained. It is also well to consider the question of uniformity in the apparatus. The only part that is liable to deterioration is the insulating material. Make this, therefore, of a uniform pattern, and arrange the various holders for its reception. With such a system nothing can fail and the insulation may be maintained easily and perfectly. It would be like renewing a glass insulator on a telegraph pole.

I come now to the discussion of the answers to the forty questions I asked by circular letter.

Out of the 400 and odd circulars I sent out, some, however, being duplicates, I succeeded in getting answers from 137 roads, operating 1,546 miles of trolley wire and 1,657 motor cars. Of this number seventy-one were Thomson-Houston, and sixty-six Edison or miscellaneous. I wish very much I could have obtained answers to a greater proportion. I certainly wish to convey my sincere thanks to those who did answer, for I realize it must have taken time and sorely tried their patience. For the sake of convenience I have divided the various questions into the following topics: 1. Trolley wire. 2. Span and guard wires. 3. Feed wires. 4. Loads carried and conditions. 5. Tests. 6. Accidents. 7. Miscellaneous.

First. The trolley wire: Of the 137 roads, ninety-nine were using copper wire, twenty-eight silicon bronze wire, eight were using both, and two were using phosphor bronze.

Of those using copper, one used No. 000; five, No. 00; three, No. 1; two, No. 2; one, No. 5 hard drawn copper; one used No. 0 soft drawn copper, making thirteen in all, and leaving eighty six as the number using No. 0 hard drawn copper wire.

Of the twenty-eight using silicon bronze, sixteen used No 4; six No. 2; one No. 3, and the five remaining roads had combinations of two or more sizes.

Of the eight using both silicon bronze and hard drawn copper, six prefer the latter.

Out of all these ninety-nine using copper not one dissents, but of the twenty-eight using silicon bronze, eleven advise copper. The proof is conclusively in favor of hard drawn copper wire and of the larger sizes, No. 0 B. & S seeming to be the standard.

In regard to the wearing, the universal testimony is that it is exceedingly slight. What wearing is observable is found to be at the switches or on the curves.

Serious mistakes have been made in the past by using iron flanged trolley wheels. These cut the trolley wire badly. Everything should be done to throw all the wear on the trolley wheels. These are much less expensive than wire, and not so hazardous for the public if they give out.

From my own information and knowledge I can say that the life of the trolley wire is much longer than I had originally anticipated. The criterion is not the years that it has been up, but the number of times the trolley wheels have passed over it. It would seem that with the ordinary brass trolley wheel the wear was about .001 of an inch to the passage of 65,000 cars. This is at the rate of one in every six minutes, for eighteen hours per day, for one year. With only this wear the life of the wire would certainly be twenty years, unless through some process of crystallization it became more brittle. I anticipate but very little trouble in this direction, but eternal vigilance is nevertheless necessary. Undoubtedly, at curves and on switches the wear is somewhat greater. How much I cannot say.

The breaking of the trolley wire has been rare, the breaks occurring either at splices or switches, or being due to some extraneous cause, such as falling trees, telephone poles or the catching of the trolley pole. One road reports a break as due to the [illegible] locomotive smoke stack. In no instance was any casualty reported, excepting in one case where a mule was killed.

Forty one roads have their trolley wires divided into sections, and considered it necessary and advisable. Analysis shows that these roads are [illegible] cities or towns.

Regarding span wires, forty-[illegible] report as using galva-

[illegible] galvanized steel, twenty as [illegible] one as using copper wire. [illegible] gauge from No. [illegible] to No. 14. Comparatively [illegible] and no casualties

My own experience has led me to adopt No. 4 B. & S. soft galvanized iron wire. Whenever a long span or a curve is to be constructed, I have had two or more of these wires twisted together into a cable.

I have found that a cable made of small wires is hard to joint, and it rusts much more quickly. Avoid joints and use a ball fastener in attaching span wire to eyebolt. On the whole, however, I have concluded that iron is not the proper material to use in any shape. It will rust, and then your structure is weak. Pursuing my investigations into this matter nearly a year ago, I found that a certain special quality of silicon bronze wire was the best. Tests of this wire in comparison to iron showed the following results:

	Diam.	Breaking weight.	Breaking weight per squ inch.	Elongation in six ft. per cent.	Twists in six feet.
No. 1 silicon bronze.	.200	2,550	81,500	.8	37.4
Galvanized iron....	.205	1,720	52,000	7.8	19.

I am aware that the price of this wire is five or six times as great as that of the iron wire, but as the total sum in either case per mile is small, I strongly recommend it. Some of this wire has been in service on the West End road in Boston for nearly a year. It certainly will never rust out. Guard wires are universally condemned but are put up as a compulsory protection from existing evils.

Third. The descriptions of the various feeder systems are so vague I will not attempt to describe them. The average distance to which power is transmitted on these roads is about three miles. The greatest is 10.7 miles on the Tacoma & Steilacoom railway, Tacoma, Wash. There are many, however, operating from eight to ten miles from the station.

Fourth. Loads and conditions: Under this heading I have includ d speeds, grades, number of tow cars hauled, passengers carried, etc. The average speed of all the roads is 8.7 miles per hour. The maximum is thirty. The average grade is 6.7 per cent., and but twelve roads report as having none, or very small ones. The maximum grade is thirteen and a half per cent., and this extends for 1,500 feet. The road suffering from such an infliction is in Amsterdam, N. Y. Thirteen roads report ten per cent. or over. Nashville, Tenn., reports an eleven and a half per cent. grade for 1,300 feet, and Burlington, Iowa, an eight and a half per cent. for 1,500 feet, while Wilmington, Del., reports a seven and a half per cent. for 3,000 feet

The loads carried up these grades by two fifteen horsepower motors are, to say the least, surprising. Amsterdam reports one motor car and fifty-two passengers. Nashville reports one motor car and seventy-seven grown passengers. Burlington, one motor [illegible] seventy [illegible] passengers and Wilmington, Del., reports one motor car towing a disabled motor car. Several roads report as towing one car with both full of passengers up eight and even nine per cent. grades, [illegible] distances. Auburn, N. Y., reports as having towed five cars, all loaded, with one motor car. The grades in this instance were slight. In [illegible] unquestionably the motors were exerting power considerably beyond their rated capacity. Trains carrying 350 passengers have been [illegible] fifteen horsepower motors, 200 passengers is an everyday occurrence. Surely this is approaching steam railroad practice. Such information is certainly useful to the electric manufacturing companies.

[illegible] number of 1[illegible] roads heard from, only thirty-two report as having made any [illegible] and fifty three [illegible] There [illegible] than a [illegible] if possible, a [illegible] and [illegible] electrician.

[illegible]

are reported of collision and running over, but these cannot be entirely avoided and are inherent in any system.

Miscellaneous: Under this heading I asked the opinion of the railroads as to the reliability, permanency and safety of the electric system. All but one report most emphatically in its praise. I regret very much that this one prefers horses. Further evidence on this point is shown by the fact that forty-four roads report as never having been stopped by any cause, twenty three were forced to stop because of the steam plant, failure of water, floods or fire and twenty-six from electrical troubles, the main cause of these troubles being lightning. I consider this a very fair showing and feel confident that as the art advances these tie-ups will grow less and less, and finally become of rare occurrence.

Now, gentlemen, I have reviewed in rather a haphazard manner the dependent system.

I have said nothing in regard to the cost of operation. It is a difficult matter to handle and a delicate one to discuss. I feel that there has been already a sufficient number of statements published to enable any man to choose his own figure from. As there is to-day no generally accepted uniform system of accounting, it simply adds to the confusion to publish additional figures unless the most thorough detail is entered into. I take this opportunity to raise my voice and urge the adoption of some standard system.

Surely a basis of comparison with the independent system is useless, since there is nothing of any value whatever to be found pertaining to the cost of this system. In all other respects also have I avoided comparison with this system.

A. B. C. COMPANY'S STREET RAILWAY EXHIBIT AT THE PITTSBURG CONVENTION.

There is not to my knowledge to-day a single railroad corporation owning and operating storage batteries solely for what there is in them, nor do I believe there ever will be. It is now claimed that litigation has interfered with their development. This is absurd. With ideality written all over the system, do you think that the powerful corporations who have spent hundreds of thousands of dollars in experiment would finally abandon them and devote their energies to a system on which they have had to spend almost an equal amount in introducing and exploiting, fighting their way inch by inch throughout the country? Had there been the slightest promise or intrinsic merit in the system, it would ere this have been in every city in the land litigation or no litigation. No, gentlemen, such sophistries are for the blind and unthinking. For years I have believed that the storage battery car should be relegated to where it belongs, a position with the air, gas and wind motors. I have no faith in them nor hope for them.

I have now briefly reviewed the dependent system, or, as I should have preferred to call it, the direct system. There are some grounds for hope in the direction of an underground or surface system. There is universal praise and [illegible] on every side for the overhead system. [illegible] operated over [illegible] miles of track in the streets of [illegible] of our towns and cities, surely testify to its merits and value. Of this number of towns and cities [illegible] no other means of transportation. [illegible] there are are purely sentimental [illegible] a city with [illegible] wires underground, where [illegible] to iron poles and a single wire for each track. The rails themselves would be a thousand times more of a nuisance and danger. The benefits to come from its introduction are incalculable. In the words of Parnell, "Hold on; fight on. A magnificent future is before you." The wonderful and marvelous development of the past is not to stop, but inevitably must continue. Electric railroading, city, town and suburban, is here for our upbuilding and natural prosperity as surely as steam railroading was fifty years ago. There are equally great opportunities for fame and fortune with this new agent as with the old. Let there be no uncertainty, no hesitancy.

The paper was ordered printed in full in the minutes of the meeting, on motion of Mr. Richardson.

Discussion.

H. F. MACGREGOR of Houston: I would like information upon the subject of guard wires. Mr. Mansfield rather says that the guard wires are an abomination. I would like to ascertain what has been found effective and simple and not a nuisance in the way of an obstruction in the street. Of course, additional wires are objectionable, but we must have them.

MR. MANSFIELD: When there is only one trolley wire to protect, we extend two light wires, about number fourteen, on each side of the trolley wire, and about eighteen inches above it, and from twelve to eighteen inches to each side. We suspend the longitudinal wires running parallel with the trolley wire upon an additional span wire. The additional span wire is insulated as perfectly as possible from the pole, and from the trolley span wire, and the longitudinal or guard wires proper are also insulated as far as possible from the span wire. In the case of two trolley wires, the general practice so far as I have observed is to stretch three guard wires, two of them outside the two trolley wires and to cover the center making all perfectly insulated from the other wires. We have never had any trouble from induction, for the reason that the guard wires are insulated from the trolley wire. I think as a protection to life and property they amount to a great deal. I think it necessary to put them up. Most municipalities require them to be put up, and as long as you keep them perfectly insulated from the trolley wire any extraneous wire which may fall will strike them, instead of the trolley wire, and will dangle in the street as a dead wire, which may be removed.

MR. MACGREGOR: Have your investigations led you to form an opinion as to the relative wear of sliding and rolling contact trolleys?

MR. MANSFIELD: No, sir. I believe only one road used a sliding contract trolley, and I think that has been abandoned.

MR. BICKFORD of Salem: I do not agree with Mr. Mansfield on the size of his guard wire. Number fourteen is too small. Nothing short of number ten should be put up as a guard wire.

MR. RAMSEY of Pittsburg: I wish to ask Mr. Mansfield how long he considers a number fourteen iron guard wire will last without rusting, so that it will be liable to break; and Mr. Bickford how long a number ten wire will last, in an atmosphere like Pittsburg, for instance?

MR. MANSFIELD: That is a troublesome question to answer; it be might several years.

MR. BICKFORD: My idea in the use of a number ten wire is not so much of its life, as its additional strength in supporting fallen wires, especially when loaded with sleet in winter. On a portion of my lines I had fallen telephone and telegraph wires on my guard wires for a long distance, and through it all we operated our cars without interruption. We used number ten steel wire.

MR. LITTELL of Buffalo: I wish to ask the gentleman if he does not think it advisable to cut up his guard wire into sections, of, say, one thousand or fifteen hundred feet, and put in circuit breakers; so that if any wire does fall, the current will not be sent a great distance.

MR. MANSFIELD: I would advise it, but it is not done on many roads. The West End road in Boston, I believe, has circuit breakers every five hundred feet. It is also done in Buffalo.

MR. WASON of Cleveland: Mr. McKinstry, who is manager of the telephone lines in Cleveland, informed me that his telephone wires in the center of the city did not last much over a year; sometimes a year and a half. In our span wires we used galvanized steel wire, and at the end of a year and a half they were rusted so much that we dared not tighten them up. We have chemical works and oil works in Cleveland, and we do not know whether the short life of the wire is due to the gases that come from these factories. I believe our road was the first one to use the soft drawn copper wires for span wire. We use soft drawn number four, the same as for ground work, that has been up now over a year, and there has been no perceptible elongation or stretching or sliding. When the storage battery will enable us to take down the span wire we will have something for scrap. Apparently the copper wire will not corrode, and the only objection I have ever

heard to [illegible] was the initial expense and the possibility of its stretching.

MR. RICHARDSON: I have had submitted to me a copper triangular tube, if I may so call it, intended to cover over the trolley wire and to guard it thoroughly from any interference with wires that might otherwise come in contact with it. I wish to ask what the gentlemen's judgment is of that device.

MR. MANSFIELD: I have looked into a great many methods of protecting the trolley wire outside of the stringing of additional wires; but I have not seen any which to my judgment would lead me to adopt it upon any road where my advice was asked. The trouble with most of these devices is that they entail heavy span wires and an additional strain upon the side poles for their support if you succeed in keeping them in place. In the winter, upon the top of these devices, there will be a large accumulation of ice and snow, which throws a greater weight upon the span wires and strain upon the side poles for their support; then again they are difficult to put in place and maintain in place. That is the result of my observations, and I do not think there is anything so good as what is generally accepted and used to-day.

The meeting adjourned until Thursday morning.

Thursday's Proceedings.

The meeting opened at 10:30 A. M.

The first business done was the appointing of the committee to nominate officers for the ensuing year and select a place of meeting for 1892.

The president appointed as the committee, Charles Cleminshaw, of Troy, N Y.; Thomas C. Barr, of Newark, N. J.; Robert McCulloch, of St. Louis, Mo.; Murry A. Verner, of Pittsburg, Pa.; C. Densmore Wyman, of New York, N. Y.; H. A. Everett, of Cleveland, O., and T. J. Minary, of Louisville, Ky. Invitations were made on behalf of Rochester, N. Y, Boston, Mass., Cleveland, O., and Houston, Texas.

The president announced the next order of business to be the report of the committee on "Public and State Treatment of Corporations," by Hon G Hilton Scribner, of New York city. In Mr. Scribner's absence, C. D. Wyman read the report.

The report was received, ordered placed on the minutes and a vote of thanks was passed to the author for the able paper he had presented.

THE INDEPENDENT—PRIMARY OR STORAGE BATTERY—SYSTEMS OF ELECTRIC MOTIVE POWER.

The next business was the report of the committee on "The Indepedent—Primary or Storage Battery—Systems of Electric Motive Power." An abstract of the report follows:

THE INDEPENDENT—STORAGE OR PRIMARY BATTERY—SYSTEMS OF ELECTRIC MOTIVE POWER.

BY KNIGHT NEFTEL.

Owing to a variety of causes the system which was assigned to me at the last convention to report on has made less material progress in a commercial way than its competitors.

So far, primary batteries have been applied only to the operation of the smallest stationary motors. Their application in the near future to traction may, I think, be entirely disregarded. Were it not a purely technical matter, it might be easily demonstrated with our knowledge of electro chemistry, that such an arrangement as an electric primary battery driving a car is an impossibility.

In view of the claims of certain inventors, I regret to be obliged to make so absolute a statement; but the results thus far have produced nothing of value.

The application of secondary or storage batteries to electric traction has been accomplished in a number of cities with a varying amount of success.

Roads equipped by batteries have now been sufficiently long in operation to allow us to draw some conclusions as to the practical results obtained, and what is possible in the near future

The advantages which have been demonstrated on Madison avenue in New York; Dubuque, Ia.; Washington, D. C., and elsewhere, may be summerized as follows:

First, the independent feature of the system. The cars are independent of each other, and are free from drawbacks of broken trolley wires; temporary stoppages at the power station; the grounding of one motor affecting other motors, and sudden and severe strains upon the machinery at the power station, such as frequently occur in direct systems; the absence of all street structures and repairs to the same and the loss by grounds and leakages are also very considerable advantages, both as to economy and satisfactory operation.

Secondly, the comparatively small space required for the power station. Each car being provided with two or more sets of batteries, they can be charged at a uniform rate without undue strain on the machinery of the power station, and as it can be done more rapidly than the discharge required for the operation of the motors, a less amount of general machinery is necessary for a given amount of work.

Another and important advantage of the system is the low pressure of the current used to supply the motors, and consequently the increased durability of the motor, and practically absolute safety to life from electrical shock.

It has been demonstrated also that the cars can be easily handled in the street, run at any desired speed, and reversed with far more safety to the armature of the motor than in the direct system. The increased weight requires simply more brake leverage.

The modern battery, improved in many of its details during the last year, is still an unknown quantity as to durability. There is the same doubt concerning this as there was at the time incandescent lamps were first introduced. [illegible] the phenomenal record [illegible] made by lamps grouped with other lamps. Similarly, some plates appear to be almost indestructible while others, made practically in the same manner, deteriorate within a very short time. It is consequently, very difficult to exactly and fairly place a limit on the life of the positive plates as yet. Speaking simply from observation of a large number of plates of various kinds, I am inclined to put the limit at about eight months, though it is claimed by some of the more prominent manufacturers—and undoubtedly it is true in special cases—that entire elements have lasted ten months and even longer.

It must be remembered, however, that the jolting and handling to which these batteries are subjected, in traction work increase the tendency to disintegrate, buckle and short circuit, and that the record of durability for this application can never be the same as for stationary work.

A serious inconvenience in the use of batteries in traction work is the necessary presence of the liquid in the jars. This causes the whole equipment to be somewhat cumbersome, and unless arranged with great care, and with a variety of devices lately designed, a source of considerable annoyance.

The connections between the plates, which formerly gave so much trouble by breaking off, have been perfected so as to prevent this difficulty, and the shape of the jars has been designed to prevent the spilling of the acid while car is running. The car seats are now practically hermetically sealed, so that the escaping gases are not offensive to the passengers.

The handling of the batteries is an exceedingly important consideration. Many devices have been invented to render this easy and cheap. I have witnessed the changing of batteries in a car, one set being taken out and a charged set replaced by four men in the short space of three minutes. This is accomplished by electrical elevators, which move the batteries opposite the car, and upon the platforms of which the discharged elements are again charged.

The general conclusions which the year's experience and progress have afforded us an opportunity to make may be summarized as follows: Storage battery cars are as yet applicable only to those roads which are practically level; where the direct system cannot be used, and where cable traction cannot be used, and applicable to these roads only at about the same cost as horse traction.

I feel justified in making this statement in view of the guaranties which some of the more prominent manufacturers of batteries are willing to enter into, and which practically insure the customer against loss due to deterioration of plates, leaving the question of the responsibility of the company the only one for him to look into.

The report was ordered placed on the minutes and filed.

DISCUSSION.

MR. BAUMHOFF, St. Louis: The company which I represent has experimented with the storage battery, and I must say that we have had no success. I believe our company was the second west of the Atlantic ocean to undertake these experiments. We had two cars, each equipped with 120 cells on an average grade of 2½ per cent., the steepest grade not over 3½ per cent. We were unable to get a greater mileage than 18 to 22 miles out of each charge. The charging of the cars required from eight to twelve hours.

We found also, that aside from leakage and the spilling of the liquid, the cells buckled and corroded; this was caused possibly by the acids. We expended a large sum of money in these experiments, but finally gave it up as a hopeless undertaking. The storage battery is certainly not a commercial success.

MR. NEFTEL: I believe the experiments the gentlemen refers to must were made at least four years ago. In the past four years a great change has come over everything connected with the storage battery. In the plates the shape has changed completely, and the storage battery of this day as manufactured by the leading companies is an entirely new thing. Great progress is going on in this direction, and we are not justified in throwing the thing aside as a failure. I remember five years ago, receiving a letter from the Thomson-Houston company, which I have preserved as a curiosity; asking me whether I thought electric traction would ever be successful, and whether it would pay an electric light company to manufacture motors for electric traction. In the light of developments already made in the general field of electric traction, we should not cast discredit on the storage battery.

MR. BARR, Newark, N. J: On this question of storage battery I only wish to refer to the road in Philadelphia, of which Mr. Sullivan is president. The Lehigh Avenue Passenger railway was built to operate storage battery cars. In May, 1890, the road started with six storage battery cars. In October, 1890, application was made to the city of Philadelphia council for the use of the overhead system, the company claiming that unless it could use it it would have to abandon the road. The council refused permission to the company to use the overhead wire, and on the first of January, 1891, the storage battery cars were abandoned and the road has since been operated by horse power.

MR. VHAY of Detroit: I represent a road which perhaps experimented with the storage battery system more than any other road in the country. The Woodward storage battery cars were put on our road for about one year and a half. The system worked very well; the cars ran at the rate of about twelve or fourteen miles an hour. The cost for coal was considerable, being $10 per day for one car. The trouble seems to have been that it takes from seven to ten hours to charge these plates, and it is not possible to make over thirty-five miles per day. They make about four trips. Some times they could get into the house, and sometimes they could not. There were no grades, but some sharp curves. We thought $10 a day for coal, and $2.50 for an engineer, when we were getting [illegible] commercial success.

[illegible] the work.

[illegible] run one [illegible] system in [illegible] charged batteries will be put in the car. The batteries can be charged [illegible] dragging them [illegible] taking along an unnecessary weight in lead.

The question of how expensive the system is going to be is controlled by the question of how often you are going to renew the positive plates. There are six cars on the line in Washington and nine in Dubuque. They have been running since early in May in Dubuque, and about three months in Washington. On certains portions of the road in Washington they are making fifteen miles an hour. If the experience of everybody connected with the cars is to be believed, they run regularly on their time, as regular as any other system, whether electric, cable or horse. I noticed in the paper that was read this morning that the question of comparative economy in running is stated to be about that of horses. We believe from what we know that it is consideraly less than horses, although we have no figures to show. We believe that in about one year it can be run in competition, so far as economy is concerned, with any overhead system.

When a car is run about twenty miles at the ordinary street car speed, it will take about two and one-half hours to charge the batteries; but practice has shown us that it is very foolish to draw out the entire charge of the battery. The question of how long the battery will run before it will absolutely break down, is not to be considered for a moment, because it is very bad practice. That is the usage which destroys the cells. If the cells are properly used in this respect, the batteries will last a long time, for many months. I know of one plant in Philadelphia in the lighting service that has run five years without change.

MR. MONTAGUE, Yonkers: I have seen within three months a storage battery car, not the Edco, that will take eighty five passengers on a sixteen foot car, and carry it up a grade of 10 per cent., and do it steadily and easily. It takes an hour and thirty minutes to charge batteries. They do not allow the batteries as a rule to run more than 20 or 22 miles; but on Decoration Day of this year three cars ran respectively, 42, 46 and 48 miles, and when they were run up to the power house the engineer had gone home, and they remained outside all night. In the morning there was sufficient power left in the batteries to take the cars in the power house. It takes about 30 seconds to charge the batteries. These cars run on level ground at a speed faster than most city governments will permit, and in mounting grades they go quite fast. On one occasion a car was mounting a grade with 30 people in it; I got out and walked along side of the car, and not until it had reached the top could I keep up with it. The grade was about 5 per cent.

MR. RICHARDSON: I want to state what seems to me to be a fair inference from what these gentlemen have told us, and from my own investigations on the subject, and that is, that the storage battery system seems only appropriate for roads running very few cars, and on a headway of perhaps ten or fifteen minutes.

MR. HOLMES of New York: I am not a delegate to the convention, but it seems to me that the gentlemen do not state what the power is that is put into the batteries, and what is taken out. I think that point has not been covered. Assuming that we have 100 horse power coming out of the generator into the station there is 10 per cent. of loss on the line of the trolley in the transmission of the power to the car in the street, so that of the 100 horse power that is developed at the generator only 90 per cent. is conveyed to the cars upon the street.

There is then a loss of about 25 per cent. out of the 90 in the motor, which reduces the net horse power developed by the motor under the car to about 68 horse power for the 100 at the station. Now we will take the storage batteries of the 100 horse power developed in the station: There is a loss, if I understand it aright, of nearly 30 per cent. in passing the current through the battery, making 70 per cent. of the power of the battery which is generated at the station. Then there is a loss of 25 per cent. on the motor, the same as in the trolley system, so that the power problem we have 53 per cent. in the battery, and [illegible] in the trolley. The difference in the battery and [illegible] the trolley car is vastly in favor of the latter, the relation being about 115 to 215; in other words the power that you have put to move the battery car is nearly twice as much as that required to move the trolley car, and therefore the consumption of coal is twice as much.

MR. [illegible]: I took for one week the [illegible] cars on the Dubuque road, and also measured at the dynamo the amount of power put into the batteries. I was enabled to get from the mileage of the cars [illegible] horse power it took per car mile, and it was [illegible] and one half per car mile. If the gentleman can get it lower by the trolley system I would be glad to know it.

MR. H[illegible]: We [illegible] power.

MR. [illegible] per cent. [illegible] think you can get any lower than that.

MR. [illegible]: I believe [illegible] useless. No doubt the future has such possibilities as [illegible]

[illegible] in the future that it will be possible to propel a car by electricity without tying it to a string from a station. The trouble is we do not see the [illegible] I [illegible] not think we can arrive at any satisfactory conclusion by continuing the discussion to day, with all respect to the storage battery people. We must bear in mind that both systems are using the same power, applied differently. I do not believe the convention has the facts before it at this time to intelligently deal with this subject. I think we can leave the matter for a time to those that are hard at work upon it.

E. A. SCOTT, Philadelphia: I am the representative of the company that has put in two successful plants in Dubuque, Ia., and Washington, D. C. We are now operating them as a commercial success. The gentlemen connected with those roads, if they are here, will probably tell you better than I, what the result has been. I have seen the changing of the plates done in Dubuque in about thirty seconds, so that the question whether a storage battery car will run 100 miles with recharging, or 50 miles, does not become a matter of importance. As Mr. Neftel stated, there is no more necessity to run a battery 100 miles than there is of making a span of horses pull a car that distance. You can work a pair of horses until they drop in their tracks, and you can work a battery until it becomes exhausted, but there is no necessity for either case. If you want to know whether any road can succeed take the successful roads that are running at the present time. Go to Washington and examine the road there, and you will be delighted with the way the cars run. As to the length of time it takes to charge a storage battery, it has been correctly stated that it takes as long to charge it as it does to discharge it. We calculate to run about 20 or 25 miles before we make a change of the batteries, and if they are run in that way in a road where grades do not exist beyond 5 or 6 per cent. there is no trouble.

MR. RICHARDSON: I differ from the remarks made by Mr. Crosby. We may not know all about the subject, as he evidently does, and it is for that reason that we wish to hear all we can. It is quite evident that, as I said before, the storage battery is suited at present only for small roads, with long headway. It would certainly not do for a road like Third avenue, in New York, where the headway is about one minute. I suppose also with reference to roads that run like the Pleasant Valley, in this city, with four different lines, one of them starting four miles from its power station, and also like the road of which I am president, which has ten different lines, with eight distinct depots and stables, it would not be applicable. The advantage of the trolley system is that all these roads could be run from one central power station, as I am told by competent engineers. I wish while on my feet to express the intense disappointment I felt in visiting the Frankfort electrical exposition this year. There was not a single exhibit to indicate the progress of electric traction in America. Several American firms had exhibits of appliances for electric lighing, but so far as I could see there was nothing to indicate the great strides we have made in electric railway matters.

RESOLUTIONS.

Mr. Wrenne then offerered the following resolution:

[illegible] character of the engine that gives [illegible] for traction purpose, would be of [illegible] association and as there is much [illegible] may be removed by investigation into [illegible] different companies in establishing active [illegible]

[illegible] that a committee of five be appointed which shall include the president and secretary, whose duty it shall be to [illegible] and report thereon. [illegible] members of the association will be of great value, the committee shall ascertain the information, make its report, and mail two printed copies thereof to [illegible] the first day of February, [illegible]

Mr. Littell of Buffalo, then offered the following resolution:

[illegible] association having learned that the collection of the statistics of electrical railroads for the [illegible] transferred to the Division [illegible] charge of A. R. Foote, special [illegible] industries, and [illegible] road construction and operation of such has of recent date been such that nearly three [illegible] the last census [illegible]

[illegible]

nomenclature for methods and parts, and a standard method of keeping accounts.

I shall not go into any discussion of the value of standard izing methods and things, feeling confident that there is a very general appreciation of the value of uniformity in so far as it can be attained without sacrifice in other directions.

First, let us consider the rating of electrical machinery. Thus far it has been common to speak of a machine as a fifteen horse power or twenty-five horse power motor, with scarcely any further suggestion of conditions under which it is supposed to operate. It must be borne in mind that an electric motor, like any other machine, a man, for instance, is capable of performing work at widely varying rates and widely varying efficiencies, and with widely varying factors of safety with respect to indefinite continuance of such a rate of work. It should further be borne in mind that an electric motor in particular is known to do its maximum rate of work when its efficiency is only fifty per cent ; that is, if twenty horse power represents the maximum rate of work, then forty electric horse power will be required to perform this work. A series motor such as is commonly used for railway work also must vary very widely in its speed while varying the quantity of work it performs per second. Now, this maximum quantity of work and the efficiency at which it is performed and the speed of the car connected with it are all matters of importance when we endeavor to get a really serviceable idea of what the machine can do, that is, of how nearly it can meet the conditions required by the particular service to which we wish to put it.

Will it serve the purpose best if we rate the machine according to its maximum capacity when its efficiency is fifty per cent., or according to some lower capacity at high efficiency, and at some speed as nearly as possble that at which the motor must be run during the greater part of its time at service? Should we use the maximum rating, we have the advantage of knowing at once very nearly what is the limit of service which the motor can perform; but, on the other hand, we fail to be told by such rating what the capacity of the machine is when doing the average work of our service.

There is at present no conventional uniformity controlling either the manufacturer or purchaser of electrical machinery in regard to these matters, which can be determined only by the custom of the trade, as it may grow up through years of uncertainty or as it may be directed to more rapid maturity by the action of such an association as this. We shall not, of course, be able at once, by any such formal action as we might take, to bring everybody concerned to an immediate acceptance of such standards as we might adopt. Yet, we will certainly go far towards hastening the time when some really definite and valuable information will be given to the purchaser when he is told that a motor is rated thus or so.

The first condition, which, in my opinion, should be connected by implication with any rating whatever is this: That the machine in question shall be able to perform its rated work indefinitely and under any condition of atmospheric temperature There is, of course, room for honest differences of opinion in regard to this point. It is well known that the maximum demands for power in street railway service are not those which last for a considerable length of time. A certain manufacturer may thus argue to himself: "This machine which I am about to advertise is able to do twenty horse power of work for half an hour, when the atmospheric temperature is ninety degrees. In my opinion this rate and time and temperature will not be exceeded in the conditions of regular service. Why, then, may I not call this a twenty horse power motor? It is true, if I were building it for stationary work in which generally the load to be carried is much more constant, I should adopt a different rating." Another manufacturer produces, perhaps, a machine of identical capacity with the one just considered, but taking a more conservative view of the matter, may feel it proper to give a rating in the neighborhood of fifteen or sixteen horse power, having in view that the machine shall be able to work at its normal capacity for an indefinite length of time, even if it were in service on the hottest day of the year known in the famous Fort Yuma. Machines of equal capacity are thus honestly put on the market at different ratings; and they may be in service on the same road without being actually subjected to such tests as would show their quality, the man who has rated high all the while getting credit for giving a more powerful piece of machinery than his competitor.

It would be possible to express the condition thus: That whatever the rate, it shall be possible to maintain that rate indefinitely under all conditions of atmospheric temperature by stating that the windings of the armature shall never show more than a given excess of heat over atmospheric temperature. A more general way of stating it, however, seems to me to serve the purpose quite as well.

There is again further room for honest difference of opinion in regard to the efficiency with which a motor can do its rated work. Suppose the manufacturer has produced a machine which can do its maximum work for an indefinite time without undue rise of temperature. There is to-day no custom of the trade distinctly understood which would prevent him from rating the machine by this maximum capacity. And, again, in stating that the machine is of fifteen horse power capacity, even if there be agreement concerning efficiency and duration, there might be disagreement of much importance in regard to speed at which its work can be performed by the motor. If it has been so constructed that it can do [illegible] power of work only at some armature speed corresponding to a linear speed of car, either much above or much below the average speed of the car, then the formation [illegible] may both be of little value for street railway service. Indeed, the use of the term "horse power" [illegible] uncertainty in it. The total [illegible] of foot pounds per minute namely 33,000, may

be made up in an infinite number of ways by an infinite number of combinations of feet of travel and pounds of pull. But for hour service we should have some known relation between these two.

It seems to me that that which the purchaser has in mind to obtain is such horizontal effort exerted at such a speed and at such an efficiency as will do the work in view. Now, the work in view varies very widely, and we cannot, therefore, obtain a convenient rating which will express this relation throughout the range of the total capacity of the motor. We may, however, select some particular conditions, say that approaching as nearly as possible to the average, and tell by a method of rating, which I will propose, what the machine can do for such condition.

Let us first consider the speed at which it is desirable to know the capacity of the motor. I think ten miles per hour is not far from the speed at which cars will be found most frequently running. If, then we state concerning a motor that it can develop so much horizontal effort at that speed, we at once have a pretty close approximation as to what load of car and passengers it can handle at that speed, since we know that twenty-five pounds per ton is a fair approximation to the average traction co efficient. Suppose, then, we are told that a motor can produce a horizontal effort of 500 pounds at ten miles an hour; it is then a quick inference that a car weighing twenty tons can be carried by such a motor at the rate of ten miles per hour on a level. We may then conveniently call this motor a "500x10."

If we further desire to get an approximate idea of what it will cost to do this work with a particular motor, we should know something of its efficiency. This can be conveniently expressed by adding another dimension Thus, say the motor is "500x10x60." The "60" indicates the efficiency percentage with which electrical energy from the line is transmitted into mechanical energy, and horizontal effort applied to the car.

It may, of course, at once be objected that such a method does not distinguish between efficiency of motor proper and the efficiency of its gearing. For a great many reasons this is not very objectionable. We buy the motor with its gearing, and I can see no particular reason why the manufacturer should not get the benefit or the blame of the good or bad gearing which he may use with his efficient or inefficient motor. Furthermore, in the single reduction motors now so widely used for ordinary street railway work, the loss by gearing transmission is very small, and probably not widely variant as between the different manufacturers. And again, in whatever high speed work which it may be feasible to do by gearless motors, the queston of efficiency or inefficiency of the gear is eliminated.

Again, it may be objected that such a method supposes uniform diameter of wheel, which must be known to the manufacturer in order that he may calculate what his motor is doing for a given car speed. Should there be no considerable variation from the thirty inch wheel now so largely used, such a diameter might be taken for granted as having entered the calculation; and if a different wheel, say thirty-three inch, becomes general, then that diameter may be assumed in the rating. I am not sure that the most frequent speed, supposed above to be ten miles per hour, is that which should enter into the service rating. It may be best to assume some lower speed at which the work is considerably heavier, and concerning the performance of which the purchaser is most doubtful

These particular points need further consideration than it has been possible for me to give them in the limited time of the preparation of this paper; and, indeed, I shall propose at the proper time that the whole matter of standards, which I endeavor here to treat only suggestively, shall be referred to a standardizing committee of this association.

In using such a method of rating as is here suggested, it may be well to allow the manufacturer to select the conditions which he prefers to express, and he, of course, must, in turn, always be ready to express the performances of his motor for other conditions of speed and efficiency which may seem important to the purchaser. The important point is that expression shall be given to the horizontal effort and speed at which it is developed, and to the efficiency of development.

It would, of course, in any such rating, be assumed that the machine is working under a pressure of 450 volts, which is not far from that found on most of the lines throughout this country. In the necessary regulation to which these motors are subjected, a part of this pressure is practically applied to some resistance, external or internal, with respect to the motor; but I can see no convenient way of taking this into account in determining upon a rating. Indeed, the action of a series motor in street railway service is very complex, and it is much more difficult than is sometimes supposed to determine upon a rating which shall give the greatest amount of valuable information. The very difficulty, however, is warrant for approaching the subject seriously and industriously.

I think it useless to attempt any change in the rating of dynamos. Their work is so much more regular than the work of a motor that the present rating in horse powers or watts seems to answer the purpose fairly well. Nor has it occurred to me as advisable to extend this rating of watts to motors, as it will be a matter of difficulty to introduce a comparatively unfamiliar term and apply it to a machine whose capacity must constantly be talked about, and which, as above stated, works under very complex conditions.

Second: I feel that the time has now come when some of the physical dimensions of electric cars may, with benefit to all, be standardized As to how far such standardization should go, committees of this association can best determine. The guiding principle it seems to me should be this: That standardization of parts should be so directed as not to interfere with the progress of invention. Bearing this in mind, may we not at this stage of devel-

opment have a standard axle diameter for cars of a given weight? Also standard key weights for gears? And while there is some uncertainty in my mind on this point, may we not have a standard gearing? It of course involves uniformity in the reduction ratio between speed of the armature and speed of the car. There is, however, now no very great difference in this respect, and the possibility of uniformity is at least worth considering.

Coming to trolley apparatus, we might have uniform poles, pole sockets, and uniform diameter of pole at the butt; also uniform length of pole and uniform diameter of trolley wheel.

It may be possible to go farther into this standardization of dimensions of parts of the truck which are not directly connected with the electric apparatus. I think it best, however, to leave that to those more familiar with truck manufacture.

It will be seen that the suggested number of standard dimensions in electrical apparatus, which thus far seems possible, is not large. Yet, certainly, uniformity of axle diameter and key weights alone would be found of much value to all interested in the business. Should this association adopt such standards, it is, of course, understood that any manufacturer who thinks he has good reason to vary from them will do so, presenting to the trade his justification for such action. It seems, however, beyond question, that a number of these points, in which there is no mystery whatever, may just as well be determined by the direct users of apparatus as by the designers, and may thus be determined once for all.

Third: In regard to standardizing nomenclature, the object is to save what may be called "lost motion" in the verbal and written correspondence incident to our business. The importance of some such effort was emphasized to me some time ago when, on reading a carefully drawn set of instructions to linemen prepared by an engineer of the Thomson-Houston Electric company. I could see that those instructions would scarcely be intelligible to a man whose experience had been confined to the material of an other company, say that of the Edison company, although the things talked about might be entirely familiar to him. Besides causing annoying repetition and much explanation between men really understanding very well the thing in question, this uncertainty of nomenclature may at times stand seriously in the way of the proper interpretation of written contracts, or of orders received by dealers.

While the adoption of a set of definitions by this association would in no sense be binding, it would yet tend to make definite that which is now indefinite. As a basis upon which some further and better work in this direction should be done, I give herewith a table showing list of proposed terms, with various terms heretofore used as equivalents, and definitions properly limiting the proposed terms. In some cases when there has been satisfactory uniformity, no equivalents are given, but definitions are suggested. The list can, with benefit, be considerably extended.

NOMENCLATURE OF ELECTRIC RAILWAY TERMS.

Generator.—(Generator, dynamo.) Machine in which the electric current is generated.
Motor.—(Motor.) Machine in which the electric current is transformed into mechanical power.
Frame.—(Frame.) Iron body of machine, including pole pieces and standards or side arms, if any, but not including base plates and bearings.
Standards.—(Standard bracket.) Supports of the bearings of generator.
Side Arms.—(Side arms, check pieces, armature bracket.) Supports of bearing railway motors.
Pole Pieces.—(Pole pieces.) That part of frame from whose surface lines of force may pass directly to the armature.
Field Coil.—(Field coil, spool.) Coils of wire wound on frame in such a way that a current passing through these coils makes magnets of the frame and the pole pieces.
Brush Holder.—Device for holding the brushes in contact with the commutator, including the insulation used in its support.
Rocker Arms of—(Yoke, rocker arm.) Device for holding brush holders in position on commutator while attaching it directly or indirectly to the frame.
Fuse.—(Fuse, fusible plug.) A metal device for opening circuit when the current becomes abnormally large, the soft metal being melted by a current of fixed quantity.
Switch.—A device for closing or opening a circuit at one or more points.
Rheostat.—(Resistance box, rheostat.) Wire or other material suitably protected and conveniently arranged to be introduced in more or less proportion into a circuit.
Trolley.—(Trolley contact bar.) A device used to transmit the electric current from the overhead wire to the cars, consisting usually of a
Trolley Wheel.—A small metal wheel making rolling contact with the overhead wire.
Trolley Fork.—Mechanically connecting trolley wheel to
Trolley Pole.—Supporting the trolley fork and wheel, and resting in a socket, which is part of the
Trolley Base Frame.
Trolley Wire.—Wire from which the trolley wheel directly receives current.
Trolley Frog.—(Frog, overhead switch, trolley switch.) A device used to fasten or hold together the trolley wires at a point where the trolley wire branches, and to guide, ordinarily, automatically the trolley wheel along the wire over the track taken by the car.
Trolley Frog.—Standard frog.) A frog designed for use at a point where two branch lines make equal convergent angles with the main line.
Right Hand Trolley Frog.—A trolley frog designed for use at a point where a branch trolley wire leaves the main line to the right in the going direction
Three Way Trolley Frog.—A trolley frog for use at a point where the line branches in three directions.
Draw bridge Cross over.—A device permitting the easy passage of a trolley wheel from one to the other of two adjacent wires in a continuous direction.
Trolley Crossing.—(Crossing frog, cross over.) A device placed at the crossing of two trolley wires, by which the trolley wheel running on one wire may cross the other, the device also holding the two trolley wires together.
Insulated Trolley Crossing.—A device placed at the crossing of two trolley wires, by which the two wires are insulated from each other and by which the trolley wheel running on one line may cross the other.
Hanger.—(Line insulator, line suspension, trolley insulator.) A device for supporting and insulating the trolley wire.
Straight Line Hanger.—The hanger used on a straight line and supported from a span wire, the strain on same being essentially vertical.
Single Curve Hanger.—The hanger supported by a lateral strain in one direction and, ordinarily, on single track curves, except at ends and the inside curve of double track.
Double Curve Hanger.—The hanger supported by lateral strain in opposite directions, used ordinarily at ends of both single and double curves and at intermediate points, [illegible] double track curves.
Feeder Clamp.—Clamp with a [illegible] which a feeder [illegible] connected to the trolley wire.
Feeder.—A [illegible] for transmitting [illegible] from the power station to the mains or the trolley wire descent.
Mains.—Wires usually [illegible] for the [illegible] current from the feeders to the trolley wire through tap wires.
Tap Wires.—Wires [illegible] current from [illegible] pole to a near point of the trolley wire.
Trolley Section.—A length of the trolley wire [illegible]
Line Section.—A part of the [illegible] insulated from other parts as to permit the supply of power to be separately controlled.
Section Box.—A [illegible] control of a trolley section or line section.

Fourth: In regard to standard methods of keeping accounts, I am permitted to present herewith information prepared by W. E. Baker, of the Thomson-Houston Electric company, long in charge of the work of maintaining motors and lines for the West End Street Railway company. Whether or not this association should take any action, such as recommending one or another method of keeping accounts, I feel sure that Mr. Baker's suggestions will be of value to those who will consult them. There is no special reason why the association should act with a view to obtaining standards in this respect, save that it will certainly facilitate in a great measure the obtaining of reliable statistics. Any one who will endeavor, as I have recently done, to get together a considerable volume of actual, reliable data on the operation of street railways, will be convinced that much remains to be done in this respect. Of the value of such garnered information I think there can be no doubt; and I am quite satisfied that this association will find itself thoroughly repaid for any efforts it may make toward the accumulation of street railway statistics. Mr. Baker writes as follows on the "Accounts and Organization of Electric Street Railways:"

"In presenting this paper, it is not offered as a treatise covering the ground of a rather pretentious title. There are many excellent and extensive works on railroad accounts in existence which ably discuss this large and important question in all its general aspects, and which apply as well to electric as to steam roads. This paper is offered rather from the standpoint of the superintendent or manager than the auditor, and in the hope only that it will prove a practical aid to the keeping of expense accounts of electric railways of about the extent and organization of the average of those at present in existence, although it is believed that the principles herein outlined are correct, and their extension to a road of any size is only a matter of increasing the details.

"It is also hoped that some of the blanks and forms for reports furnished herewith will be an aid to some who, the author knows, have found some trouble in this direction.

"From the superintendent or manager's point of view, the matter to be arrived at is to have presented to him, in a concise and correct form, such a statement of the operating expenses as will enable him by careful study of the figures to reduce expenses, to compare the operation of his road with that of others, and in general to enable him to exercise such care and watchfulness over the outgo and income as will render the enterprise a commercial success. The price to be paid for the success of an electric road is eternal vigilance and a 'stitch in time.'

"The first and most important matter in the expense accounts is the classification or division of expenses and the second practical matter is how to separate into these divisions the expenses, without too much detail or clerical labor. For this purpose a manual should be carefully prepared.

"In this manual there should appear four general divisions of expenses, namely: General expense, transportation expense, maintenance of way and buildings and maintenance of equipment. Under these are subdivisions, and under each are clearly expressed the proper labor or material to be charged to them.

"Statements are frequently seen about as follows: Motive power at so much per mile; car repair at so much per mile; and, frequently, conductors and motor men's wages, being a very large single item, appears by itself, and the statement winds up with 'other expenses' at so much per car mile.

"Now unless it is clearly understood what is included in the term 'Motive Power,' or the term 'Car Repairs,' or the term 'Other Expenses,' such statements are apt to be very misleading.

"Does 'Motive Power' include the power house expenses only? It may or may not. Does 'Car Repairs' include the repairs on the car bodies only, or the repairs also on the motors? It is clearly necessary to have these matters defined and in the manual before referred to all this should appear in detail.

"If, then, the classification in this manual is followed, and a statement is presented that general expenses, transportation expenses, maintenance or way and building expenses and maintenance of equipment expenses, are each so much per car mile or per month, it will be found by reference to the manual just what expenses are included in each of these items. It will also be found advisable that in a general way the divisions of expenses in this manual should be made in such a way, that the first two general divisions include those expenses which do not add to the value of the property, and the last two general divisions include those expenses that do so add in some degree to the value of the property.

"For instance, it adds nothing to the value of the property to pay conductors and motor men, wages, although it may add to its earnings. It adds nothing to pay clerks' salaries, insurance, or to pay for wrecking or getting derailed cars on the tracks; while it does add to the value of the property more or less to renew the rails and ties, paving, to repair the armatures and steam plant. Or, it would perhaps be better to express it in this way: That the expenses on the last two divisions tend to keep the road in its original state of completeness as when first equipped. In whatever way the expenses are kept, for an intelligent understanding of them, they should be based on a written manual of this nature

"With this as a basis and by following methods similar [illegible]

[illegible] tion is expressed in four different manners, namely per cent. of expenses to earnings, net earning, expense per car mile and [illegible] certain value for comparison. Neither alone tells the whole story.

"There has [illegible] gard to a [illegible] electric roads. It may be doubtful if such standard units can be satisfactorily agreed upon or will satisfactorily express the result; but at any rate, it must be composed of some function of the results of operation as expressed in this blank.

"The next matter is how to arrive at and keep these expenses sufficiently accurate and without too much clerical labor; and this brings us primarily to the Stock or Supply Account. All material while in the stock room and until used evidently bears the same relation to the company as cash in till or bank, except for availability, and should be so treated. Material should not be charged to the Expenses of the Road until used, and should be charged, when used, regardless of [illegible] received or paid.

"A careful record should be kept of all material received and all material used, on blanks somewhat similar to forms 'E' and 'D,' bound in book form and herewith presented. It is sometimes considered better to have the form 'D' on loose sheets instead of bound, and there are variations to be made in the blank to suit individual cases that will be apparent.

"The Material Received book or form 'E' will be found to pay for itself in checking bills and preventing duplication. The material used is arrived at by charging it out of the stock room on foreman requisition in small quantities as usual, or obliging a foreman to make a daily or weekly or monthly report of the materials he uses on a proper form. A simple form is that of form 'F' herewith. One man should receive all the material for the road; he may of course be a storekeeper for this purpose, if the road is sufficiently extensive; or if not, this duty may be added to the other duties of the clerk.

"An invoice book with copies of all bills should be kept, and a monthly summary of both books will be made, giving from the Invoice Book all the charges to stock, and from the Material Used all the credit to stock and all the charges of material to Expense properly classified. If, in addition, a stock ledger is kept it will be found that all errors and mistakes in foremen's and in clerk's pricing, etc., will correct themselves, and it will be easy at any time to check up the ledger with the material actually on hand in the stock room.

"In regard to the labor, there are many forms of time books used; the one here presented as form 'P' is convenient, and the foremen soon learn to classify their time with little trouble and few mistakes. On the Pay Roll should be classified these expenses, and the total of all expenses is easily arrived at.

"The mileage sheets, form 'A,' will be found very complete, and will give a record of the mileage of each car per month. The original records can be taken from the conductors' reports most easily on a blank book, and transferred to these reports monthly. The conductors' reports should cover a report of the number of passengers carried on each trip, the number of trips made, and the route. There are many excellent forms for these.

"To summarize: If the superintendent, as is frequently the case, has an office distinct from the office of the company, he would be required to have the following books: Stock Ledger, Time Books, Pay Rolls, Material Used and Material Received books; and copy books as follows will be a convenient arrangement: A letter book, a copy book for pay rolls a requisition book, unless he buys his own supplies wholly, when this becomes an order book, a Daily Report of Earnings book or deposit book, a Motor Book for copying reports made on a blank form 'S,' and a statement and bill copying book for bills made against other parties; and the monthly reports to be made will be about as follows: Mileage Report, Material Used Report, Balance Stock Ledger, Receipts Report, Invoice Summary. The daily reports would be of daily earnings and of condition of motor cars.

"No treatment has been attempted of the general books of the company, the income accounts, etc., as these are generally well understood, and the remarks generally are only elementary; but I have been led to make them by some samples I have had the misfortune to examine when endeavoring to arrive at the expenses of a road."

Under Mr. Baker's direction a manual for the classification of expenditures was prepared by H. L. Bettis and used with very excellent results. This manual will be presented to the public in print at a later day. Although that which has been said above by Mr. Baker and myself cannot be considered as more than a series of suggestions, this paper has evidently reached the limit of its proper length for presentation before this body.

DISCUSSION.

At the conclusion of the report [illegible] that a committee on stand[illegible] ture, dimensions and [illegible] appointed by the association.

MR. MACFARREN, of Pittsburg: I have long felt the necessity for some uniformity in this respect and it is time, in my opinion, that [illegible] to keep in rank with similar societies, which have all adopted meth[illegible] that no matter of [illegible] association, so that [illegible]

[illegible] the committee to consist of seven members, including the president and secretary.

[illegible]

Mr. Eppley of Orange presented the following reso- [illegible]

[illegible]

[illegible] day [illegible]

Secretary.

Mr. Henry of Pittsburg, presented this resolution, [illegible] was adopted.

[illegible] the American Street Railway as- [illegible] the Boston Lines [illegible] New York and New England [illegible] Passenger association and Trunk [illegible] reduced rates of fare to those in attendance at the tenth annual meeting of the association [illegible]

Resolved, that the association respectfully urges upon the Western Passenger association that the same courtesy be extended to the [illegible] traffic associations in order [illegible] extensive [illegible] membership.

ELECTION OF OFFICERS.

The committee on nominations reported in favor of the following officers for the year 1891–2: President, John G. Holmes, Pittsburg, Pa.; first vice-president, Thomas H. McLean, New York, N. Y.; second vice president, James B Speed, Louisville, Ky.; third vice-president, Albion E. Lang, Toledo, O.; secretary and treasurer, Wm. J. Richardson, Brooklyn, N. Y.; executive committee, Henry M. Watson, Buffalo, N. Y.; Lewis Perrine, Jr., Trenton, N J; W. Worth Bean, St Joseph, Mich.; Murry A. Verner, Pittsburg, Pa.; Thomas C. Pennington, Chicago, Ill.

The committee also recommended Cleveland, O., as the place for the next meeting. The recommendations were in both cases ratified by the convention.

The following resolution was adopted:

[illegible] with the recommendation of the [illegible] in the report, the question of the [illegible] the executive committee whose duty it shall be to take under advisement the question of hotel accommodations [illegible] as an inducement for the association to go to any city; and as soon as the selection is made, the secretary be re- [illegible]

The chair appointed Messrs. Littell of Buffalo and Richardson of Brooklyn a committee to escort the newly-elected president to the chair.

Mr. Watson, the retiring president, presented Mr Holmes to the association, and the latter briefly thanked the convention for the honor conferred upon him.

The convention then adjourned.

The New President.

John G. Holmes, the new president of the American Street Railway association, is president of the Citizens' Traction company of Pittsburg and one of the best known and most successful street railway magnates in the Smoky City. He was born in Pittsburg, and comes from a family that has been identified with the street railway interests of that city ever since the running of the first horse car in 1859 his father, Nathaniel Holmes, having been a moving spirit in its organization He was educated at Dickinson College, Carlisle, Pa., and began his business career in 18[illegible]6, in the [illegible] Holmes [illegible], and is now the senior member of the firm. This is the oldest banking house in [illegible]

Mr. Holmes began his street railway career in 18[illegible], when, as a boy thirteen years old, he affixed the seal and [illegible] newly organized Citizens' Passenger Railway company, which built the first street railway west of the Allegheny mountains. This road began at the corner of Penn and Sixth streets, in what was then the [illegible] extended from Penn avenue, [illegible] Allegheny River, to Lawrenceville, where the United States arsenal is now located. In 1871 Mr. Holmes was elected treasurer of the company, [illegible] office which he has [illegible] The road [illegible] the 25 [illegible] operated by electricity, [illegible] one of the best paving [illegible]

Delegates in Attendance.

[illegible]

Bartlett, Chas. H., treasurer Manchester Street Railway company.... ....Manchester, N. H.
Bartlett, A., superintendent Consolidated Street Railway company.......... .... Syracuse, N. Y.
Baumhoff, George W., superintendent Lindell Railway company ... . St. Louis, Mo.
Beadle, George, proprietor Petersburg Street Railway company .. .. .Petersburg, Va.
Bean, W. Worth, president St. Joseph & Benton Harbor Railway company....... .. St. Joseph, Mich.
Bichford, J. H., engineer Scranton Street Railway company .... Scranton, Pa.
Bigelow, Thomas S., vice-president Pittsburg Traction company..... ....Pittsburg, Pa
Blackwell, Jonathan H., director City Railway company................ ....Trenton, N. J.
Bogarto, H M., director Attleboro, North Attleboro & Wrentham Street Railway company. Attleboro, Mass.
Brady, John C., vice-president Erie Electric Motor company.................. ....Erie, Pa.
Bronsdon, W. H., general superintendent Union Railroad company .Providence R. I.
Browning, G. Geroge, treasurer Camden Horse Railroad company.................... Camden, N. J
Bullock, George, vice-president South Covington & Cincinnati Street Railway company....Covington, Ky.
Bullock, George, director Cincinnati Street Railway company ....Cincinnati, O.
Burgett, Henry W., vice-president and treasurer Union Street Railroad company.........Dover, N. H.
Burleigh, J. J., electrician Camden Horse Railroad company ....Camden, N. J.
Burr, Allston, Brockton Street Railway company, ...Brockton Mass.

Campbell, H. M , attorney Detroit Citizens' Street Railway company .. ..Detroit, Mich.
Carpenter, Reid, treasurer Citizens' Electric Railway, L. & P. company.. ... .Mansfield, O.
Chapin, J. B., superintendent Worcester Consolidated Street Railway company...........Worcester, Mass.
Chapman, James R., vice-president Consolidated Street Railway company.........Grand Rapids, Mich.
Charlton, B E., president Hamilton Street Railway company......................... Hamilton, Ont.
Clark, F. H., director Eckington & S. H. Railway company........................Washington. D. C.
Clegg, C. B., president Oakwood Street Railway company ... . .Dayton, O
Cleminshaw, Charles, general manager Troy & Lansingburg Railway company. ....Troy, N. Y.
Cottrell, E. W., Detroit Citizens' Street Railway company ....Detroit, Mich.
Coyle, John A., president Lancaster City Railway company.............................Lancaster, Pa.
Cronyn, V., president London Street Railway, ...London, Canada.
Crosby, O. T., president Utica Belt Line Railway company.....................Utica, N. Y.

Davis, H. J., secretary and treasurer Brooklyn Street Railway company... .... Cleveland, O.
Davis, E. W., superintendent Pittsburg Traction company... ... ... Pittsburg, Pa.
Delany, W. H., director North & East River Railroad.. ... ... New York, N. Y.
Dickie, A. W., superintendent cars and brakes, Brooklyn City Railroad company..... Brooklyn, N. Y.
Douglass, E. P , director McKeesport & Reynoldton Passenger Railway company.. ... McKeesport, Pa.
Dunloys, G. T , Washington & Georgetown Railway company........................Washington, D. C.
Durbin, C. K , superintendent Denver Tramway company.......... .... Denver, Colo.
Duty, Edwin, superintendent East Cleveland Railroad company.... ....Cleveland, O.

Edwards, E. B., president Ridge Avenue Passenger Railway company................. Philadelphia, Pa.
Elkins, George W., president Pittsburg Traction company ... ... Pittsburg, Pa.
Ellis, Charles E., president Citizens' Passenger Railway company.... ....Philadelphia, Pa.
Eppley, Francis M , president Orange, Crosstown & [illegible] Railway company ..... Orange, N. J.
Everett, H A , secretary and treasurer East Cleveland Railroad company......................Cleveland, O.
Everett, A., president East Cleveland Railroad company. .. .. Cleveland, O
Everett, H. A., general manager Toronto Railway company.............. .... .Toronto, Can.

Fenner, Samuel J., superintendent Camden Horse Railroad company......................Camden, N. J.
Ferguson, W. B , director Worcester, Leicester, & Spencer Railroad company Worcester, Mass
[illegible], electrical engineer Newark Passenger Railway company, Newark & South Orange Railroad company...................... ...Newark, N J.
[illegible] president [illegible] Street and Grand [illegible] .... New York, N. Y.
[illegible], treasurer Nashua Street Railway [illegible] Nashua, N. H.
[illegible] director Lancaster City Railway company [illegible] Lancaster, Pa
[illegible] company [illegible] Louis, Mo.
[illegible] company [illegible] Pa
[illegible]
[illegible]
[illegible]

Gormly, C. M., secretary Citizens' Traction company .... Pittsburg, Pa.
Graham, Wm. H., secretary Federal Street & Pleasant Valley Passenger Railway company......Pittsburg, Pa.
Griffith, T. E., secretary Hamilton Street Railway company .... Hamilton Ont
Guild, C. F , president Attleboro, North Attleboro & Wrentham Street Railway company...Attleboro, Mass.
Gunn, James, secretary Toronto Railway company .. .. Toronto, Can.

Haines, Wm., superintendent Williamsport Passenger Railway company.... ....Williamsport, Pa.
Hamilton, D. R., president St. Louis Railway company . .. ... St. Louis, Mo.
Hanna, M. A , president Woodland Avenue & West Side Street Railroad company........... Cleveland, O.
Hanna, J. B., secretary Woodland Avenue & West Side Street Railroad company....... ...Cleveland, O.
Harrington, W. E., superintendent Wheeling Railway company..................... ..Wheeling, W. Va.
Harris, John, superintendent Cincinnati Street Railway company.........................Cincinnati, O.
Hasbrouch, D. B., secretary Houston & W. Pavonia Railway company..........New York, N. Y.
Hathaway, Charles, president Cleveland City Cable Railway company .. .. Cleveland, O.
Henry, D. F., president Federal Street & Pleasant Valley Passenger Railway company......Pittsburg, Pa.
Hill, B. V., superintendent Trenton Railroad company .. .. Trenton, N. J
Hineman E. S , treasurer Fort Wayne & Elmwood Railway company......................Detroit, Mich.
Hippee, G. B., secretary Des Moines Street Railway company..........................Des Moines, Ia.
Holmes, John G., president Citizens' Traction company................................Pittsburg, Pa.
Holton, H., president Derby Street Railway company... ....Birmingham, Conn.
House William A., Jr , general manager Baltimore Traction company ... ...Baltimore, Md.
Hurd, F., president Bridgeport Horse Railway company. .... Bridgeport, Conn.
Hurley, P. E , assistant superintendent City Railway company.. ....Trenton, N. J.

Jenkins, T. M., superintendent South Covington & Cincinnati Street Railway company ...Covington, Ky.
Jenkins, John G , director Atlantic Avenue Railroad company and Broadway Railroad company ....Brooklyn, N. Y
Jewell, W. S., superintendent Citizens' Street Railway..............................Indianapolis, Ind.
Johnson, Thomas H., director Newburyport & Amesbury Horse Railroad company.....Newburyport, Mass.
Johnson, J. H., president City & Suburban Railway company.........................Savannah, Ga.
Jones, Geo. S., director Milwaukee Street Railway company. ....Milwaukee, Wis.

Keily, George W., president Toronto Railway company......... .. ..Toronto, Can.
Kelsey, Israel A.. president New Haven & West Haven Horse Railroad company.. West Haven, Conn.
Kennedy, D. J., president Cicero & Proviso Street Railway company.....................Chicago, Ill.
Kerper, George B , president Findlay Street Railway company..................................Findlay, O.
Kidder, Willard, vice president Terre Haute Street Railway company................Terre Haute, Ind.
Kidder, C , director Terre Haute Street Railway company .. .. Terre Haute, Ind.
Knowles, G. H , general manager Nashua Street Railway.............................Nashua, N. H.

Lang, Albion E., vice-president Toledo Consolidated Street Railway company.................Toledo, O.
Larius, William H., president York Street Railway company........ ... ...York, Pa.
Lasher, T. B., secretary and treasurer Bridgeport Horse Railway company............Bridgeport, Conn.
Lee, Preston, vice president Wilmington City Railway company......... ....Wilmington, Del.
Lewis, D. F., president Brooklyn City Railroad company................................Brooklyn, N. Y.
Lincoln, Fred H., electric engineer Toledo Consolidated Street Railway company ......Toledo, O.
Littell, H M , general manager Cincinnati Inclined Plane Railway company....... .... Cincinnati, O.
Loughridge, W. J., vice-president Passenger & Belt Railway company......................Lexington, Ky.
Lowry, Thomas, president Minneapolis Street Railway company and St Paul City Railway company ....Minneapolis, Minn,

MacJarren S. L., secretary and general manager Schenley Park & Highlands Railway company ....Pittsburg Pa.
MacGregor, H. F., general manager Houston City Street Railway company...............Houston, Tex.
Magee, C. L., president Duquesne Traction company ....Pittsburg, Pa.
Mahony, John, vice president People's Railway company.................................St. Louis, Mo.
Manning, Thomas S., director Citizens' Passenger Railway company. .. . Philadelphia, Pa.
Mansfield, George W., director Attleboro, North Attleboro & Wrentham Street Railway company, ... Attleboro, Mass.
Moran, W. W., treasurer Omaha Street Railway company .... Omaha, Neb.
[illegible] Omaha Street Railway company . . .. Omaha Neb.
Martin, Henry, president Mt. Auburn Railway company ...Cincinnati, O
[illegible], Central Crosstown [illegible] company . New York, N. Y.

Matlack, Chas. D., secretary Second and Third Street Railway company..................Philadelphia, Pa.
McCarrick, James W., director Norfolk City Railroad company..........................Norfolk, Va.
McCulloch, Robert, vice-president Benton Bellefontaine Railway company, Cass Avenue & Fair Grounds Railway company, Citizens' Railway company, and general manager St. Louis Railway company..............................St. Louis, Mo.
McIntire, L. H., engineer and manager Harlem Bridge, M. & F. Railway company....New York, N.Y.
McKee, H. Sellers, chairman executive committee Rochester Railway company..........Rochester, N. Y.
McKenzie, William, vice-president Toronto Railway company..........................Toronto, Can.
McLean, Thomas H., secretary Twenty-third Street Railroad company................New York, N. Y.
Miller, N. G., director Norfolk City Railroad company..................................Norfolk, Va.
Minary, T. J., general manager Louisville Railway company..........................Louisville, Ky.
Minary, C. K., general manager Rochester Railway company........ ....Rochester, N. Y.
Moore, E. J., president Lombard & South Street Railway company..................Philadelphia, Pa.
Morse, George C., superintendent Taunton Street Railway company.................Taunton, Mass.
Morton, N. E., superintendent Merrimac V. H. Railway company, and Naumkeag Street Railway company.................................Salem, Mass.
Nagel, Charles F., superintendent West Chicago Street Railroad company...............Chicago, Ill.
Norvell, S. T., president Duglass County Street Railway company................West Superior, Wis.
Odell, J. J., director Consolidated Street Railway company.........................Grand Rapids, Mich.
Odell, Charles, president Newburyport & Amesbury Horse Railroad company.........Newburyport, Mass.
Owen, B. J., president Reading City Passenger Railway company..........................Reading, Pa.
Paine, Henry C., vice-president Milwaukee Street Railway company..................Milwaukee, Wis
Parker, R. F, treasurer Columbia Railway company ....Washington, D C.
Parsons, George, director City & Suburban Railway company.... ....Savannah, Ga.
Parsons, Parry, engineer City & Suburban Railway company............................Savannah, Ga.
Peavey, James F., president Sioux City Street Railway company.........................Sioux City, Ia.
Perkins, G. B, director Toledo Electric Street Railway company.........................Toledo, O.
Pennington, T. C., treasurer Chicago City Railway company.............................Chicago, Ill.
Perrine, Lewis, Jr., president Trenton Horse Railroad company.........................Trenton, N. J.
Pfetch, J. F., general manager Erie Electric Motor company....................................Erie, Pa.
Polk, J. S, president Des Moines Street Railroad company.............................Des Moines, Ia.
Porter, B. W., superintendent Derby Street Railway company.......................Birmingham, Conn.
Price, G. M. secretary New Brunswick City Railway. ....New Brunswick, N. J.
Quaid, A. H, superintendent Cicero & Proviso Street Railway company.......................Chicago, Ill.
Ramsay, Wm. McC., electrical superintendent Federal Street & Pleasant Valley Passenger Railway company..................................Pittsburg, Pa.
Reed, J. W., auditor Pittsburg Traction company ....Pittsburg, Pa.
Reid, W. R., superintendent Salt Lake City Railway company.......................Salt Lake City, Utah
Rhoads, H. R., president Williamsport Passenger Railway company..........................Williamsport, Pa.
Richardson, Wm., acting president D D E. B. and R. R. company...................New York, N. Y.
Richardson, William, president Atlantic Avenue Railroad company...................Brooklyn, N. Y.
Richardson, William J, secretary Atlantic Avenue Railroad company...................Brooklyn, N Y
Robison, D., Jr., president Toledo Electric Street Railway company............................Toledo, O.
Robison, J. J., secretary Toledo Electric Street Railway company..............................Toledo, O.
Roebling, F. W., director City Railway company ....Trenton, N. J.
Rogers, A. D., president Columbus Consolidated Street Railway company................Cleveland, O.
Rogers, A. H., director Metropolitan Railway company....................................Springfield, Mo.
Romaine, H., vice-president Paterson Railway company........... ....Paterson, N. J.
Rude, Clark, president Citizens' Electric Railway, L. & P. company.................................Mansfield, O.
Rugg, J. E, superintendent Citizens' Traction company.......................................Pittsburg, Pa.
Rulon, Thos. D, superintendent car department Second and Third Street Railway company ....Philadelphia, Pa.
Russell, B. W., director Newburyport & Amesbury Horse Railroad company.........Newburyport, Mass.
Sage, Henry A., president Easton, S. E. & W. E. Passenger Railway company.................. Easton, Pa.
Sawyer, William D., president Union Street Railroad company........ ....Dover, N. H.
Schloss, S, vice-president Fort Wayne & Elmwood Railroad company.......................Detroit, Mich.
Scull, William S., Camden Horse Railroad company. ....Camden, N. J.
Scullin, John, president Union Depot Railway.... ....St. Louis, Mo.
Shaw, E. P., Jr., general manager Black Rock & Salisbury Railway................Newburyport, Mass.
Sinclair, W. H., president Galveston City Railway company...................................Galveston, Tex.
Smallman, Thomas H., director London Street Railway....................................London, Canada.
Smith, W. A., general manager Omaha Street Rail way company........ ....Omaha, Neb.
Smith, J. C., president McKeesport & Reynoldton Passenger Railway company............McKeesport, Pa.
Smith, R. H., superintendent Passenger & Belt Railway company.......................Lexington, Ky.
Smith, Charles, superintendent Findlay Street Railway company.....................................Findlay, O.
Smith, Charles H., superintendent Troy & Lansingburg Railway company.............. ....Troy, N. Y.
Smith, Frank B., secretary Metropolitan Railway company........ ....Springfield, Mo.
Speed, J. B., president Louisville Railway company, ...Louisville, Ky.
Stephenson, Wm. J., president Columbia Railway company...........................Washington, D. C.
Sterrett, M. G, electrical engineer Brooklyn City Railroad company...................Brooklyn, N. Y.
Stevens, Samuel A., secretary and treasurer New Haven & West Haven Horse Railroad company ....West Haven, Conn.
Stoll, C. H., president Passenger & Belt Railway company..................................Lexington, Ky.
Stone, Wm. A., solicitor Federal Street & Pleasant Valley Passenger Railway company......Pittsburg, Pa.
Sullivan, P. F., secretary Lowell City Railway company......................................Lowell, Mass.
Sweeney, J. M., president Wheeling Railway company........... ... .Wheeling, W. V.
Trimmer, D. K., director York Street Railway company........... ....York, Pa.
Trusdale, George, president Eckington & S. H. Railway company.................. Washington, D. C.
Vandeveer, J. H., general manager Scranton Street Railway company..........................Scranton, Pa.
Verner, Murry A., director Rochester Railway company...................................Rochester, N. Y.
Vhay, James H., president Fort Wayne & Elmwood Railroad company................... Detroit, Mich.
Walker, N. H, superintendent Manchester Street Railway company................Manchester, N. H.
Wardell, F. S., general manager Duluth Street Railway company............... ....Duluth, Minn.
Wason, Charles W., vice president East Cleveland Railroad company............ ....Cleveland, O.
Watson, Henry M., president Buffalo Railway company .... Buffalo, N. Y.
Weiss, W. H., president San Antonio Street Railway company.......................... San Antonio, Tex.
Welheimer, Albert, director Reading City Passenger Railway company...................Reading, Pa.
Whitney, George I., president Central Traction company..................................Pittsburg, Pa.
Williams, Charles, president Manchester Street Railway company.................. Manchester, N. H.
Winslow, Samuel, president Worcester, Leicester & Spences Railroad company..........Worcester, Mass.
Woodward, H. R., vice-president Central Railway company............................. ......Peoria, Ill.
Woodworth, C. C., treasurer Toronto Railway company..Toronto, Can.
Wyman, C. Densmore, vice-president C. P., N. & E. Railroad company..................New York, N. Y.

Applications for Membership.

Representatives of the following named companies filed applications for membership:

Schuylkill Electric Railway company, Pottsville, Pa.; McKeesport & Reynoldton Passenger Railway company, McKeesport, Pa.; Boston & Revere Electric Railway company, Boston, Mass.; Second Avenue Passenger Railway company, Pittsburg, Pa.; Allegheny Traction company, Pittsburg, Pa.; Allentown & Bethlehem Rapid Traction company, Allentown, Pa.; Amsterdam Street Railway company, Amsterdam, N. Y.; Duquesne Traction company, Pittsburg, Pa.; Lebanon & Annville Street Railway company, Lebanon, Pa.; Shenandoah G. & A. Street Railway company, Shenandoah, Pa.; Citizens' Street Railway company, Vincennes, Ind.; Consolidated Street Railway company, Syracuse, N. Y.; Pawtucket Street Railway company, Pawtucket, R. I.; Citizens' Electric Railway company, Mansfield, O.; Oil City Street Railway company, Oil City, Pa.; Colorado Springs Rapid Transit Railway company, Denver, Colo.

Letters from ex-Presidents Julius S. Walsh, St. Louis, Mo; C. B. Holmes, Chicago, Ill., and C. A. Richards, Boston, Mass., were read expressing regret at their inability to be present at the meeting.

The Banquet.

The banquet was the crowning feature of the meeting and was one of the most enjoyable affairs in the history of the organization. There was a brilliant assemblage of representatives of Pittsburg's best society to welcome the members of the association. The banquet hall was profusely decorated, and excellent music was furnished during the evening. The floral display was pronounced the most elaborate ever seen in the Monongahela House. In the center of the middle table was a large air ship, representing the future of rapid transit. It consisted of a car suspended from a balloon made of roses and carnations and it was placed on a bed of roses six feet long. To the right was the old-time horse car and to the left the present electric car. These set pieces were handsomely designed. Vases of large chrysanthemums on beds of ferns occupied places at different ends of the tables. Between them were vases of American Beauty La France, and other choice roses. Dotted in between them were ferns, roses and palms. [illegible] chrysanthemums. Rare passion vines in flower and [illegible] were large pyramids of palms. The chandeliers were [illegible] tapers, were on the tables.

Mayor Gourley, who made the first speech of the evening, said, after welcoming the members:

"The occupation of the poor car horse has almost entirely gone. [illegible] turist or, it may be, the motive power of the laborious cart; but whatever his employment, I have no doubt, were we able to comprehend his musings, we would often find him, in his restful hours, sadly contemplating the marvelous changes a few years have wrought.

"Just sixty years ago the first horse car for use in the streets of any city was built in the United States. Street railways are, therefore, not only a growth of the nineteenth century, but they are an American institution. Of electric and cable motors I have neither the mechanical or scientific knowledge to speak intelligently. On these complex subjects I am compelled to observe a discreet silence.

"In the world's younger days intelligence was conveyed by crude methods. Of old, watchmen stood on the heights and cried aloud; trumpeters blew a blast from hill to hill; or legionaries, with elevated flags and spears, sent tidings afar. 'Swift as a post' was not an inappropriate simile even in primeval days. Egypt's learned priesthood knew not how to avail itself of mysterious vocal tubes; the monarchs of Mexico and Peru maintained a corps of runners who bore dispatches to the farthest limits of their empires. Another generation conveyed their wishes in the mirrors, the pealing of bells, the thunder of cannon or the flight of birds. Then came the mail coach with its fleeter officials and fleeter steeds. This in turn was superseded by the triumph of steam, the locomotive and express train. Then came to light a new invention before which the wildest dreams of romance became sober realities.

"The electric telegraph, the grandest invention of the age, the triumph of an American citizen, excelled forever all other methods for the transmission of intelligence. It united the extremes of the world and secured the absolute unity of man.

"Not more wonderful was the electric telegraph of less than half a century ago than are the inventions of later years for the further utilization of electric force; and when we remember the great achievements of the recent past, is it not within the range of human possibilities that before the twentieth century shall have fully dawned upon the earth, electricity shall constitute the mighty power which shall, on land and on sea, move the commerce of the world?

Hon. W. C. Moreland, who responded to the toast, "Our Two Cities," gave a detailed account of the various industries which Pittsburg and Allegheny possess. Bishop Whitehead spoke upon "Home, Sweet Home" and Hon. S. Wisé, who was expected to respond to the toast "The Street Railway, What it Was and What it Is," was detained in Richmond and sent a letter expressing his regret. "The Press" was represented by C. L. Magee. In his speech on the "New Public Sentiment —Quick Time," Congressman W. A. Stone said:

"The man who formerly rode upon a street car did so because he was tired. The man who rides upon a street car to-day does so because he is in a hurry. No one in a hurry ever took a horse car. The American people can never get enough time."

He referred to the fact that there were many "references" in scripture to the electric railway but, he said, the projectors of rapid transit lines were unable to find anything in scripture about a cable railway. They doubted whether Job, or Nahum, or Ezekiel ever saw one, but they had seen electricity. The Pittsburg street railway men hardly knew what system to adopt. They were very much impressed with the storage battery. The Pleasant Valley company planted the first pole, and was the first to give the people rapid transit. This caused trouble, and the articles published on the deadly overhead wires would now make interesting reading for a lunatic. All prejudices have now been overcome. Once when a wire got astray and connected with a hand rail a man got shocked, but when it was discovered that he was a candidate for office the people thought it was not so bad if it was only loaded for candidates. "We still hope to obtain a better article of electricity, and by mixing it with a little dynamite and natural gas, we can make quicker time, and our transit more rapid. While the street railway men of the two cities fight frequently among themselves, they are good natured people, and take great pride in their street railways. They feel honored by the meeting of this association here and when you who come here from other cities shall take your leave, you will take with you a better knowledge of a busy city with great possibilities, with natural gas in abundance, with great beds of coal superior for coke and fuel, and with the largest producing oil wells in the country, with three great rivers, a city of beautiful women, and brave, strong men, and will bear with you the [illegible] every street railway man in our sister cities."

Excursions and Entertainments.

On Friday morning the delegates [illegible] at the convention [illegible] Mayflower and proceeded [illegible] Rivers, to the Davis Island [illegible] of the wicket pattern [illegible] which contains the largest [illegible] The boat then proceeded [illegible] Keesport, making [illegible] works and the Edgar Thompson steel works. The Grand Army Band of Pittsburg [illegible] was served on board.

The Souvenir Badge.

The Electrical Supply company's souvenir badge proved extremely popular, and as much disappointment was expressed by railway men who were not fortunate enough to procure one before the supply was exhausted, the Electrical Supply company has pro-

THE SOUVENIR BADGE.

mised to have some more made up and forwarded to all electric railway men who write for them. The appearance of the badge is shown in the accompanying cuts.

Convention Notes, Exhibits and Personals.

F. DeRonde represented the Standard Paint company of New York.

William Taylor and M. M. Wood represented the Electrical Supply company, Chicago.

P. C. Ackerman of the American Electrical Works extended the courtesies for his company.

James F. Kelly of the Edison General Electric company renewed acquaintances at the headquarters.

John I. Beggs of the Chicago office of the Edison General Electric company was at the convention.

The Edison company's "mem" was a most appropriate souvenir, and the demand far exceeded the supply on hand.

Theo. P. Bailey represented the western department of the Thomson-Houston company's street railway interests.

The Duplex Street Railway Truck company was represented by John D. Elwell. It had a display on the Mayflower.

The Charles Munson Battery company, Chicago, showed the belts recently made for the Pittsburg & Allegheny Traction company.

S. S. Leonard of the Hill Clutch Works, Cleveland, was on hand, and extended an invitation to his friends to visit him at Cleveland next year.

The Reliance Safety Gauge company of Chicago was well represented. It showed a full line of its devices, and attracted considerable attention.

An interesting display of graphite from the Blombogina mine was exhibited by W. G. Wilmot of the United States Graphite company of Saginaw, Mich.

Entertainments were held in the Edison company's headquarters Monday and Tuesday evenings, and they proved an agreeable relief to the members.

W. J. Cook of the McGuire Manufacturing company of Chicago was on hand to explain the merits of the street railway truck manufactured by his company.

G. H. Keating of Bay City, Mich., represented the H. M. Loud & Sons, Lumber company of Oscoda, Mich., and had an exhibit of poles for electric railway purposes.

The Weston quick break switch, which was recently illustrated in these columns, was displayed by Wm. H. Weston & Co., Philadelphia, the manufacturers of the device.

The Short company issued a handsomely illustrated catalogue which will no doubt be kept by the members as a souvenir of the meeting at Pittsburg. It was really an artistic production.

The interests of the Detroit Electrical Works were well [illegible] for at the convention by Messrs. Benton and Lockwood. Both of these gentlemen were untiring in their efforts to entertain the visitors.

The Westinghouse company kept open house in its parlor in the Monongahela house, and entertained delegates and visitors. Members of the association visited the works [illegible] many courtesies.

[illegible] representing the John G. Brill company, [illegible] the members and visitors. He took occasion to impress on the delegates the points of superior- [illegible] by the Brill company.

The [illegible] company's representatives were [illegible]. The company's parlors at head- [illegible] the meeting and visitors [illegible] awaiting them.

The Calorific Ventilating Heater company, Chicago, [illegible] The [illegible] heater [illegible] street car [illegible]

[illegible]

[illegible]

[illegible]

Carpenter heater has already been described in these columns. It was recently perfected and is now in the market.

E. W. Bennett represented the Western Electric company of Chicago, which had an extensive and attractive display. Hard drawn copper wire, weather-proof wire and Patterson cables were exhibited together with numerous specialties.

Charles A. Schieren & Co., New York, were represented by E. P. Atkinson of the New York house, and G. H. Fisher, manager of the Philadelphia branch. The firm had an attractive display of perforated belts and link belts for electric power stations.

The "literature" issued by the manufacturers and supply men contained many striking features and was far superior to the ordinary run of advertising catalogues. Many of the companies issued special pamphlets profusely illustrated and handsomely printed.

The Standard Underground Cable company made a hit with its bouquets for the members making the trip down the river Friday. To each bouquet was a handsome blue streamer bearing the inscription "Compliments S. U. C. Co., Pittsburg." The little memento was fully appreciated.

The Interior Conduit & Insulation company of New York, exhibited a section of its underground system consisting of an iron box containing sixteen conduits, four series of four tubes. One end of the box was filled with insulating compound, showing the company's method of underground insulation.

R. B. Corey represented the Electrical Supply & Construction company of New York city. His specialty, the Ward arc lamp, was shown to advantage in practical operation on the barge which contained the majority of the exhibits. Mr. Corey received many complimentary notices on the excellent results obtained.

E. H. Oswald and D. L. Hungerford, representing the Benedict & Burnham Manufacturing company, New York, had an attractive exhibit in the main corridor of the Monongahela, consisting of samples of trolley feed and magnet wires on reels. This company manufactures hard and soft drawn copper high grade insulated and magnet wires, and wires for street railway purposes.

In addition to the display of the Detroit Electrical Works on the Mayflower the company had a car on the Duquesne Traction company's road, which was operated by a single motor geared to both axles. This equipment is a duplicate of the equipment in operation on the Merrimac Valley road, Lawrence, Mass., and the Aurora Street railway, Aurora, Ill., where the motors are working on very heavy grades.

C. T. Chapin, president, Frank D. Russell, general manager, and C. J. Donohue represented the Rochester Car Wheel Works of Rochester, N. Y. This concern had on exhibition eight street car wheels ranging in diameter from 12 to 36 inches, and in weight from 180 to 400 pounds. The display included a Barr contracting chill. Broken pieces of wheel were displayed, showing the depth of the chill. The wheels are shown just as they come from the sand, and were not specially finished.

Maybin W. Brown, president and manager of the Eastern Electrical Supply company of Boston, was on hand and received his friends at the headquarters of his company at the Monongahela house. He had an exellent display of specialties on exhibition neatly arranged. They were carefully examined by many practical men. The company's snow plow, which has attracted so much attention was explained by Mr. Brown and the Winton railway line insulator was shown. There were many other specialties and novelties on exhibition in this company's display.

The Peckham Motor Truck & Wheel company of Kingston, N. Y., had three exhibits. On the barge, a full-sized cantilever truck, with radial gear and interchangeable wheels was shown. In the main corridor at headquarters near the convention hall, was a Peckham cantilever expansion truck frame with radial gear, and in Parlor 29 excellent models of Peckham trucks were shown so that the construction of the truck could be easily understood. In addition to these models there were samples of wheels and axles. E. Peckham, president, and E. C. Stark, represented the company.

The Schneider Combination Car company, Chicago, exhibited models of combination summer and winter cars These cars have changeable seats in sections and steps. A winter car may be readily converted into an open car by the removal of the outer panels, which are made in sections, and the seats turned over so as to face outward, while extending lengthwise as in a closed car. This leaves space for the conductor to pass through for collections. Old cars can be changed to the new style, thus effecting a great saving. The company was represented by John G. Schneider, superintendent and vice-president.

The display of the Standard Underground Cable company of Pittsburgh, was one the most attractive exhibits on the Mayflower. It consisted of railway feeder and electric light wires. A pyramid of wire reels flanking the space contained waterproof cables for feeders, magnet wire, office wire and annunciator wire. Samples of the company's underground ducts were also shown, and a case containing samples of cables and wires of all sizes and kinds, artistically arranged occupied a prominent place. The company was represented at the convention by J. W. Marsh, vice-president and general manager; W. A. Connors, general superintendent; George L. Wiley, manager of the eastern sales department; F. E. Degenhardt, manager of the western sales department, and F. A. Rinehardt, secretary and treasurer.

[illegible] Heater in the Electric Merchandise company's parlor proved an attraction of no little [illegible] Mr. Mason had an opportunity to show the good qualities of these heaters and he improved it to the satisfaction of all who had occasion to call. There were many chilly hours in the morning and evening during the convention, and members about the headquarters made frequent expeditions to the Electric Merchandise company's comfortable parlor. There were many other excellent specialties shown there. A full line of railway supplies were displayed. General-Manager Mason was assisted by Messrs. England, D. B. Dean and Adams.

Alexander, Barney & Chapin of New York had a prominent position in the main corridor near the entrance to the convention hall. Here was arranged a most attractive display of devices for electric cars and power houses. The special feature of the display was the new incandescent A. B. C. railway lamp. This lamp has a carbon support, which is sealed in the tip of the glass bulb, to prevent excessive vibration and consequent rupture of the carbon filament. Special attention was attracted to this exhibit by blasts from the signal horns, which were operated at frequent intervals by an A. B. C. dry battery. Mr. Chapin attended the convention in the interest of the company.

The Pittsburg *Commercial Gazette*, speaking of the A. B. C. company, pronounced the display of this general electrical supply concern without doubt the most novel one in the hotel. It continued: "It is located in the most prominent place in the house, just in front of the ladies' parlor. The firm is represented here by the vice-president, Charles E. Chapin, and Henry G. Issertell of the railway department. These two gentlemen spent all day yesterday arranging a display that would attract the attention of the people, and that they succeeded was proven by the immense crowd that thronged around their display to examine the coach and signal trumpet which was numerously on exhibition and made itself heard in all parts of the hotel."

J. W. Meaker and Col. Norton, president and secretary of the Meaker Manufacturing company, Chicago, had an exhibit on the Mayflower, consisting of car fare registers, which, it is claimed, cannot be tampered with. They register every time the bell rings, and they are in use on the lines of the Duquesne Traction & Federal Street & Pleasant Valley companies. The portable register is practically the same in construction. A portable attachment has recently been brought out, which the conductor can take from one car to another as he changes about, so that his accounts will show the total amount collected by him during his day's work, while the total of each car is also shown. By this combination it will be readily understood that each car has its own account, as also has each conductor, and each is independent in its results.

The Electrical Supply company of Chicago made a very complete and interesting exhibit of electrical railway material in parlor 37 and in the hall leading to the convention headquarters. Electric railway men expressed themselves as well pleased with the improvements shown in construction material, special interest being manifested in Wood's trolley catcher, Wood's car connector, the Wirt volt and ampere indicators, the Electrical Supply standard trolley wire hangers and insulators, Reed oil feed for trolley wheels, Shield Brand feeder wire, Habirshaw undeiground and flexible conductors. Contractors were also much interested in a pole ratchet shown. Parlor 37 contained many new inventions in railway material, was well arranged, handsomely decorated and crowded with visitors from the opening to the closing of the convention.

The World's Congress of Electricians of 1893.

The meeting of the Chicago Electric club of October 19th, at which Prof. Elisha Gray read a paper on the World's Electrical Congress, was a decided success. About one hundred gentlemen were present, including several representatives of the World's Columbian Exposition, and the greatest interest was manifested in the subject in hand. Vice-President Kempt, who was chairman of the special committee that had charge of the arrangements for the meeting, occupied the chair.

After the reading of Prof. Gray's paper, which was presented in the WESTERN ELECTRICIAN of last week, the chairman called upon Col. R. C. Clowry, chairman of the World's Fair directors' committee on electricity, who said:

In regard to the electrical department of the World's Fair I would say that we are making very fair progress. We are having meetings twice a week, and we are very much encouraged. We have experienced more or less embarrassment and discouragement from time to time, but I think that is all past now, and everything is working smoothly. We had a long session to-day and passed upon plans for the lighting of nearly all the leading buildings. Mr. Sargent and Mr. Stieringer were present. They have been giving very close attention to the business and have moved their quarters to the fair grounds. At first there were so many heads and different departments that it seemed as though we would never get separated, but everything is settled now, and I think we will have no more trouble.

The chief of the department of electricity was then called upon, and spoke as follows:

PROF. J. P. BARRETT: I feel doubly grateful, I assure you, for the confidence expressed in me by the members of this club, and the unanimous support I have received from you all; and if that continues there is no possible chance on earth for a failure. Whatever differences of opinion we have had here heretofore, I tell you this fair is too big for any one to get in the way, and I am going to be right in the swim. I am going to the fair, gentlemen. I do not know that I can say anything more except to repeat my thanks

to you, and I hope to merit your confidence, and at the end of the fair I will be ready to make a speech to you.

At the request of the chairman, B. L. Sunny, a director of the exposition and a member of Col. Clowry's committee, addressed the club.

MR. SUNNY: It seems that about every time I stand up in this club it is for the purpose of thanking it for some favor or honor conferred. I can only repeat my thanks, as I have often done, and say that it has always afforded me the greatest pleasure to be of any assistance to the club, or in furthering the interests of electricity generally, and my only fear is that I have come very far short of the mark that you have set for me.

In connection with the World's Fair I think that one of the happiest ideas that was hit upon was this intellectual gathering which was contemplated in this auxiliary organization. I do not think that any of the conferences that are to be held will be of any more importance or have a greater bearing upon the scientific and practical part of the world's fair business than the proposed conference of electricians. It is not only advisable and wise that a congress of electricians be held, but it seems to me, and it no doubt seems to all of you, that it is an absolute necessity that this congress be held, and at this time. As Prof. Gray has stated in his paper, we have had no congress of electricians of any importance since that held in Paris in 1881. Since then the greatest changes have taken place in the electrical world. A great many things have happened to make it necessary that the scientists and the electricians from all over the world should get together and take up the electrical service as it is now performed, and I think that they could put finishing touches on it that we are very sadly in need of.

The names of a number of practical electrical units, which are now in vogue, have never been officially adopted by an electrical congress. These units are the Gauss, for the unit of intensity of magnetic field, which was proposed by Sir William Thomson; the Weber, as unit of the strength of the magnetic pole, proposed by Clausius & Siemens years ago; the Watt, as unit of activity and power, proposed in 1882 by the late Sir William Siemens; the Joule, as unit of electric work, proposed in 1882 by Sir William Siemens. The names for these units should be officially adopted by the next international electrical congress. The Henry, which was proposed as the name for the unit of self-induction at the Frankfort electrical congress, has not been adopted yet universally, and this matter has also to be decided at the next electrical congress. The legal ohm, as determined by the Paris congress in 1881 for a term of ten years, has been determined much closer by the committee on electrical standards of the British Association. There are still in use in this country and abroad three units, viz.: the British Association unit, the legal ohm and the true ohm, according to the latest determinations of the above named committee. A new legal value of the ohm shou'd be adopted at the next congress. These are matters of vital importance and they represent only a small part of what the next electrical congress will have to do.

A brief review of the enormous additions that have been made to the general electric service since the Paris congress of 1881 may not be amiss as indicating and emphasizing the importance of this proposed gathering of electricians, not only for the purpose of adopting new standards and changing old ones, but with a view of devising better methods for carrying on the great work.

When the Paris convention was held in 1881 the telephone was only four years old, and had only found its way into general commercial use to a small extent. The great problem of furnishing a large number of subscribers with acceptable service had scarcely been touched upon. The multiple switch-board now found in every important exchange in the world had not been perfected. Steel and iron wires were universally used, while the later and better practice is to avoid resistance and inductorial disturbances by the use of copper wire entirely and the substitution of metallic for grounded circuits. The problem of working telephone wires underground had not been taken up.

Arc and incandescent lighting came into commercial use after 1883, and since that time about 325,000 arc lights and 3,500,000 incandescent lights have been installed, calling for an investment of approximately $275,000,000. Only those who have followed the introduction of the electric light interestedly can form any adequate conception of the difficulties encountered, and, in a more or less satisfactory way, overcome, not only in the development of the proper apparatus but in the practical work of furnishing service. Among the problems met with, and only partly worked out, is the important one of the operating of arc and high pressure incandescent wires underground. The storage battery came out for commercial use a few years ago, but is not sufficiently perfected to be placed in general use. Of all of the new developments in electricity, none has proven so attractive, and promised so much as the storage battery, and that the difficulties in its practical use will be speedily eliminated can be regarded as a foregone conclusion.

The electric railway has come to us since the Paris congress, and in the last five years recent statistics indicate that 354 roads have been equipped electrically with 4,513 cars running over 3,000 miles of track. This would represent an investment of approximately $21,000,000, omiting the cost of the usual accessories, such as steam plant, overhead construction, etc.

The transmission of power by electricity is new comparatively, but is developing with a speed that promises to make use of every fall of water that has sufficient power in it to make it worth transmitting. The lighting, pumping, drilling, hoisting and ventilating of mines can all be done by electricity, generated by the power of a fall of water ten or twenty miles away from the mine, not only with an enormous saving over the present method, but with greater reliability and more freedom from the mishaps that now characterize the operation of mines.

The telautograph, or writing telegraph, is one of the newest and most remarkable additions to the list of helpers to mankind, and at once appeals to the wonder, that such a device could be made to work successfully, and to the enthusiasm, because if such a difficult undertaking can be accomplished anything seems feasible with the electric current.

In addition to the above there is the phonograph and electrical devices of lesser moment, all, however, filling their peculiar spheres of usefulness.

I cannot pay as much attention to the strictly technical part of the work as most of you, but I can realize that in the absence of the determination of these units there must necessarily be much confusion, and that if a remedy is not speedily applied the embarrassment must be of a serious character. Therefore I hope that the movement for an electrical congress in 1893 so auspiciously begun will grow and will result in an unparalleled gathering of the greatest minds in the world.

The National Electric Light association, as you know, is made up of the owners and operators of electric light plants all over the United States and Canada. These are the men who back the scientists and electricians by putting up the cold, round dollars as showing their faith in them. This association appointed a committee on World's Fair matters a few weeks ago, and I have the honor of being the chairman of that committee. I want to pledge to this undertaking the sincere and hearty co-operation of the National Electric Light association, and to assure all who are interested that no assistance that the association can in any way extend will be for one moment withheld.

THE CHAIRMAN: Gentlemen, I think this subject is not fully exhausted yet. There are a number of strangers present to night whom we do not often see with us, and I want them to take notice now that the chances are that they will be called upon. And in the meantime, while the strangers are getting their thoughts together, I would like to hear, and I know you all would like to hear from Mr. Dyrenforth on this subject.

W. H. DYRENFORTH: I look upon the coming World's Fair as a particularly auspicious occasion for the new science of electricity. It is bound to be the key-note of the future of the science of electricity. That fair and the success of that fair, so far as this great science is concerned, depends to a very great extent upon the scientific ability, the energy and the practicable executive ability of the four men to whom has been entrusted the electrical exhibit. While I am not personally acquainted with all the gentlemen who have that in charge I know some of them personally. The others I know, as you all do, by reputation, and we all feel confident that the exhibit, that the entire science of electricity, so far as represented by this club, is placed in the best possible hands. In Professor Gray we have an originator of ideas; in Colonel Clowry we have another; in Mr. Sunny we have the practical man, the commercial man, and in Professor Barrett we have the man who not only originates ideas but who has the ability to carry them out in the best possible manner.

THE CHAIRMAN: We have a gentleman with us who represents England, Mr. St. John Day. Will he kindly favor us with a few remarks?

MR. DAY: It is my great misfortune to be called upon this evening, because I had not the slightest idea of the possiblity of any such accident happening to me. Still greater is my embarrassment and difficulty in view of my less acquaintance with the surroundings. I scarcely know what to say; the magnificence of Chicago amazes me. It has been my delight and my good fortune to be almost continually associated with the gentlemen of the World's Fair in connection with their efforts for carrying out a great enterprise in connection with the fair, the congress of electricians, auxiliary congress as it is called. But I think I may truthfully say that it will be the greatest and grandest congress of electricians which the world has ever had the opportunity of viewing in the near vista of a not dim future. With the work of the Paris Congress in 1881 I am quite familiar, having been there and worked there, and having had occasion in a professional capacity to be particularly acquainted with it. I can conceive of nothing so important, and I say it in the most emphatic way I can, although the words scarcely come to me to express the emphasis I desire to give to the extreme importance of the work which is to be done in that direction in Chicago.

I should like to make a suggestion in regard to the work which I think should be done by eliciting the aid of the experience, the experiments and the practical conclusions which have been arrived at by many of my friends on the European side of the Atlantic; but I think it may be safely said in reference to the gentlemen to whom this club and the World's Fair people have entrusted the carrying out of this great congress, that it could be placed in no better hands. The work of Elisha Gray was known, lauded and cherished in Europe almost before it had been appreciated and come to the full light in other lands. We saw in the work which he did in his extremely modest way the beginning of the great future of electricity. We look to Prof. Barrett in Chicago as a leader and guide in some of the larger and rougher applications of electrical science. The work of Mr. Sunny, in connection with the great company which he represents, is already known to all, and therefore I say with the utmost confidence that the whole world, not merely Chicago, not merely the World's Fair authorities as they exist and are known here in Chicago, but the whole world looks to these four gentlemen as the great pioneers, as the eminent men who are entrusted with the carrying out of this electrical congress. And if it is in my power in the slightest degree to aid them by connections and by refererence to my friends in Europe, I can only say that my services will always be at their disposal.

Other gentlemen were called upon and responded as follows:

F. G. BEACH: I really have nothing to say upon this subject. The subject of the World's Fair is one which I have taken a great interest in, but I have been so busily engaged in the ordinary routine of my business that I have not had time to give it much attention, to enable me to speak intelligently to the [illegible] can only express my [illegible] the success of the enterprise, as [illegible] cord with the [illegible]

D. K. TELL: [illegible] tists seem to me a very [illegible] the early days of Chicago I had something to do with Prof. Barrett and Prof. Gray. There are times in a man's life when he has the chance of promoting the interests of the public at large. That chance I had several years ago, but I did not do as Prof. Barrett said; I did not keep up with the procession, the World's Fair. I was left behind; but at the same time I have kept up reading and thinking about the wonderful questions involved and the wonderful minds that have solved the great problems in electricity. My connection with the electrical science has been very short, but I have a deep interest, Mr. Chairman and gentlemen, in these questions. I hope that this club will, as it has appointed the best men in the club, represent Chicago in the wonderful advancement of the electrical science, and the men who have made the laws of nature flexible to their wills will yet shine, and make Chicago shine as one of the foremost electrical cities on earth.

MR. SHUMAN: I certainly feel very poorly equipped to undertake the task of either instructing, entertaining or amusing in any way the Chicago Electric club. I feel, however, that it is a very high honor to be called upon to act in that behalf. This is the first time I have ever had the pleasure of meeting the assembled club, and I assure you it is a very rare pleasure, gentlemen. I know very well and have known for a number of years several of your distinguished members. Col. Clowry, Prof. Barrett, and several others are personal friends of mine, and I can say frankly that I am very much and very agreeably surprised to find that the Electric club is a permanent institution in Chicago. I perhaps ought to be ashamed to confess that I have been ignorant up to the present time regarding the importance and general character of this club. But I assume from the gentlemen I see here who compose this club that it certainly ranks amongst the foremost of the scientific clubs of Chicago, if not of the United States, and that it will at the World's Fair and in the congress of scientific people hold its own and hold the place of Chicago among the scientific cities of the world.

The extent to which electricity has spread, as one of the useful arts of the world in the last few years, particularly in the United States, has been very surprising to me. I remember a few years ago when electricity, except for exhibition purposes, was almost unknown in Chicago, I found that the miners' cabins along the line of the Union Pacific railroad were lighted by incandescent lights. The streets of cities where gas lights were impossible were lighted by a light which I presume was the Thomson-Houston. It was two or three or four years later before Chicago adopted the electric light in the streets generally or in the houses. And yet electricity is not used as it should be, in my judgment, and is not used so extensively as it will be after the World's Fair Congress has been held, and the subject of applying it to household uses as well as using it as a motive power shall have become more extensively developed.

GEO. B. SHAW, Eau Claire, Wis.: I have been much entertained by the remarks which have been made by the distinguished gentlemen who addressed you. I have been particularly impressed by the remarks of Mr. Sunny, who gave us a list of the different units which are required, but which have not yet been standardized. I would like to add one, a unit of success. Now, as a stranger in this city, I suggest to the respectful consideration of Mr. Sunny and of the club, that the word "Chicago" be used as a unit of success. The only difficult thing about the suggestion is that there is no place on earth sufficiently large to enable the unit to become standardized.

One thing in connection with the World's Fair which embarrasses the manufacturers is, that, although as the distinguished gentleman from abroad has said, the time is short in which all this work is to be done, as a matter of fact the time is so far in advance that the manufacturers are wondering among themselves if the apparatus which they are making to-day is not going to be a chestnut by the time of the World's Fair in 1893. And in making applications for space I believe that this doubt does exist in the minds of the manufacturers. It is apparent everywhere that the World's Fair is to be a magnificent success, and there is no question that the electrical exhibit will be the best feature of the fair. We who live in the Northwest have a proprietary interest in Chicago, and we feel as much interest in the success of this enterprise as those of you who are fortunate enough to live within the borders of this great city. We realize that in order to secure the services of gentlemen of sufficient ability to prosecute this work on behalf of the World's Fair, we must ask men who are busily engaged in the commercial and other branches of the field to devote their time to this work, and yet we look to these gentlemen to formulate for us outlines and plans, and perhaps to submit the architecture of this grand superstructure, and we, as manufacturers, as exhibitors and others, will contribute what we can to make the superstructure what it ought to be.

C. H. WELLS, Pittsburg: As an outsider I have heard a great deal about the reason why the fair must of necessity be a failure. I have discovered to-night one of the reasons why the fair must of necessity be a success. You have not only put forward your best men to do the work, but you have rallied to their support and you are holding up their hands in the work which they have to do. I am sure that these gentlemen feel that they have behind them a constituency that is going to uphold them in their undertaking, and a man who has nothing to fear from the rear can do a good deal of fighting in the front.

F. W. PARKER: I am confident that no criticism can be made of the selection of the four gentlemen of the committee, except that one of their number is [illegible] the plain title of Mister. There is Prof. Gray, Co..

[illegible] and plain Mr. Sunny. That is an anomaly that is not to be allowed under a republican government. I think we should give him the title of Doctor, for instance, and call him Dr. Sunny, in order that all the men on the committee should have titles.

There is one little fragmentary thought that seems to have escaped us to-night. Those of you who are familiar with the exposition of 1889 of Paris, and those of you who are familiar with the manufacturers of Europe, who have seen the tapestries of France, who have seen the laces of Belgium, the pottery of England, the Sevres ware, and the glass of Italy and Bohemia, the hammered metals of Russia, and all the magnificence of the productions of Europe, I think you will be ready to say that there is some question whether the United States, with all of its ingenuity and skill, can quite equal some of the things which were seen in that exposition. In other words, we may be confident of success in some directions, but can we be entirely confident of surpassing Europe in all respects? I think not. But if there is any one thing in which the United States is entirely at home, if there is any one field in which we have supremacy, it is the electrical field. We have the telegraph, the telephone, the phonograph, the arc light, the incandescent light, and last but not least the telautograph, as the things that America has given to the world; and while it may be true that some of the Europeans have delved a little deeper in the science of electricity, the energetic and skillful work that Americans have done have made electricity a lasting, living factor in modern civilization. Now, in the Paris Exposition, the thing which attracted the greatest attention, which seemed to be viewed with the greatest pleasure and satisfaction, was the American electrical exhibit, notwithstanding the excellence of the European exhibit. Now, then, if that is true, the thing that I would have said to those gentlemen if they were here, and the thing which I say to you, Mr. Sunny, as representing them, is that if we do stand so supreme in electricity, it would seem to be a wise policy on the part of those who have the control of the fair, to put electricity at the head, and make it the first thing of all things which we will show to the world, because there we are supreme.

Another reason why this should be done, is that the great tendency of this age in which we live is toward consolidation, concentration and unification everywhere. The individual grows less, and the institution of the state grows more and more. The greatest factor in the advancement of unification and consolidation has been electricity. Therefore, if we were treating the World's Fair as a queenly woman, we should crown her with a coronal of electricity, as the Empress of India wears the Kohinoor diamond as the richest and brightest gem in her diadem.

Rapid Transit in New York and Chicago.

A writer in the *Chicago Herald* contributes an article on the relative merits of the public improvements of New York and Chicago. Here is an interesting paragraph: "Rapid transit in Chicago has been retarded, and is not as advanced now as it should be, but it will come in good time. And in respect of street railways, Chicago was before New York in this improvement, and even now has as many miles of track as she within three and sixty-two one-hundredths miles. No sane resident of Chicago brags of the cable car service, and yet New York is only just building her first cable road—just when the rest of the world has found out that the cable is uneconomical and has to be abandoned in favor of electrical power."

CORRESPONDENCE.

New York Notes.

New York, Oct. 21.—The rapid transit plans have been made public at last, and it is with a feeling of relief [illegible] received. The board of aldermen held a special meeting to receive the report, but it was decided at [illegible] to postpone the consideration of the plans until Wednesday, Oct. 28th.

[illegible] readers of the WESTERN ELECTRICIAN, Chief Engineer W. L. Worthen, whose plans in their most essential features the commission has adopted, believes that electricity will be the motive power employed in the tunnel. The importance of Mr. Worthen's opinion will be appreciated more fully if it be [illegible] deemed it unwise that [illegible] form of power answering the essential conditions of speed and non-com[illegible] [illegible] with the water [illegible] [illegible] for the special work. As to speed, Mr. Worthen expressed himself as [illegible]

[illegible] against the Julien people, but now the beaten parties have [illegible]

rope last summer, and that its expiration there carried with it expiration in this country. On Oct. 21st Judge Coxe decided to reopen the case to allow them to make good this claim.

Fires seem to have been the order of the day—particularly yesterday—among the electrical people. Last night there was a blaze in the station of the United States Electric Light company. According to the firemen, the fire, which was confined to the platform under the dynamos, was caused by crossed wires. The damage was slight, however, and only about twenty feet of flooring was torn up. Several circuits were cut out for the night. The next unfortunate was the Safe and Sure Electrical company, 156 West Forty-third street. The fire in this case originated in a furniture store below. Loss, $5,000 with $2,000 insurance. Word comes this morning that the factory of the Gibson Storage company at Chatham, N. Y., was burned yesterday. The loss is said to be $15,000. F. L. P.

TRADE NOTES.

The Laminar Fibre company of Boston has recently made some very successful tests with a new conduit which it will soon present to the trade.

The Standard Electric Time company of New Haven, Conn., will make an exhibit of apparatus at the Merchants' Exposition at Augusta, Ga. The company will be represented there by G. W. Hutchinson.

H. C. Storrs, who has been connected with the North American Construction company for some five years, has recently associated himself with the Columbia Electric company of St. Paul as electrical engineer.

The Reading Electrical company of 41 Federal street, Boston, reports business as being far in excess of that of a year ago. Mr. Stanwood of this company is at present taking a short business trip through the East.

The New Haven Insulated Wire Company of New Haven, Conn., is now very busy on some orders recently received from the West. This concern is rapidly growing into prominence, and the wire produced is growing steadily in favor.

The American Circular Loom company of 620 Atlantic avenue, Boston, manufacturing the well-known "Canvas Jacket" wire, has successfully competed for a large number of western orders. The careful manner in which it has manufactured its insulation is now showing for itself.

M. C. J. Hubbell of the Hubbell Portable Electric Lamp and Power company, 61 Broadway, New York, left last week for an extended trip through the West. He will be in Detroit for some time and thence will go to Chicago. It is understood that he will make arrangements for the extensive introduction of his new battery.

It is understood from General Manager J.M Jarvis that the Berlin Iron Bridge company of East Berlin, Conn., is the successful competitor for the iron work of the Delaware Iron company's plant at New Castle, Del., whose plant was recently destroyed by fire. This is one of the largest contracts of this kind that has been awarded this fall.

The regular dividend of two per cent. in cash, amounting to $7,500, was paid October 10th, on the $375,000 of preferred stock of the Great Western Electric Supply company. A dividend is also to be paid on the common stock of the company, if the business continues to prosper for the next two or three months as it has for the past three.

The Easton Electric Cable company finds that its business for August and September has increased fifty per cent. over that of the same months a year ago. It is compelled to run the factory at night in order to meet the wants of the trade. The duplicate orders which were received from mining concerns have demonstrated the wire to be fully equal to representations.

It is stated that Prof. Elisha Gray of Highland Park laid some Okonite wire underground without any protection whatever, over three years ago, on which his telautographic experiments have since been conducted. The wire is still in perfect condition, showing the best possible insulation resistance. The Central Electric company reports that all comments on this insulation are favorable.

The Underwood Manufacturing company of Tolland, Conn., is making a fine reputation with its cotton-leather belting. This concern has recently filled an order for the National Electric Street Railway company of Victoria, B. C. for a belt 50 inches by 85 feet. It has also received three very large orders from Japan. One of the three orders from this for eastern country will be used at the palace of the Mikado.

Congratulations for the Hill Electric company of Boston are in order, in that it has G. H. Poor, formerly general superintendent of the American Brake company of St. Louis, identified with it in the work of reorganization. Mr. Poor is well known to all railroad men in the West, as having introduced and pushed to success the well-known Boyer railway speed recorder. It is predicted that the Hill company will ere long feel the effect of his energetic efforts.

John N. Spencer has just been made assistant superin[illegible] company's factory at St. Paul, Minn. Mr. Spencer resigned his position as superintendent of the Casho Machine company of Wilmington, Del., [illegible] for the past two years, to come West. His physician advised the change to a drier climate on account of his health, and the Columbia Electric company is to be congratulated in having secured his services. Mr. Spencer is well-known in the East as a man of much ability.

BUSINESS.

The *Daily News*, Chicago, is operating all its presses and ventilating apparatus with Eddy motors.

Kohler Bros. & Grier, Chicago, are installing an Eddy motor in the Chicago post-office for the printing department.

C. MacLaughlin of J. H. Bunnell & Co. was recently elected one of the directors of the Central Electric Railway company of Paterson, N. J.

The presses of the Philadelphia *Inquirer* will hereafter be operated by electricity. A 40 horse power Eddy motor has been installed for this purpose.

The Central Electric company is pushing the sale of Paiste switches, of which it has a large stock, and can fill almost any kind of an order from the warerooms.

The Perkins Electric Switch company of Hartford, Conn., has recently added new machinery to its plant. This factory is now working early and late to supply the demand for Perkins apparatus.

H. & E. C. Baxter of 18 Fulton street, Brooklyn, report trade very brisk, and are receiving large orders for their various supples; also that there is a steady demand for their slow speed carbon brush motor.

The Bryant Electric company of Bridgeport, Conn., has recently completed arrangements with W. H. Gordon & Co. of 115 Broadway, New York, to carry a full line of its incandescent lamps, sockets, cut-outs and various electric supplies.

"Cutter's Petite Pulley" is the name given to the small-sized lamp supporting pulley which George Cutter has designed for use with incandescent lamps. The many stations from which incandescent street lighting is done need such an article, and it is said that this pulley exactly answers the purpose.

F. D. Voorhees of the Norwich Insulated Wire company of New York reports that work is rapidly progressing on the new factory at Harrison, N. J. While the company is able to handle orders by working overtime, the increased facilities will enable it to take better care of a rapidly growing business, and also further improve the manufacture of the Trinidad wire.

George H. Meeker, manager of the New York Insulated Wire company, 78, 80 and 82 Franklin street, Chicago, has received the first of the shipment of three car loads of Grimshaw white core and B. D. wires from the factory at Wallingford, Conn. In this shipment there is one million feet of trade numbers 228 and 227, No. 14 B. & S. wire, or more than enough to reach in a straight line from Chicago to Davenport, Ia. The Vulca wire ducts are about to be put in the new Masonic hall at Utica, N. Y., and are extensively used throughout the West.

H. C Goodrich, well known as one of the pioneer residents of Chicago, has become interested in an electrical enterprise, having organized a company with a factory at 31 South Canal street to be known as the Goodrich-Coleman Electric Works. Clyde Coleman, formerly with Freeman, Coleman & Co., is the junior member of the firm, and will also give the new enterprise the benefit of a large number of new electrical inventions that he has perfected. Mr. Goodrich is a well known mechanical engineer, having at one time been engaged in the manufacturing of sewing machine specialties, and brings to his new undertaking an experience that should insure its success.

W. S. Barstow, general superintendent of the Edison Electric Illuminating company of Brooklyn, writes as follows to H. Ward Leonard & Co., relative to Mr. Leonard's new scheme for motor regulation: "We have just permanently equipped our passenger elevator with your new system of motor power, and are greatly pleased with the result. In this system the motor operates continuously at its highest efficiency, and there is no likelihood of the armature burning out, due to sudden changes of load. We are able to instantly reverse the car and motor, at any speed, without any strain whatever; while the motion under all conditions is similar to that of a hydraulic elevator."

The firm of Whitmore & Robinson, consulting electrical engineers, 133 Essex street, Boston, Mass., has just issued a neat little circular to iron and steel manufacturers and dynamo builders, calling attention to the excellent facilities which the concern now offers for making accurate and reliable tests on the permeability of iron and steel of all grades. These engineers have had long experience in making such tests, and have recently equipped a laboratory which is unexcelled in its appointments. Any kind of electrical or magnetic testing is in their line. They are prepared to calibrate ammeters and voltmeters for use on alternating or continuous current, test insulated wires, dynamos, motors and transformers, make permeability tests on iron and steel, photometry measurements, etc.

The Shipman Engine company of Boston, Mass, is finding that there is nowadays a very close association between the dynamo and a good steam engine. This company reports the sale to the State Agricultural College at Ames, Ia., of a 6 horse power engine for running a dynamo for the college. It has sold also to the State Agricultural College of New Mexico at Las Cruces an 8 horse power engine for the same purpose. It may be mentioned farther that the Shipman company has shipped to the Hawaiian Islands within the past six months eight engines for electric light work, and the company's agent at that point advises that the engines are giving perfect satisfaction, having arrived in good condition and been properly set up and started. A 2 horse power engine and complete electric plant for the rajah's palace has also been lately shipped to Madras, India.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS.

PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., Brooklyn, N. Y.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation is more durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are also prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped around a joint and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible cables with Clark Insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

CHICAGO AGENTS: The Electrical Engineering Co., 320 Dearborn St. TORONTO, ONT. AGENTS: The Toronto Electrical Works.

MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 1201 Market St., Philadelphia, Pa.

See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES A SPECIALTY.

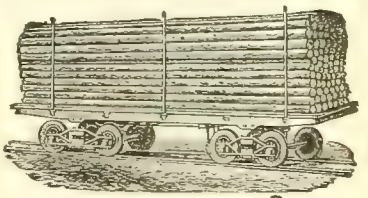
L. BLATZ, 103-107 West Monroe St., CHICAGO.

PLATINUM.

JAS. SCHAWEL & CO., 29 JOHN ST. NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

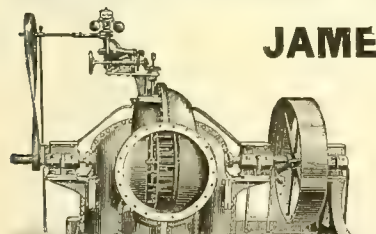
JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL, FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.



Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

PATENTS.

For applications filed during the remainder of 1891 my fees will be due only on allowance, if desired. Write for particulars. WM. H. BABCOCK, Attorney at law and solicitor of Patents, 709 G St. N. W., Washington, D. C. P. O. Box 221, Formerly examiner in U. S. Patent Office. FIFTEEN YEARS' PRACTICE.

The Winner of 1890 will win again in 1891. Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Queen's "1891" Portable Testing Set.

For Illustration see THE WESTERN ELECTRICIAN. Sept. 19. page 183.

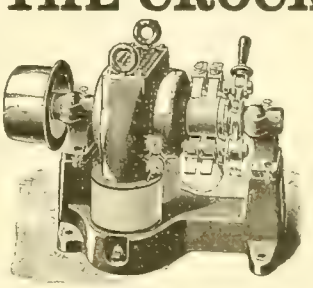
The galvanometer in this set is made of the D'Arsonval type, and is extremely sensitive, without being affected by *mechanical vibrations*, as on shipboard, or by intense *magnetic disturbances*, as in proximity to a dynamo. It is especially recommended for making tests where a galvanometer with fibre suspension cannot be used.

Send for Illustrated Descriptive Catalogue, 1-66

QUEEN & CO., PHILADELPHIA.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipments. Correspondence Solicited.

430--432 WEST 14TH ST., NEW YORK.

AN EXPENSIVE DELAY

Will Not Occur If You Order Supplies from Us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers; Packard High Grade Lamps; Eddy Motors; "Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

931 Rookery, CHICAGO. 134 E. 6th St., opp. Hotel Ryan, ST. PAUL. 400 W. Michigan St., DULUTH.

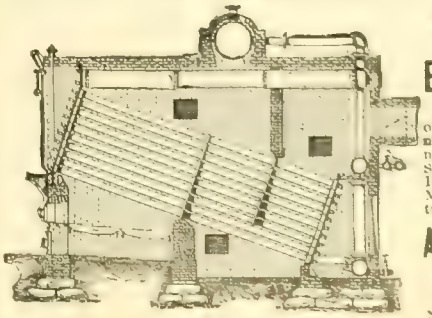
SEND FOR CATALOGUE AND DISCOUNT SHEETS.

ROOT'S WATER-TUBE BOILER.

SAFE. ECONOMICAL. DURABLE

AN EXCELLENT

Electric Plant Boiler.



ROOT SECTIONAL SAFETY BOILER.

Adopted by the Electric Light Companies of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City and a great many others, also by the Armington & Sims Engine Co., Providence, R. I., the Lynn Belt Line Street Ry. Co., Lynn, Mass. and the Thomson-Houston Electric Co., Lynn, Mass.

Abendroth & Root Mfg. Co.,

28 Cliff St., New York.

BRANCHES: Boston, Philadelphia, New Orleans, Dallas, Rochester, Cincinnati and Chicago.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

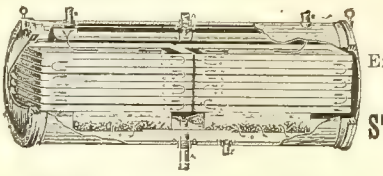
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

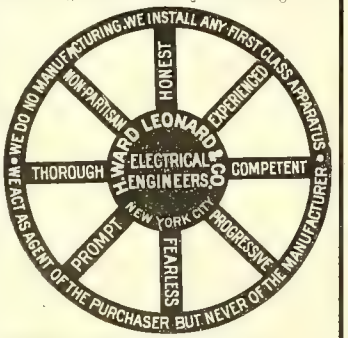
STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

REMEMBER

That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

H. WARD LEONARD & CO.,

Contracting and Consulting Electrical Engineers.



Write for descriptive pamphlet if you wish to use electricity for any purpose whatever.

Electrical Exchange Building,
NEW YORK CITY.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingots, Slabs, Sheet Wire and Castings at lowest market rates.

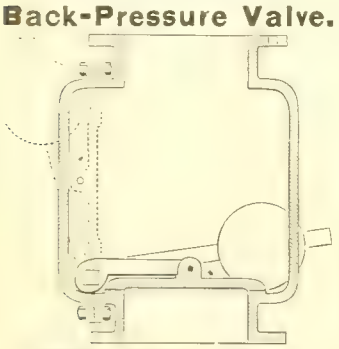
Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.

THE EXCELSIOR

Straight-Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,

229 S. Franklin St., Chicago.

EVERYTHING IN

WIRE—FUSE— STRIPS.

MANUFACTURED BY

The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

73-75 W. Jackson St. RELIABLE

WE ARE FITTED WITH RELIABLE Machinery and Tools, And Employ RELIABLE Workmen.

All Kinds of Electrical Apparatus to Order.

CHICAGO ELECTRIC MFG. CO.

BINDERS

FOR THE WESTERN ELECTRICIAN,
ONE DOLLAR.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

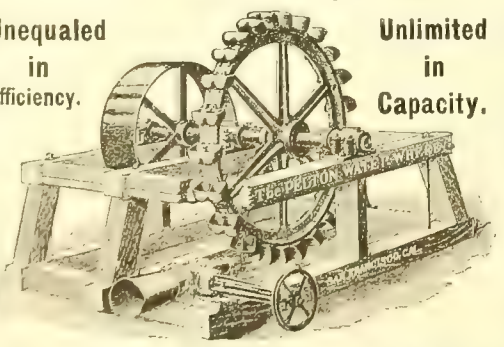
JAS. McLAUGHLIN, Mfg. Electrician.
50 N. Clinton St., Chicago.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS
H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 10 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,
121-123 Main St., San Francisco, Cal., U. S. A.
143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

Gleason & Bailey Mfg. Co.,

(LIMITED.)

GENERAL WESTERN AGENTS FOR THE

STEUBEN INCANDESCENT LAMPS,

The best in the Market,

Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.

Rubber Covered, Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and catalogues.

BERNSTEIN ELECTRIC CO.

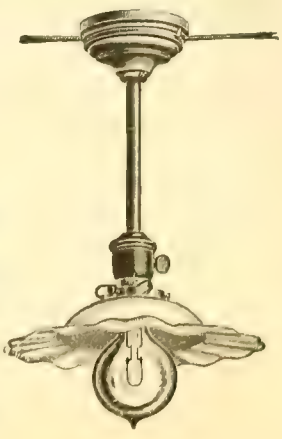
INCANDESCENT LAMPS

—FOR—

ARC LIGHT CIRCUITS.

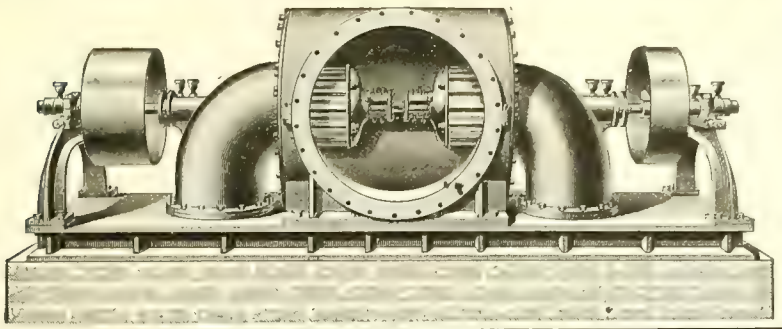
SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,
BOSTON, - MASS.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES [illegible] CELEBRATED WATER WHEEL, [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** [illegible] diameter, being **double** the **Power** of most wheels of [illegible] used by a number of the leading electric [illegible] In its economical use of water it is without an equal, producing [illegible] per cent of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended [illegible] as is required and it can be belted directly to dynamo.

The accompanying engraving represents a pair [illegible] **VICTOR TURBINES** arranged on a horizontal shaft with Conical Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO. CLEVELAND, OHIO.

MAKERS OF HIGH-GRADE

CARBONS

FOR ELECTRIC LIGHTING.

MAP OF THE UNITED STATES.

A large, handsome Map of the United States, mounted and suitable for office or home use, is issued by the Burlington route. Copies will be given free when it can be done without expense for transmission; or they will be mailed to any address on receipt of six cents in postage by P. S. EUSTIS, Gen'l Pass. Agent C. B. & Q. R. R., Chicago, Ill.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215 — 136 Liberty St., NEW YORK

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

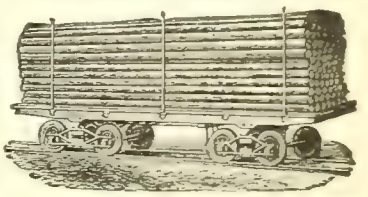
FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing. Will carry two different kinds of material in opposite directions at the same time.

Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. Pres. J. LESLIE WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

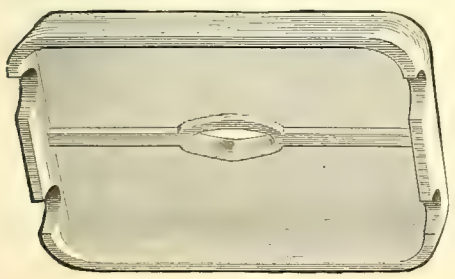
VULCANIZED FIBRE CO.

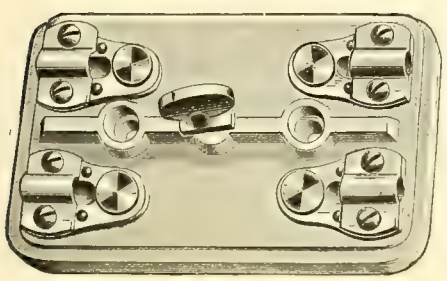
ESTABLISHED 1873.
SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.





CUT-OUTS,

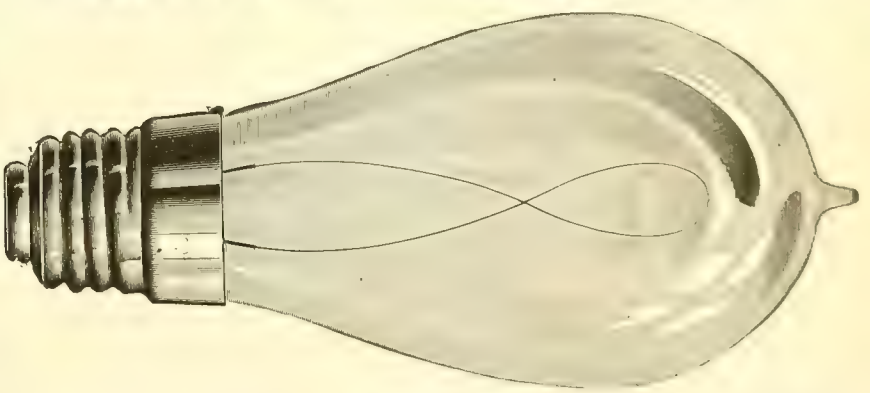
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

C. & C. ELECTRIC MOTORS AND DYNAMOS.

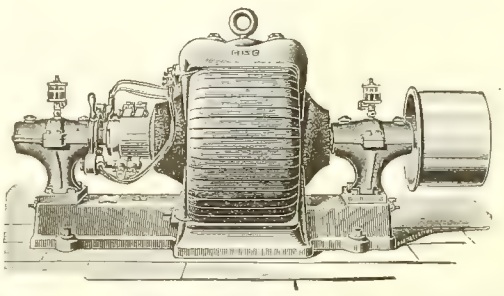
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.

"BE YE THE JUDGE."

HAVE YOU TRIED THE

ECONOMIC INCANDESCENT LAMP?

If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again.* Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

CEO. L. KIRKHAM, Manager. 1017 Chamber of Commerce, CHICAGO.

MORE WORDS ARE NEEDED

TO DO JUSTICE TO THE

PERRET ELECTRIC MOTOR.

The Elektron Manufacturing Co.—

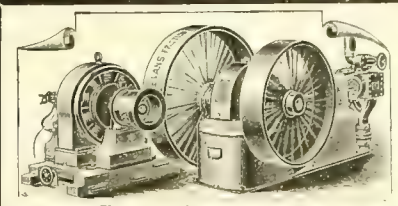
OFFICE OF CURTIS MANUFACTURING CO., Manufacturers of Carriage Robes,
Fifth Avenue and 16th Street, New York City, September 16, 1891.

[illegible] were words enough in the English language to express my admiration of the Perret Motor I might do justice to its good qualities; but there are [illegible] every working day since it was put in, and not one cent has been expended on it except for oil. It drives our six heavy machines as steadily as a clock. [illegible] best power we could get and would not part with it unless I could get its equal. I take special pride in showing it to my friends. It's not a plaything, but business every day. If any one wants to know what it can do, just send them up to me. Yours truly, CURTIS MANUFACTURING CO.

THE ELEKTRON MANUFACTURING CO., SPRINGFIELD, MASS.,

New York Office, 89 Liberty Street.

Selling Agents: WASHINGTON, D. C. J. I. Burkett & Co., 1109 New York Ave. NEW ORLEANS, LA. George Buquie, 140 Gravier St.
CHICAGO, ILL. The Electrical Engineering Co., 320 Dearborn St. ST. PAUL, MINN. F. J. Renz, 95 East Fourth St.
PHILADELPHIA, PA. Pennsylvania Machine Co., 29 North Seventh St.



For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.

Evans' Cones.
For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | **CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.**

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K.K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

BEST MAST ARM IN USE.

More Lamps Trimmed. No Lamps Broken.

CATALOGUES ON APPLICATION.

STAR IRON TOWER CO., FORT WAYNE, IND.

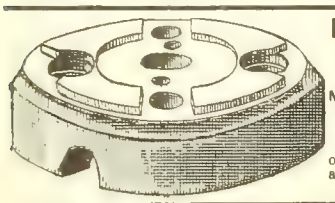
SEND FOR New American Electrical Directory, just published; very complete lists. Invaluable for its information of Lighting and Railway Plants.

THREE GOOD BOOKS.

DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.

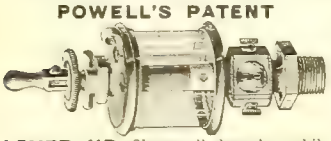
ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO, ILL.

ONE DOLLAR EACH.



EMPIRE CHINA WORKS,
144 to 156 Green St., Green Point, BROOKLYN, N. Y.
MANUFACTORY OF
Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.
Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of
TRUE HARD PORCELAIN.

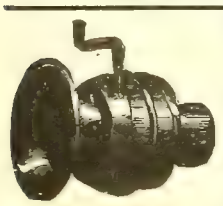
POWELL'S PATENT



LEVER UP—Shows oil dropping while machinery runs.

SIGNAL OILERS

Still in the Van as the BEst for HIGH-GRADE ENGINES and DYNAMOS. The stop-feed features prevent waste of oil which item alone will more than save their cost in a short time. HAS OTHER EXCEPTIONAL POINTS OF MERIT. Send for full descriptive circular. Address THE WM. POWELL CO., CINCINNATI, OHIO.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical
ANNUNCIATORS AND BELLS.
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE. Out August 1st.

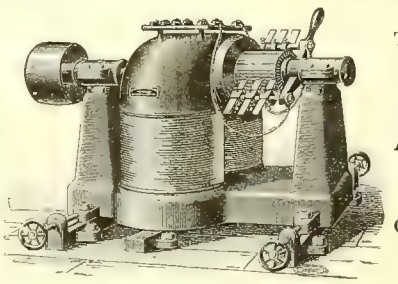
The Card Electric Motor and Dynamo Co.,

CINCINNATI, OHIO.
MANUFACTURERS OF
ELECTRIC MOTORS AND DYNAMOS.

Incandescent **Dynamos** from 20 to 350 Light's.

Arc or Incandescent **Motors** from $\frac{1}{8}$ to 30 Horse Power.

Motors for the Arc Circuit a Specialty.



These Motors have the Highest Efficiency, Low Speed and Self-Oiling Bearings.

AUTOMATIC, SIMPLE, DURABLE AND CLEAN.

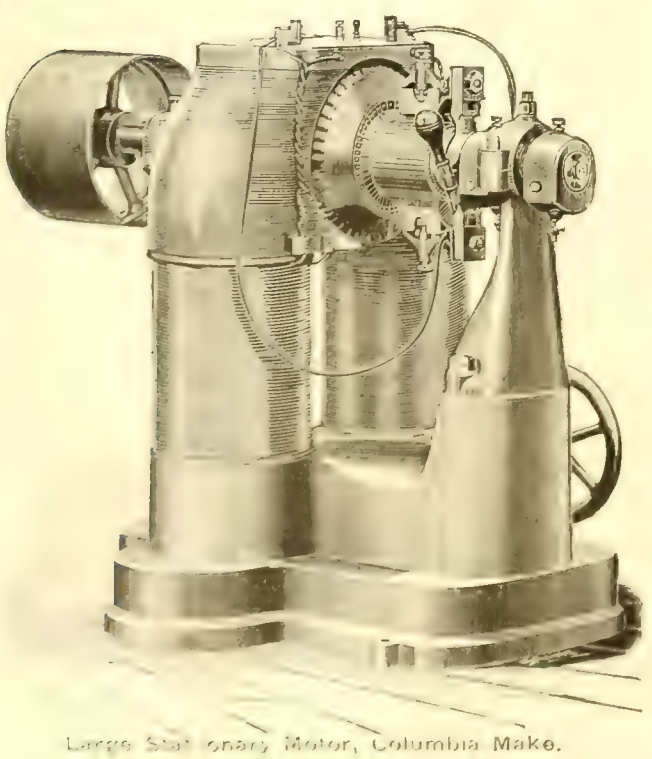
Correspondence Solicited.

AGENTS.—Boston: The Eastern Electrical Supply and Construction Co., 65 Oliver Street. Chicago: The Thos. L. Johnson Co., 312 Dearborn Street. Milwaukee: Henry Ramien, 641 Third Street. Washington, D. C.: J. Geo. Gardner, 1005 H. Street. St. Louis: Slagl Electrical Engineering Co., 1106 Pine Street. Montgomery, Ala.: W. F. Murphy. Detroit, Mich.: The Michigan Electric Co., 212 and 214 Griswold Street. Minneapolis, Minn: J. M. Lennon, 22 Loan and Trust Building.

Subscribe for the Western Electrician.

COLUMBIA ELECTRIC CO.,

MANUFACTURERS OF



Large Stationary Motor, Columbia Make.

MOTORS, GENERATORS, DYNAMOS, LAMPS, SUPPLIES AND SPECIALTIES.

ALL GUARANTEED MECHANICALLY, ELECTRICALLY AND LEGALLY.

ST. PAUL, - - MINN.

THE NATIONAL TRANSFORMER SYSTEM

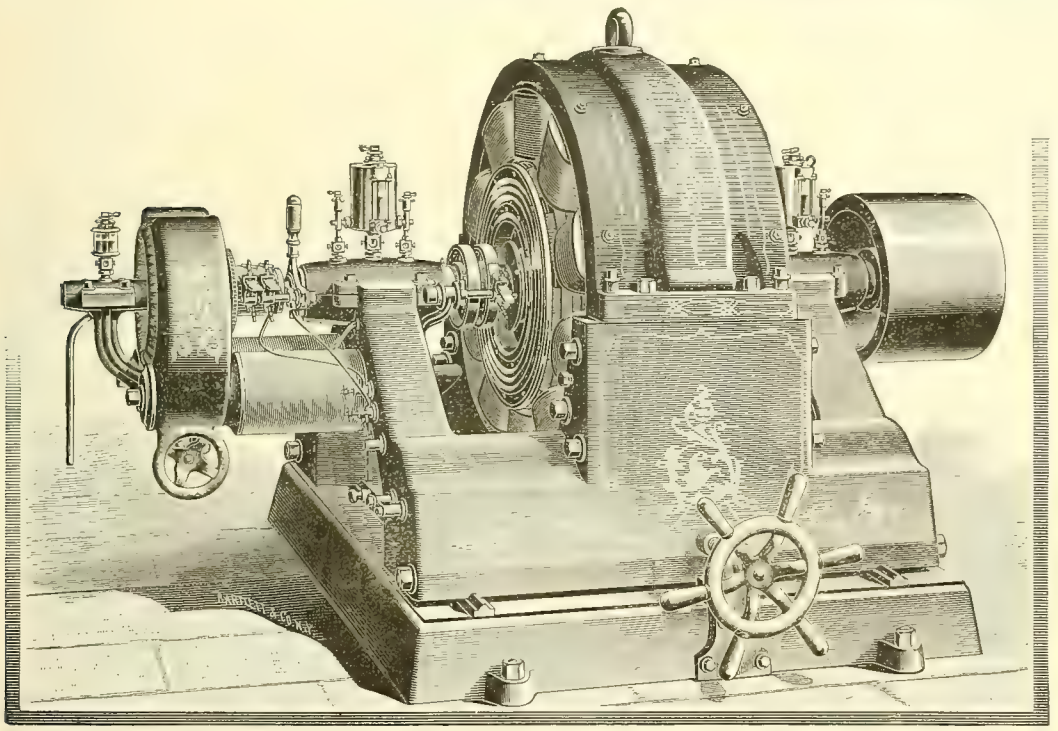
OF INCANDESCENT LIGHTING.

Florence, S. C., August 19, 1891.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.:

GENTLEMEN:—I write this to tell you of the wonderful performance of our Alternating Dynamo, which is a 750 lighter of your manufacture. Last night, while at supper, a cross got on our mains by their sagging on to a telegraph wire, and my engineer, who is a new man, ran the dynamo with the ampere meter needle clear on the end of the scale, which is about 80 amperes, or equivalent to approximately 1,600 lamps. It ran that way until it chocked down a 100 H. P. engine with 110 pounds steam, and then he sent for me. Strange to relate, the machine was not damaged a particle. The excessive current had melted all of the 4 fuses on the board, but the engineer had put in new ones and heavier ones, and had started up again. I consider that we have the only dynamo on earth that would stand such a strain and not be injured. I shall of course see to it, that a thing of this kind does not happen again.

[Signed] A. A. FORMAN, Supt. Florence Impvt. & Mfg. Co.



THIS IS THE MACHINE THAT WE BUILD.

Self-Contained Alternator. Capacity 1,000 16 C. P. Lamps.

SEND FOR CIRCULARS AND PRICES.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

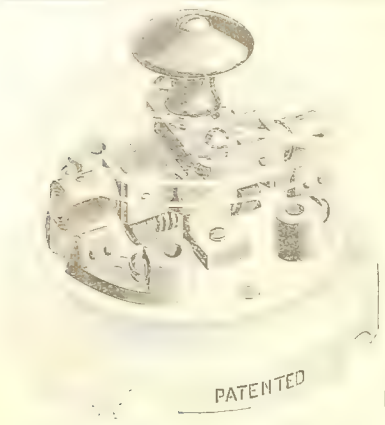
COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

AGENTS

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.
SEATTLE, WASH.,	Chas. H. Baker & Co.
ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
DETROIT, MICH.,	Commercial Electric Co.
DENVER, COLO.,	The Mountain Electric Co.
WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
SAN FRANCISCO, CAL.,	National Electric Development Co.
KANSAS CITY, MO.,	Thomas Wolfe, 515 Main St.
DULUTH, MINN.,	The Electrical Eng. & Supply Co.



OF SOME THINGS ONLY THE BEST!

Three years ago we brought out what was THEN the best switch on the market—now we are doing the same thing again,

BRINGING OUT THE BEST.

THE UNION ELECTRIC MFG. CO.,

BRIDGEPORT, CT.

NEW YORK: Alexander, Barney & Chapin. BOSTON: Eastern Electrical Supply Co.

THE ELEMENTS OF DYNAMIC ELECTRICITY AND MAGNETISM.

A Book For Learners. **JUST OUT!** **Price, $2. Postage Free.**

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.

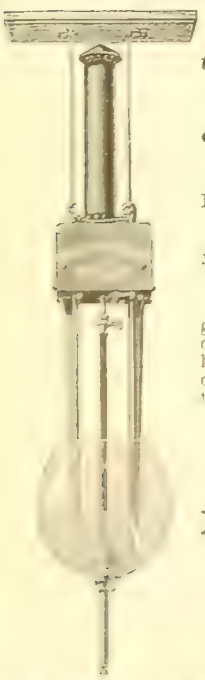
FITCHBURG, MASS, U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

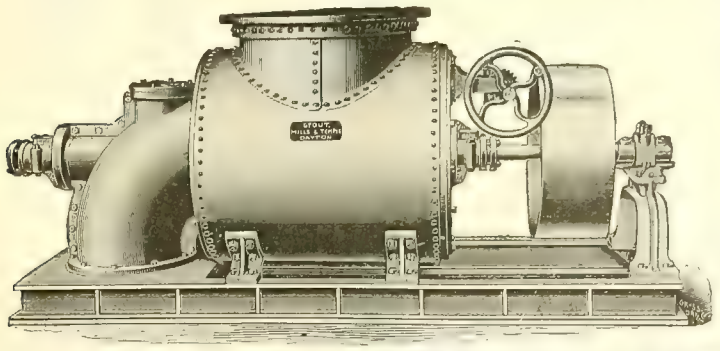
ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

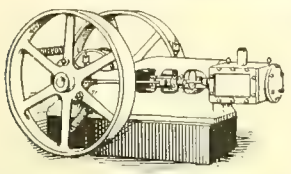
ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North Street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

STEAM PLANTS

INSTALLED BY

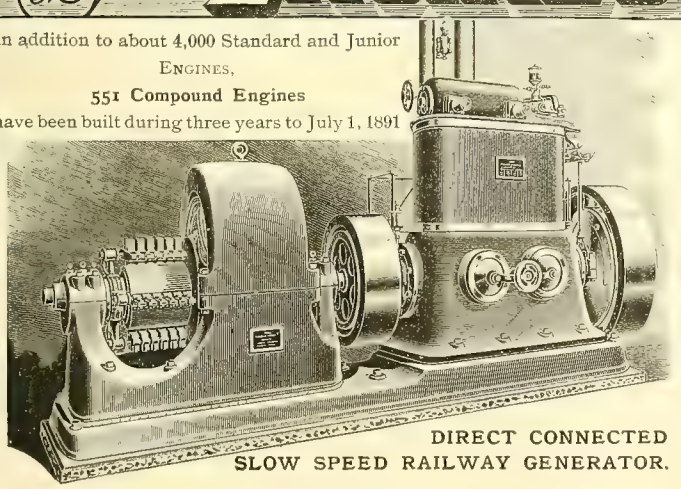
W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

WESTINGHOUSE ENGINES

In addition to about 4,000 Standard and Junior ENGINES,
551 Compound Engines
have been built during three years to July 1, 1891



DIRECT CONNECTED
SLOW SPEED RAILWAY GENERATOR.

125, 250, 500 HORSE-POWER.

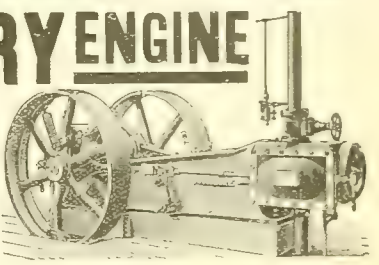
Also Direct Connected Slow Speed Alternating Dynamos of equivalent capacity.

For Circulars and Estimates on Complete Plants, address our Engineers.

THE WESTINGHOUSE MACHINE COMPANY.
BARTLETT & GRAY PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application.



STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES | Philadelphia, 942 Drexel Bldg.
San Francisco, 29 & 31 Spear St.

FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST.
HALF TONE PLATE A SPECIALTY
CHICAGO

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC.
All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street,
CHICAGO.

MAIN OFFICE,
649 and 651 Broadway,
New York.

Geo. H. Meeker,
Western Manager.

AND CHICAGO.

DID YOU SEE IT AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.,

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.

DON'T GET CAUGHT

IN THE WIRE TRAP.

THIS IS A TRAP that a good many superintendents and buyers for electric light stations fall into. A poor wire is dear at any price. The wire may look all right. It may be weather-proof or water-proof until the salesman who sold it gets out of town; but

TO KEEP OUT of this trap, buy good wire; one that when you once put it into a building, you will know to be as good in ten years as the day it was bought.

USE SAFETY WIRE. It has a *seamless rubber insulation*; it is absolutely flame-proof. It is used and heartily indorsed by the intelligent electricians of the country. Miles of it are in use in the New York subways, and it has never been necessary to replace a foot of it.

WRITE US and we will send you our new Pocket Wire Book. It contains valuable information.

A QUESTION.

? Which is the cheapest in the end. Three lamps that cost 40 cents each and only burn 200 hours each, or one lamp that costs 50 cents and burns 600 hours? ?

ANSWER.

3 lamps at 40 cents - - $1.20
1 lamp at 50 cents - - .50

Amount saved, $ .70 by using a good lamp.

THE PERKINS LAMP IS A GOOD LAMP.

THE KNAPP ELECTRICAL WORKS,

Western Agents Safety Wire and Perkins' Lamps,

54 and 56 Franklin St., CHICAGO.

EVERY MAIL

Brings us renewed expressions of confidence in our Shield Brand Moisture-Proof Wire; and a great many orders are coming in; many more than we formerly received. People are beginning to appreciate the difference between a *Moisture-Proof* Wire and that class of wires which are so largely sold under the general name "Weather-Proof." Some of them are fairly good, but most of them are of but little value as regards insulation. It would be just as well to use bare wire, and more sensible, because it would be cheaper. We sell a great deal of Weather-Proof Wire ourselves—our P. & B., which we honestly believe is one of the best, but none of them can compare with our Shield Brand Moisture-Proof, which needs no silver-tongued orator to expound its merits. We are the

SOLE MANUFACTURERS

and our factory is now running over-time to enable us to make ***prompt shipments.***

THE WIRT VOLT INDICATOR.

(PATENTED.)

Is intended to be left in circuit continuously, and can be relied upon for constancy and accuracy under the most trying conditions. The resistance of the instrument is high—making the consumption of energy small. An adjustable index permits *reading at a distance*, indicating variations from normal pressure.

THE SCALES

On these Instruments are spread out so as to give a wide deflection over the most useful range, and a smaller deflection over that part not so much used. This arrangement will be appreciated by every practical user.

We are prepared to furnish special instruments to order for any capacity, and invite correspondence.

THE WIRT AMPERE INDICATOR.

(PATENTED.)

This instrument is designed for the practical work of Station Electricians and answers the conditions more perfectly than any instrument yet sold.

The working parts being simple and well made, will stand handling, shipping, and all ordinary use.

Made in any size from 10 to 1,000 Amperes.

The Electrical Supply Co.,

WESTERN OFFICE AND WAREHOUSES

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

Eastern Office and Factories
Ansonia, Conn.

STREET CARS

FOR SALE

ON ACCOUNT OF

Increase of Business

AND THE

Adoption of Electricity.

THE

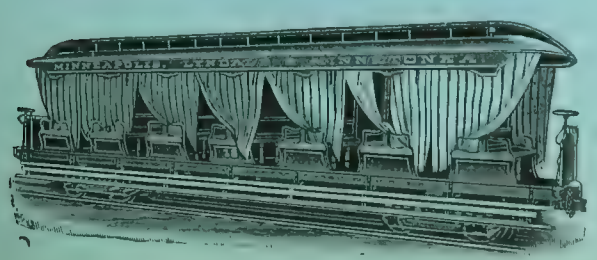
MINNEAPOLIS STREET RAILWAY CO.,

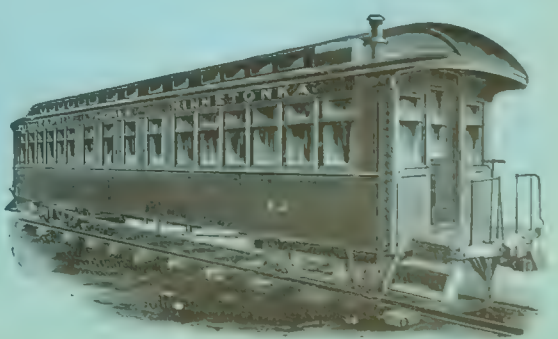
Of Minneapolis, Minn.,

OFFER FOR SALE THE FOLLOWING EQUIPMENT:

63 12-foot Cars, all fitted with Fare Boxes and "Small" Conveyors.
76 Extra "Small" Conveyors for 14 and 16 ft. Cars.
63 Extra "Slawson" Fare Boxes.
12 Steam Motors, 15to 20 Ton.
2 Locomotives and Tenders, 20 and 25 Ton.
21 Passenger Coaches, 26 to 40 ft.
34 Open Passenger Excursion Cars, 34 ft.
8 Flat Cars, 30 ft.

Most of the cars have been in service only a short time, and all are in first-class condition. We can make changes or alterations and fit them up to suit, and will sell very cheap. The gauge of any of the cars can be changed to suit purchaser. Full description and photographs mailed upon application.





FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

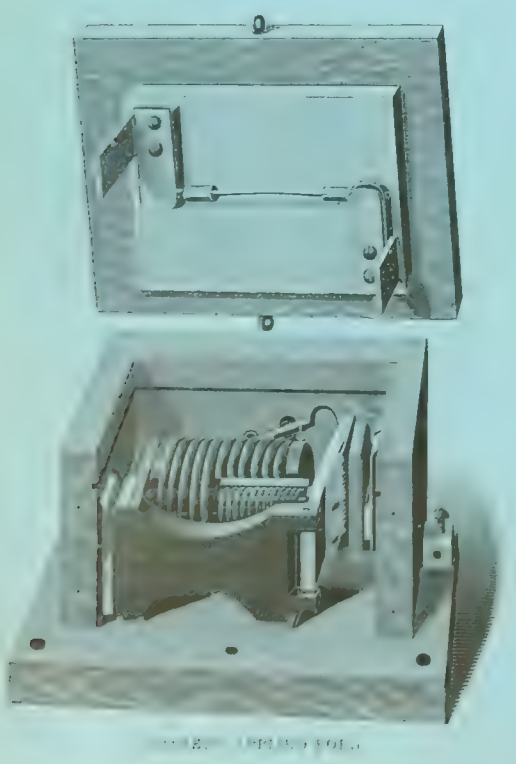
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

GEORGE CUTTER,

Electric Specialties.

333 "THE ROOKERY," CHICAGO.



Cutter's Magnetic Cut-out.

Lightning Arrester AND Cut-Out Combined.

Built on Correct Scientific Principles.
Gives Perfect Protection to the Motor.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, NOVEMBER 7, 1891. No. 19

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

The Minnesota Brush Electric Company

HAVE JUST BOUGHT

82½ MILES

of Arc, Incandescent and Power Cables

INVESTIGATION PROVED IT THE BEST.

OF THE Standard Underground Cable Co.,

New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,

20 CORTLANDT ST., NEW YORK.

GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,

"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,

MANUFACTURERS, IMPORTERS AND DEALERS IN

THE "CHAMPION" BATTERY,

Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.

THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies

Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

New York & Ohio Company, WARREN, OHIO.

MANUFACTURERS OF THE Packard HIGH GRADE INCANDESCENT LAMP

AGENTS:

J. W. Peale, No. 1 Broadway, New York.
Electric Eng. & Supply Co., Syracuse, N. Y.
Central Electric Co., Chicago.
The Electrical Eng. & Supply Company, St. Paul, Minn.
St. Louis Electrical Supply Co., St. Louis.

CLOWER, HARRIS & CO.,

CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS

The largest Electrical Supply House west of the Mississippi River. EVERYTHING ELECTRICAL.

289 ELM STREET, DALLAS, TEXAS.

WILLARD L. CANDEE, H. DURANT CHEEVER, Business Managers. F. CAZENOVE JONES, Manager of Factories.

The International OKONITE COMPANY, LIMITED.

13 Park Row, New York.

OKONITE TRADE MARK

INSULATED

WIRES AND CABLES,

For Aerial, Submarine and Underground Use.

Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

WRITE FOR PRICES ON

TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.

R. D. Nuttall Company,

Allegheny, Pa. New York.

THE 1891 ELECTRIC MOTOR AND BATTERY.

SIMPLE. DURABLE.
ECONOMICAL. EFFICIENT.

For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at

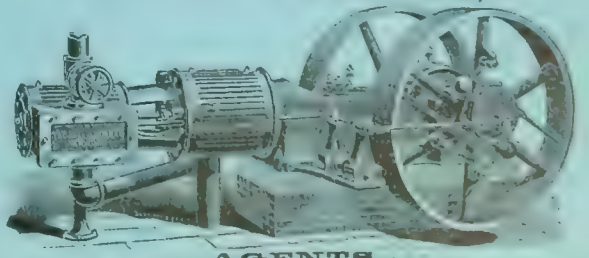
ONE-HALP PRICE.

Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IMPROVED BALL ENGINES,

BUILT BY THE BALL & WOOD CO., NEW YORK.



AGENTS

W. B Pearson & Co., Home Insurance Building, Chicago, Ill.
Thos. G. Smith, Jr., 11 Hammond Building, Cincinnati, Ohio
W. A. Day 128 Oliver Street, Boston, Mass.
A. M. Morse & Co., St. Louis, Mo.
Cooley & Vater, Minneapolis, Minn.
Mead & Stringham, 291 Hammond Building, Detroit, Mich.

The Thomson-Houston ELECTRIC CO.,

MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co. ——
Alexander, Barney & Chapin i
American Electrical Works. xiii
American Tube & Iron Co. xii
Andrews & Co., A. H. xix
Baggot, E xiv
Bain Electric Mfg. Co. ix
Ball Engine Co. xix
Ball & Wood Co., The i
Beckerleg, Jas. G. xiv
Beggs, J. E., Mfg. & Supply Co. iv
Bernstein Electric Co. ——
Blatz, L. ——
Borden & Selleck Co. xv
Braun Illustrating Co xix
Brownlee & Co. xii
Brookfield, Wm. xii
Brush Electric Co. xvii
Butler Hard Rubber Co ——
Buxton, Geo. B ix
C. B. & Q. R. R. xv
C. & C. Electric Motor Co. xvi
Card E. Motor & Dynamo Co. ——
Central Electric Co. v
Chicago Electric Mfg. Co. xv
Chicago Electric Motor Co. xiii
City of Big Rapids, Mich. xiv
Clower, Harris & Co. i
Chicago Insulated Wire Co. xvii
Colburn Electric Mfg. Co. x
Columbia Electric Co. vii
Consol. Elec. Mfg. Co., The. ——
Cowles Elec. Smelt & Alum. Co. xiv
Crocker-Wheeler Elec. Mo. Co. xiii
Day's Kerite Insulation i
Dayton Globe Iron Works Co. xix
Delaware Hard Fibre Co. xvii
Detroit Electrical Works. ——
Densmore Typewriter Co. xii
Eastern Electric Cable Co. xiii
Easton Electric Co. xv i
Edison General Electric Co. vi
Edison General Electric Co., Cable and Wire Department. vi
Electric Construction & Sup. Co. viii
Electric Merchandise Co. x
Electric Secret Service Co. x
Electrician Pub. Co. xv, xviii
Elec. Construction Co., The. xiii
Electrical Engineering Co. ——
Elec. Eng. & Supply Co., The. ——
Elec. Supply & Contracting Co. ix
Electrical Supply Co., The. xxii
Elektron Mfg. Co. iv
Empire China Works. xiv
Erie Electrical Supply Co. xv
Evans Friction Cone Co. xvii
For Sale iv, xiv, xv
Foster, O. A. i
Fort Wayne Electric Co. xxiv
Gleason & Bailey Mfg. Co. Ltd. xiv
Globe Carbon Co. xv
Great Western Elec. Supply Co. ix
Greeley & Co., The E. S. i
Goodrich-Coleman Elec. Wks. iv
Heisler Electric Co. iv
Hill Clutch Works. xvii
Hine Eliminator Co. ——
Holmes, C. H. xiii
Holmes, Booth & Haydens. xvi
Hood, Wm. x
India Rubber & Gutta Percha Insulating Co. xxiii
Interior Conduit & Insulation Co. x
International Okonite Co. i
Kartavert Mfg. Co. xiv
Keller & Degenhardt xii
Knapp Electrical Works. xxi
La Roche Electric Works. iv
Law Telephone Co. xiii
Leonard & Co., H. Ward. xiv
Leffel & Co., Jas. xiii
Loud, H. M. & Sons Lumber Co. xiv
McLaughlin, James xiv
Mason, James H. xiii
Milliken Bros. iv
Monitor Electric Co. x
Mosher Arc Lamp Co. ——
Munsell & Co., Eugene. xiii
Murphy, T. J. xv
National Carbon Co. iv
National Electric Mfg. Co. ——
N. Y. Belting & Packing Co. ——
New York Insulated Wire Co. xvi
New York & Ohio Co. i
N. W. Elec. Specialty Co. ——
Nuttall Company, R. D i
Ostrander & Co., W. R. x
Palste, H. T. xii
Page Belting Co. xv
Partrick & Carter Co. ——
Payne & Co., Geo. W. viii
Pearson & Co., W. B. xix
Pelton Water Wheel Co xiv
Phœnix Glass Co. ix
Pond Engineering Co xix
Powell Co., The Wm. ——
Queen & Co. xiii
Ries Elec. Specialty Co., The. x
Rockford Electric Mfg. Co. xii
Royal Electric Co. ——
Samson Cordage Works xi
Sargent & Lundy xiii
Sawyer-Man Electric Co. xi
Schawel & Co., Jas. xii
Schieren & Co. Chas. A. xii
Schoonmaker, A. O xii
Schuyler Electric Co. viii
Short Electric Railway Co. xii
Schultz Belting Co. xiv
Sperry Elec. Mining Mach. Co. xv
Standard Underground Cable Co. i
Stanley Electric Mfg. Co. xxiii
Star Electrix Co. xxiv
Stearns Mfg. Co. xix
Sterling, W. C. xv
Steuben Elec. Mfg. Co., The ix
Stilwell & Bierce Mfg. Co. xiv, xv
Sunbeam Incand. Lamp Co vii
Taussig, S. ——
Temple, J. C. xv
Thomson-Houston Elec. Co. ii, xx
Union Electric Mfg. Co., The. ——
Union Electric Works. xv
Union Hardware Co. xii
U. S. Electric Lighting Co. xi
Van Nuis C. S. i
Vulcanized Fibre Co. xv
Wanted xiii, xiv
Western Electric Co xvi
Westinghouse Elec. and Mfg Co ——
Westinghouse Machine Co. xix
Weston Electrical Instrum't Co. xii
Williams Engine Works. xix
Woodbridge & Turner Eng. Co. xv
Woodhouse & Rawson, Ltd. ——
Worthington, Henry R. xii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelt. & Alum. Co.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Union Electric Works.
Western Electric Co.

Anti-friction Metal.
Turner Brass Works.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Columbia Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Samson Cordage Works.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.' The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Castings, Brass.
Blatz, L.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electric Supply & Contracting Co
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Steuben Electric Mfg. Co.
Temple, J. C.
Thomson-Houston Electric Co
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Bagge, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Columbia Electric Co.
Detroit Electrical Works.
Easton Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Columbia Electric Co.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co. The.
Star Electrix Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrolliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The
Beggs, J. E., Mfg. & Supply Co
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co,
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Columbia Electric Co.
Detroit Electrical Works.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co. The.
Star Electrix Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Columbia Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Steuben Electric Mfg. Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm

Mining Apparatus, Electric.
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors
Bain Electric Mfg. Co.
Braun Illustrating Co.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Foster, O. A.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Pumping Columns.
American Tube & Iron Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co

Trolley Cord.
Samson Cordage Works

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Tubing
American Tube & Iron Co.

Turbine Wheels.
Dayton Globe Iron Works Co
Leffel & Co., James.
Pelton Water Wheel Co
Stilwell & Bierce Mfg. Co

Type Writers.
Densmore Type Writer Co.

Valves
Beckerleg, Jas. G.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. **THE NATIONAL CARBON CO.** CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

NOW THEN! FOR SALE CHEAP!!

Eight 500 light Thomson Houston Incandescent Dynamos, 110 volts.
Two extra Armatures for same.
Four American Arc Machines, 65 lights, 2,000 candle power.
60 miles No. 19 American Elect. Wire used about one year.
One 60 H. P. Horizontal Boiler, full front.
One 65 H. P. Westinghouse Automatic Engine.
High speed Engines, Pumps and equipments for Electrical Stations on hand.
Two Schuyler Arc Dynamos, type 2, No. 1, ten lamps each.
Twenty 2,000 Candle Power Arc Lamps, Schuyler.
Two Resistance Boxes.
17 Thomson-Houston 1,200-candle power arc lamps.

JOHN E. BEGGS M'F'G. & SUPPLY CO., 74 Cortlandt Street NEW YORK.

Goodrich-Coleman Electrical Works,

NEW ELECTRICAL THEORIES DEVELOPED.
Manufacturers of Specialties and Novelties under Contract.
31 South Canal Street, - CHICAGO.

IMPORTANT.

THE HEISLER SYSTEM IS THE
ONLY APPARATUS
MADE FOR LONG DISTANCE LIGHTING THAT IS
SELF-CONTAINED
AND PROVIDED WITH ABSOLUTELY
AUTOMATIC REGULATION.

Our Series Socket is **SAFE, RELIABLE,** and **DURABLE,** and is protected with **INSULATED** covering, notwithstanding the claims of monopoly of these features by other manufacturers.

Series Sockets and Lamps for Arc Light Circuits.

WE INVITE INVESTIGATION.

HEISLER ELECTRIC CO.,

DREXEL BUILDING,
PHILADELPHIA, PA.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

56 LIBERTY STREET, NEW YORK.
MANUFACTURED BY MILLIKEN BROS.
59 DEARBORN STREET, CHICAGO.

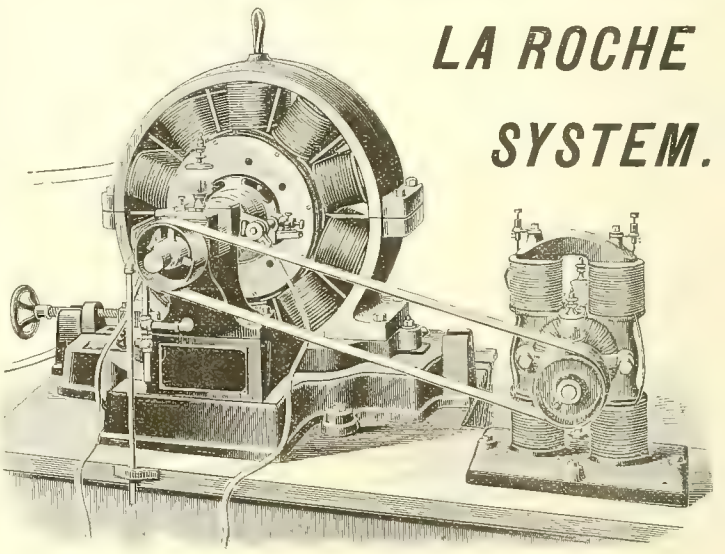
Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,
FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

MORE WORDS ARE NEEDED

TO DO JUSTICE TO THE

PERRET ELECTRIC MOTOR.

The Elektron Manufacturing Co.—

OFFICE OF CURTIS MANUFACTURING CO., Manufacturers of Carriage Robes,
Fifth Avenue and 16th Street, New York City, September 16, 1891.

Gentlemen:—If there were words enough in the English language to express my admiration of the Perret Motor I might do justice to its good qualities; but there are not. We have used it every working day since it was put in, and not one cent has been expended on it except for oil. It drives our six heavy machines as steadily as a clock. I consider it the very best power we ever had, and would not part with it unless I could get its equal. I take special pride in showing it to my friends. It's not a plaything, but useful every day. If any one wants to know what it can do, just send them up to me.

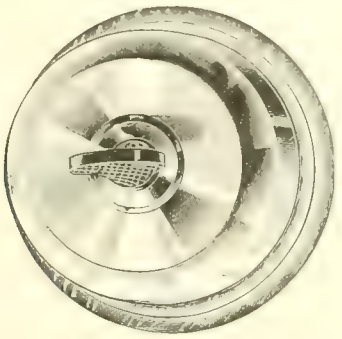
Yours truly, CURTIS MANUFACTURING CO.

THE ELEKTRON MANUFACTURING CO., SPRINGFIELD, MASS.,

New York Office, 89 Liberty Street.

Selling Agents: WASHINGTON, D. C., J. I. Burkett & Co., 1109 New York Ave. NEW ORLEANS, LA.—George Baquie, 140 Gravier St.
CHICAGO, ILL., The Electrical Engineering Co., 320 Dearborn St. ST. PAUL, MINN., F. J. Benz, 95 East Fourth St.
PHILADELPHIA, PA., Pennsylvania Machine Co., 29 North Seventh St.

PAISTE SWITCHES.



5 Ampere Paiste Switches, Porcelain Bases, 30c.
10 do. do. do. do. do. 35c.

OUR ST. LOUIS BRANCH.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

OUR KANSAS CITY BRANCH.

OKONITE
TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

OUR OMAHA BRANCH.

OKONITE
TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
118 S. 15th St., Omaha, Neb.

OKONITE
TRADE MARK

CENTRAL ELECTRIC
MINNEAPOLIS ST. PAUL CHICAGO
SAN FRANCISCO DENVER OMAHA KANSAS CITY ST. LOUIS DETROIT NEW YORK NEW ORLEANS
OKONITE
TRADE MARK.

OUR DENVER BRANCH.

OKONITE
TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., Denver, Colo.

We haven't much on our page this week,
but we want you to READ IT ALL.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

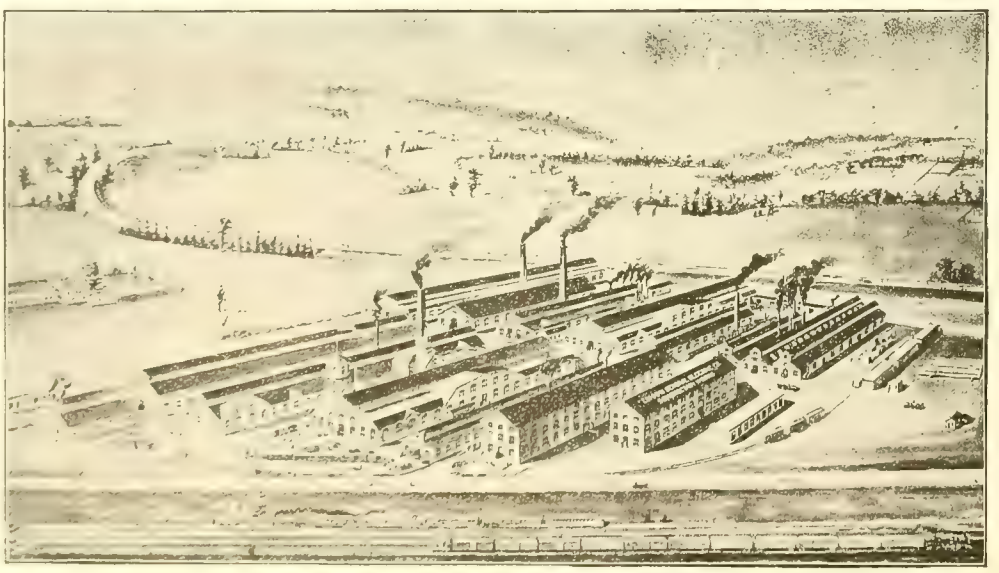
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

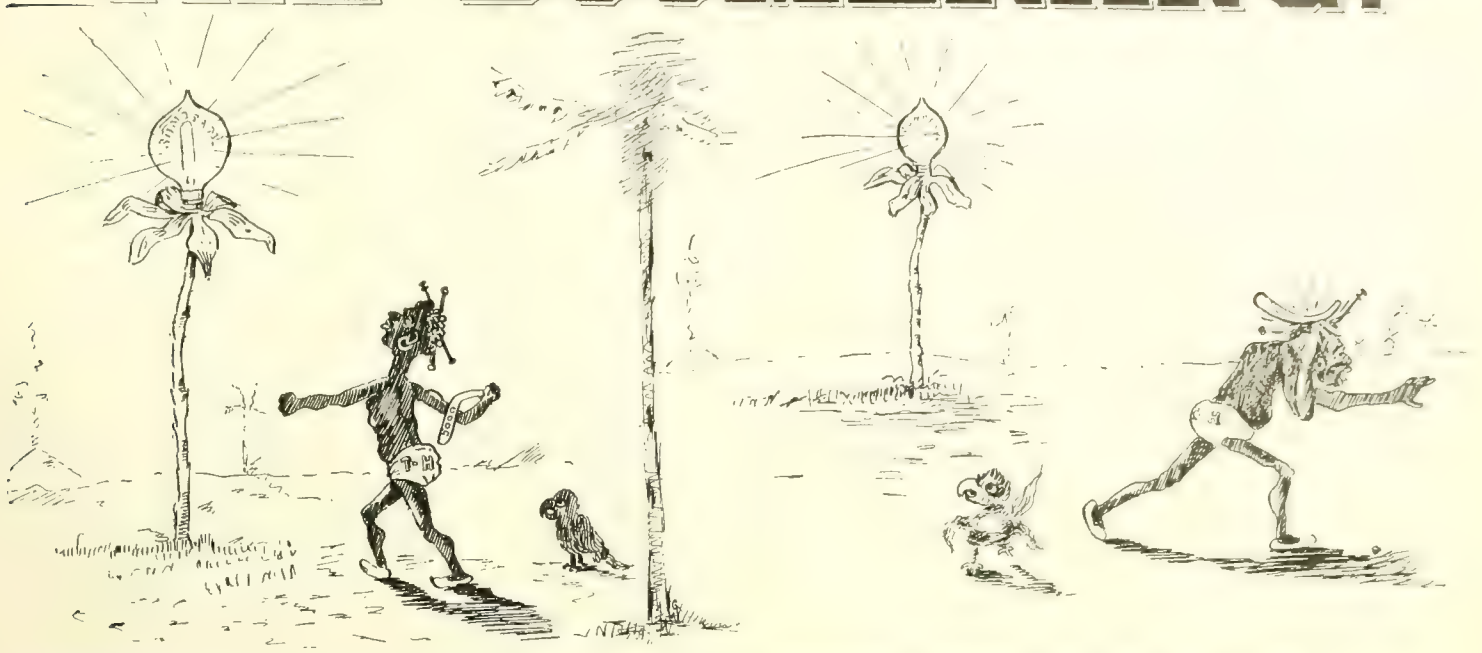
AT THEIR SCHENECTADY WORKS.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE BOOMERANG.



TIPPOO HIPPOLITE:—"*Yo' jess hol' on, Polly—dat bread fruit boun' to tumble. Watch me whack it.*"—

T.-H. ADVERTISEMENT.

"—On the porch at my said hotel, said lamp burned continuously for 4,620 hours, burning out July 15, 1891. —"

"—We have probably 200 Thomson-Houston lamps burning that have burned 5,000 hours. The lamps were all I could ask. Have tried "Sunbeam," ..... and other lamps made in Chicago, and the ....., all of which are no good on earth."—

POLLY:—*Fo' de lawds sake, Tippoo! Can't you jis' no better 'n dat? You done whack* ***yourself.***"

T.-H. EXPERT.

Treatise on Incandescent Lamps.

"While numerous reports have been published in which phenomenal records for life have appeared -no tests have shown that the lamps were of any value for illumination after a run of 500 or 1000 hours. The writer has yet to see a lamp whose candle power after 1,000 hours' run was not so much reduced as to make it **worthless.**"

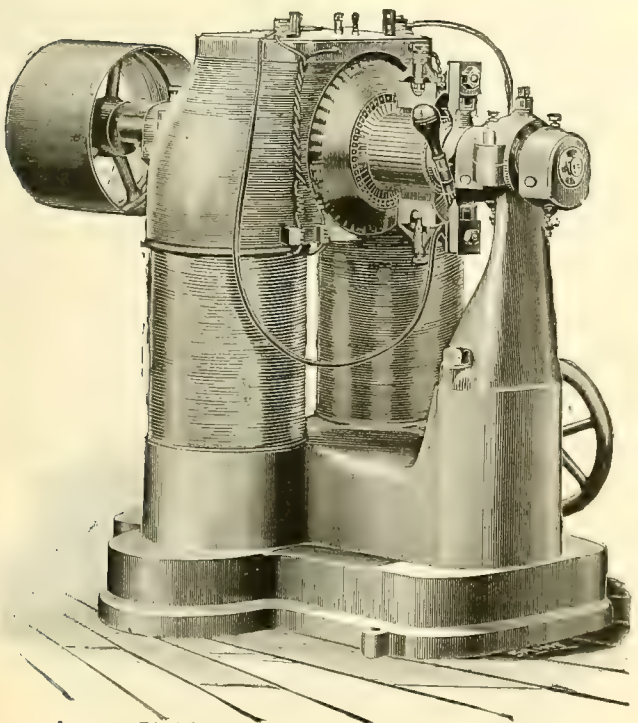
A SUGGESTION. The next time that the Thomson-Houston Company wish to show the superiority of their goods and assume the responsibility for a statement made by one of their customers directly reflecting on goods made by their competitors, it might first be well for them to make sure that they are on the right side of the fence themselves.

WE CAN furnish a lamp of high efficiency or a long-lived lamp, as our customers may desire. Each style will be found to give a whiter light and more light per dollar of expenditure in current than similar lamps made by other manufacturers.

THE SUNBEAM INCANDESCENT LAMP CO., 805 Chamber of Commerce Bldg., CHICAGO.

COLUMBIA ELECTRIC CO.,

MANUFACTURERS OF



Large Stationary Motor, Columbia Make.

MOTORS, GENERATORS, DYNAMOS, LAMPS, SUPPLIES AND SPECIALTIES.

ALL GUARANTEED MECHANICALLY, ELECTRICALLY AND LEGALLY.

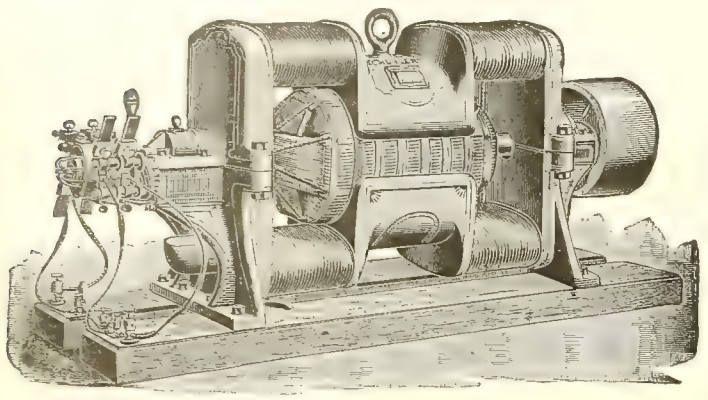
ST. PAUL, - - MINN.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

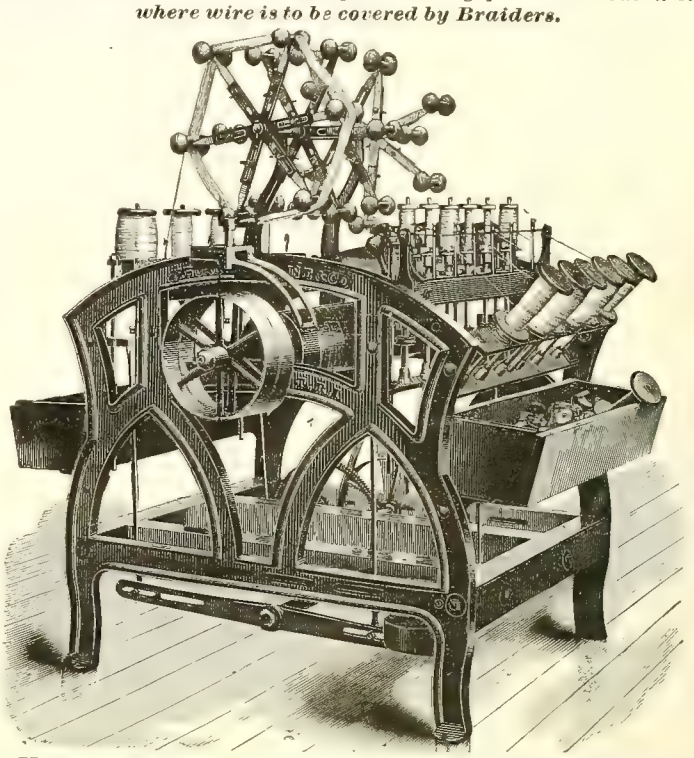
MIDDLETOWN, CONN.

GEORGE W. PAYNE & CO.,

MANUFACTURERS OF

BRAIDER SPOOLERS,

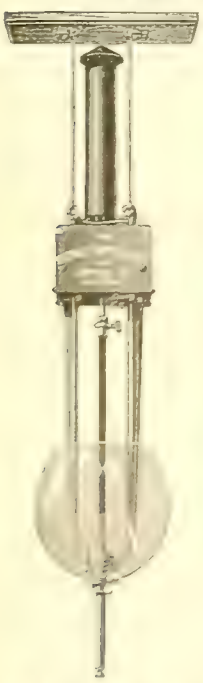
Used in connection with Braiding Machinery for Electrical Work where wire is to be covered by Braiders.



Machines built when required to double two or more ends, with drop motions to stop spindle when end breaks, also when bobbin is full.

Works 102 Broad St., PAWTUCKET, R. I.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

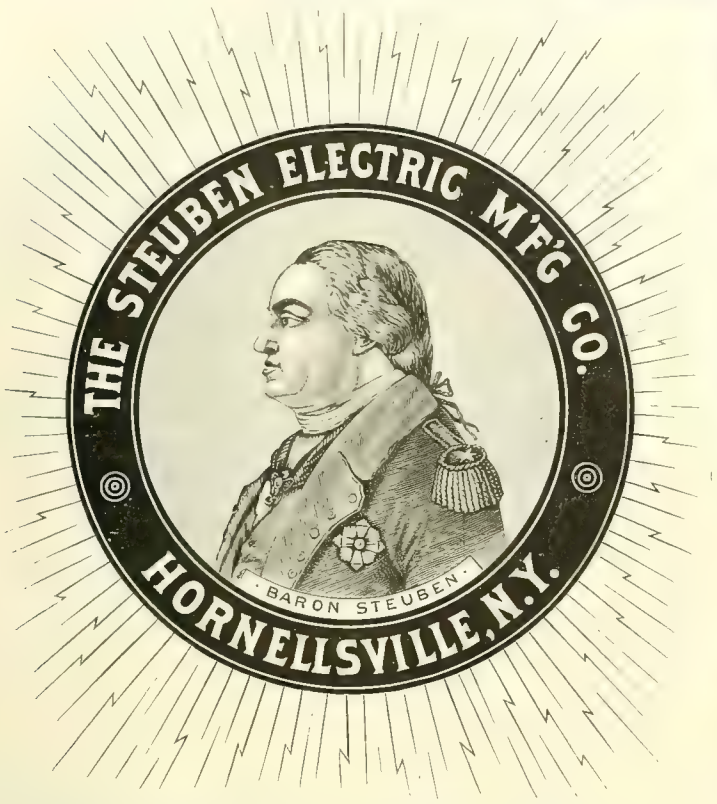
Telephone Building,
NEW YORK CITY.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

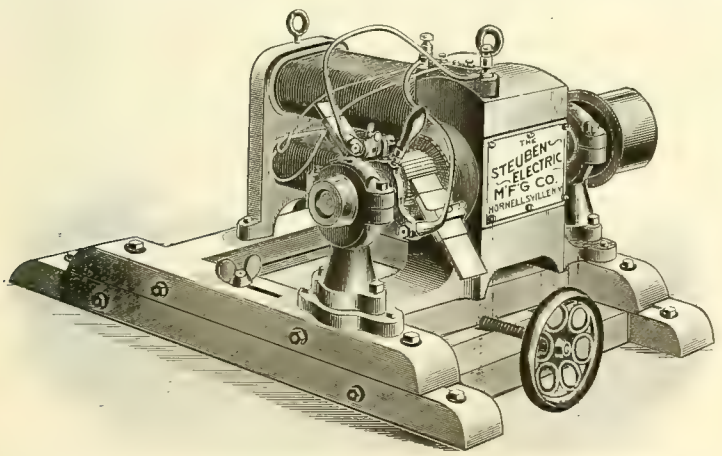
JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.



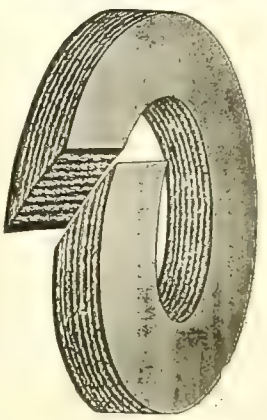
DO YOU want a first-class DYNAMO with which to DRIVE your competition? If so, DIRECT your inquiries to us.



ELECTRICAL AND MECHANICAL ENGINEERING AND SUPPLIES.

REPAIRING ELECTRICAL MACHINERY

The Electric Supply & Contracting Co.,
Nevada Building,
S. E. Cor. 5th & Sycamore Sts., CINCINNATI, O.



Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every state in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,
17 VIRGINIA ST., EAST SOMERVILLE, MASS.

REMOVAL NOTICE.

On and after *November 1,* our *New York Salesrooms* will be located at

42 MURRAY ST.

YOURS TRULY,

PHŒNIX GLASS CO.

You can Put It up Yourself.	Lights Are Standard And Full size.	Thoroughly Reliable And Practical.	Prices Reasonable.	Send For Illustrated Pamphlet.

BAIN ELECTRIC MANUFACTURING CO.,

47 So. JEFFERSON STREET,

CHICAGO.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

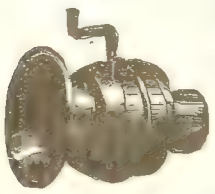
Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

Something Entirely New. NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED. **Simple, Efficient, Economical.**

Indorsed by the Electrical Press, and Prominent Electrical Engineers and Electricians. For Particulars and Prices write to

THE RIES ELECTRIC SPECIALTY COMPANY, PATENTEES AND SOLE MANUFACTURERS REGULATING SOCKETS.

Baltimore and Eutaw Sts., BALTIMORE, MD.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN St.

FITCHBURG, MASS, U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

SUBSTANTIAL, NEAT, ECONOMICAL.

ELECTRIC RAILWAY SUPPLIES

EXCLUSIVELY

OUR BUSINESS.

ELECTRIC MERCHANDISE

COMPANY,

CHICAGO,

11 ADAMS STREET. ILL. W. R. Mason, Gen. Mgr.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

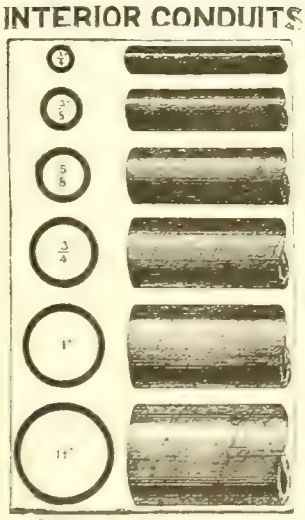
16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

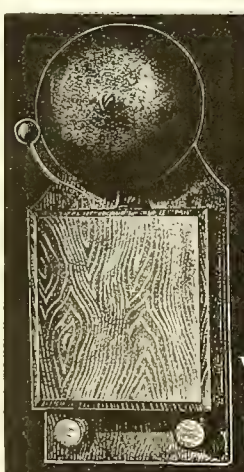
INTERIOR

CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 220 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.



MONITOR

WOOD-BOX

BELLS

ARE THE BEST.

Polished Case, Nickel Plated Trimmings, Heavy Magnets, Quick Stroke, Clear Ring.

Write for Quotations to . . . .

C. A. HARMOUNT, M'gr,

MONITOR ELECTRIC COMPANY

149 Wabash Av., CHICAGO, ILL.

Western Agents Alfred F. Moore's Wires and Cables.

THOMAS STURGIS. Prest. Wm. C. LANE. Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY. NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

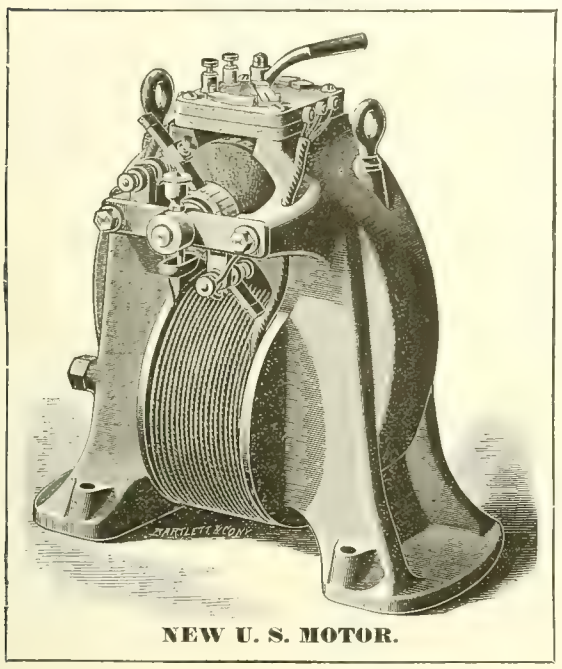
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Miles of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

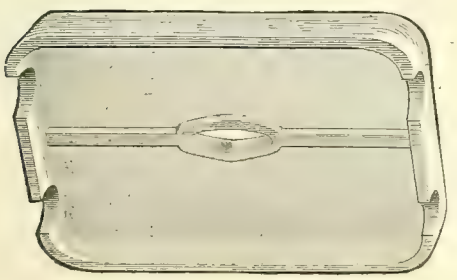
MOTORS and GENERATORS

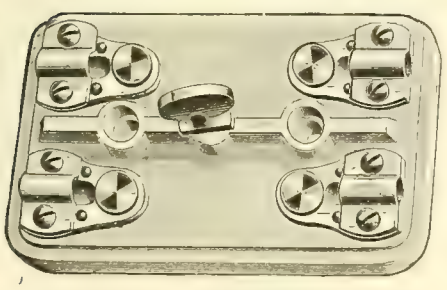
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

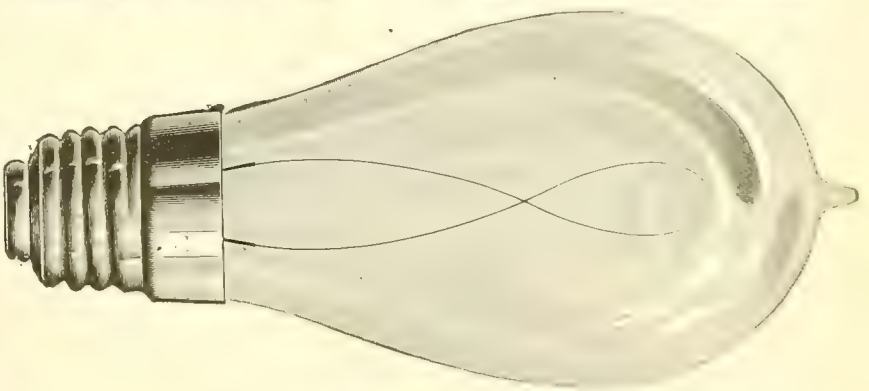
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

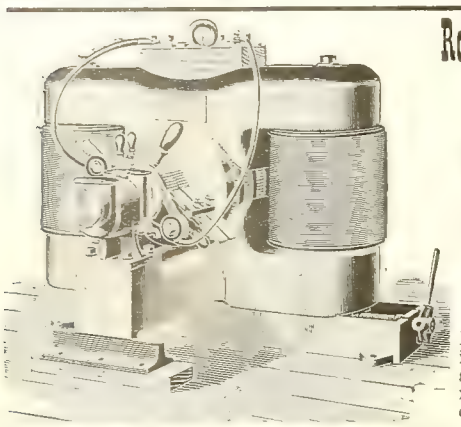
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway).

Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 1201 Market St., Philadelphia, Pa.

See our full page advertisement in issue Sept 12, for illustrations, prices, etc.

MICA.

For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

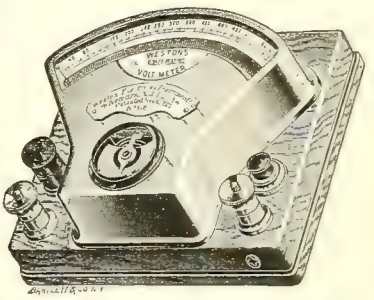
CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. **Chicago Branch, 93 and 95 Lake Street.** ST. LOUIS. ST. PAUL.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

PLATINUM.

JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

The "DENSMORE,"

The World's Greatest Typewriter,

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type-bar machines.

Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Steel throughout.

STANDARD KEY BOARD with shift carriage for capitals. Call or send for catalogue.

[illegible] The height of perfection. To buy any other than the 'DENSMORE' [illegible] Stenographer, National Park Bank.

[illegible] dealer in all cities as soon as possible, and in the meantime will ship [illegible] good commercial rating.

DENSMORE TYPEWRITER CO., 202 Broadway, New York.

AMERICAN TUBE & IRON CO.,

MANUFACTURERS OF

Wrought Iron and Steel Welded Tubing

OF EVERY DESCRIPTION.

We Make a Specialty of Pumping Columns for Mines.

Main Office: 98 John St., New York.

OFFICES AND WAREHOUSES:

50 & 52 S. CANAL ST., CHICAGO, ILL.

923, 925, 927 N. SECOND ST., ST. LOUIS, MO.

167 FIRST AVENUE, PITTSBURGH, PA.

19 PEARL STREET, BOSTON, MASS.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

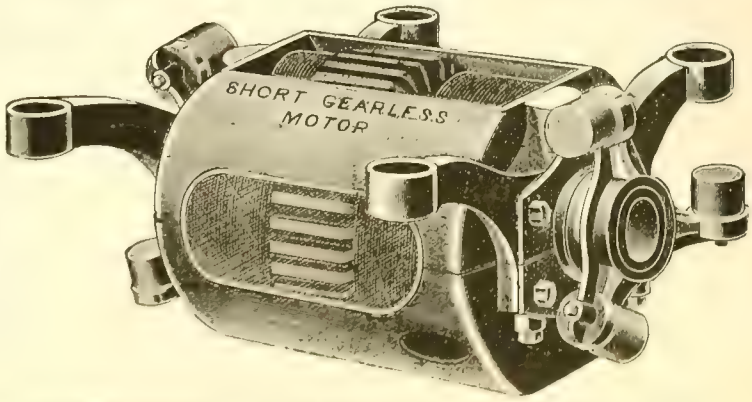
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

The Gearless Motor



Is now a reality to hundreds of street railway officials who visited Pittsburgh during the Street Railway Convention. It is pronounced by all "**A Brilliant Success.**" Buy no equipment until you have examined Short Motors and obtained prices from

THE SHORT ELECTRIC RAILWAY CO., CLEVELAND, OHIO.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, NOVEMBER 7, 1891. No. 19

Temporary Lighting and Power Plant at the World's Fair.

Much has been written in relation to the electrical features at the World's Fair, but the first tangible evidence of the part that electricity will play in the great exposition is to be seen at the temporary electric lighting and power station now in operation at Jackson Park, and illustrated in the accompanying views. This interesting installation has been erected simply for the purpose of furnishing light and power on the grounds while the work of construction is going on. By its aid the workmen will be able to prosecute building operations at night, when necessary, and power can be furnished to the saw-mills and other machinery more safely and conveniently than by any other method. Before May 1, 1893, the plant will have fulfilled its mission, and the rough wooden building in which it is housed will have been torn down, the machinery being returned to the owners for such use as they deem best.

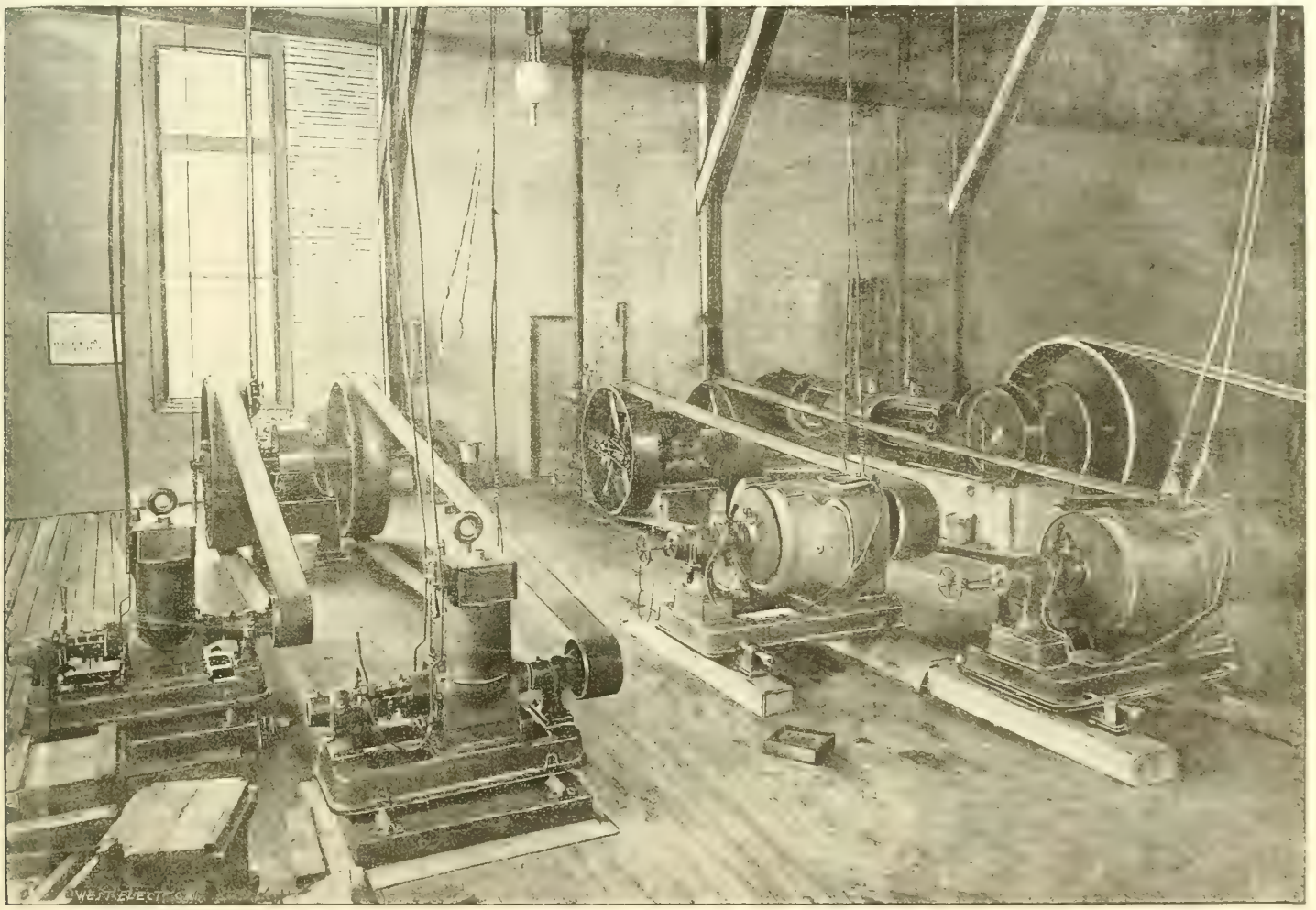


FIG. 1. TEMPORARY LIGHTING AND POWER PLANT AT THE WORLD'S FAIR.

An illustration of the temporary station building, at that time not quite finished, was shown in the WESTERN ELECTRICIAN of October 10th. The visitor to the grounds will find it directly south of the transportation building and west of the mines building, not a great distance from the Sixty-third street entrance.

At the present time the plant consists of three engines and five dynamos, in addition to a complete boiler equipment. It is owned by the Edison General Electric company, but is leased to the World's Columbian Exposition until January 1, 1893. Bids for furnishing the installation were solicited by the construction department, and as the offer of the Edison company was by far the lowest it secured the contract for the electrical machinery. Although only intended for temporary use the machinery is all new and of the most modern type of Edison apparatus.

In the general view presented in Fig. 1 two arc and two incandescent dynamos are shown. The latter, on the left, are of the familiar type of Edison machines, and are belted to a 50 horse power Ball engine. The dynamos are rated as 200-light machines, and at present are carrying about that numbr of lights, or half the capacity of the plant.

The two arc dynamos furnished by the Edison company are shown on the right of the picture. They are driven by an 80 horse power Phœnix engine and are capable of supplying 50 lights each. They are of the Edison-Sperry type, and represent a new branch of the Edison company's varied industries.

The big 125 horse power generator is shown in a separate picture, Fig. 2. This machine is of 100 kilowatts capacity and is the largest regular size made at the Edison works. It is operated by a large engine of the Corliss type. Two arc dynamos will shortly be added to the plant. The switch-board is illustrated in Fig. 3.

Two Babcock & Wilcox boilers, each having a capacity of 250 horse power, will furnish steam, although only one has been put into use as yet. One of the boilers is equipped with an automatic stoker, worked by a small engine. The operation of this ingenious device will be watched with interest when it is in working order. A 100 foot iron stack is now being erected on the boiler house.

The plant is in charge of J. H. R. Ward, the construction work having been done under the direction of L. A. Scovil. Frederick Sargent, electrical engineer for the department of construction, has general supervision of the entire equipment.

The line work is, of course, only temporary, and the wires are stretched on poles. All the saw-mills which the contractors use in cutting material for the buildings will soon be run by electric power. Every steam engine, except the one used in generating power at the central station, will be moved from the grounds. Contractors have been ordered to substitute motors for steam engines, As electrical power is furnished to the contractors free, all of them readily fell into the new order of things. It is asserted that motors aggregating 360 horse power have already been called for by contractors. The use of electrical power was determined upon to reduce the risk of fire to a minimum and to guarantee continuous work, both night and day, in the mills.

Freiburg, in Switzerland, is said to possess the cheapest supply of electric power in the world, the cost being about three cents per horse power per hour.

Electric jewelry usually takes the form of pins, which are made in various designs. One such trifle copies a daisy, and has an electric spark flashing from the center, another is a model of a lantern in emerald glass, while a death's head in gold, with a ray gleaming from each eye, is a third. The wearing of electric jewelry necessitates the carrying about of an accumulator, which resembles a spirit flask, and is generally stowed away in a waistcoat pocket. Brooches are made occasionally for ladies' wear, but as women have no available pockets, a difficulty arises with regard to the battery.

American Institute of Electrical Engineers.

[illegible] committee on the international electrical congress of 1893 was held in the office of the secretary, 12 West 31st street, New York city, October 27th. The committee is composed of the following named members: Edward Weston, Dr. S. S. Wheeler, Geo. A. Hamilton, Prof. Henry Norton, Prof. Chas. R. Cross, C. H. Haskins, R. W. Pope, Prof. W. A. Anthony, F. L. Pope, Prof. S. J. Houston, T. C. Martin, T. D. Lockwood, G. N. Phelps, C. O. Mailloux and Carl Hering. The committee organized permanently, and

[illegible] PAY [illegible] AND POWER PLANT AT [illegible] AGRICULTURAL FAIR.

elected F. L. Martin chairman and R. W. Pope secretary. It was voted that the members of the existing committee on units and standards be added to the congress committee and also the following named members: Prof. Elihu Thomson, Prof. Alexander Graham Bell, Dr. E. L. Nichols, Nikola Tesla and Ludwig Gutmann. A subcommittee of three was appointed by the chair, composed of Carl Hering, W. A. Anthony and A. E. Kennelly, to formulate a provisional programme for the work of the congress. The chairman is a member ex officio of this committee. It was recommended that the council appoint a committee to be sent to Chicago as soon as possible, to represent the claims of the institute to a leading part in the congress and to arrange for its co-operation with the authorities there upon a proper basis. The council subsequently appointed Prof. Elihu Thomson, C. H. Haskins and F. L. Pope as such committee.

At the meeting of the council the following named associate which was freely discussed, the report of the committee on units and standards was taken up, and after considerable discussion it was decided to take no definite action upon it at present. Prof. Ryan communicated some corrections in his paper read at the September meeting, but on account of the lateness of the hour further discussion was postponed.

Electrical Type-setting Machine.

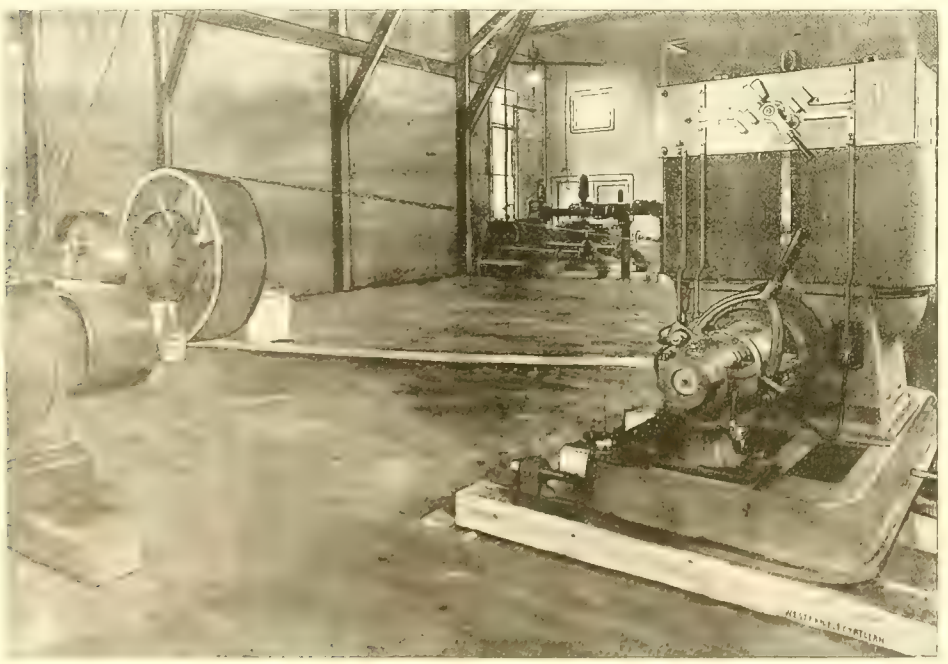
Erle Beals of Muskegon, Mich., has invented a type-setting machine in which electricity is employed, He first transfers the copy to perforated strips of paper by a machine resembling the type-writer. These strips are then taken to a second machine, which, working automatically by electricity, sets up the type, and as each line is composed impresses it into matrix paper, making a mold or matrix of the line. When a column of matrix lines has accummulated the ordinary stereotyping process is resorted to. The quick fixing of the face of type in the matrix paper Mr. Beals recognized as one of the greatest obstacles and at the same time a most important and desirable feature of the machine, and he claims to have labored much over this point. His success in this particular is accomplished by an entirely new method as to the application of heat that fixes the finest lines of type faces as clearly as does a metal matrix. By the action of electricity on a series of magnets the types are brought into their proper places. A series of needles passes over the perforated strip of paper and whenever a needle drops into one of the holes made by the perforator the electric current thus closed actuates the magnet corresponding to the particular letter of that perforation. The action of the machine is entirely automatic and is also very rapid.

A 2,700 Light Contract.

When the Venetian building now in process of construction at 34 and 36 Washington street is completed it will be one of the handsomest office and commercial buildings in Chicago. It is to be sixteen stories high and will be made attractive by elaborate ornamentation. Electric lighting will not be neglected, as is shown by the contract for wiring 2 760 lights, which has been awarded the Chicago Edison company. Current will be taken from the Adams street station. Geo. A. Fullerton & Co. are the owners of the building.

The Bradbury-Stone Storage Battery Car at Sioux City, Ia.

A view of the Bradbury-Stone storage car is presented in the accompanying illustration. The car as shown is in



[illegible] THE [illegible] CAR.

[illegible] Sioux City where it [illegible] recently tested. A trial trip made on September 22d created a most favorable impression. The run was over the Riverside line, from the junction to North Riverside and return. About thirty persons were on the car when the trial trip was made. There is a fine piece of track between the power house and [illegible] Soon after starting along here Mr. Bradbury gave [illegible] Christian Knapp, who acted as motor man, [illegible] the car [illegible] away. A speed of [illegible] miles an hour was attained for the distance of nearly half a mile.

The car was under perfect control. By a simple movement the car may be stopped at will by an electric brake. There are electric buttons for the use of passengers in stopping the car and for the conductor in ringing up fares.

It is claimed by the Bradbury-Stone people that the time made on level was as high as 25 miles an hour, and on an up grade 13. The car ran off the track

BRADBURY-STONE STORAGE BATTERY CAR.

five times. It returned to the track twice without stopping, and the other three times a piece of 5x5 timber was placed in front the wheels. It was stopped within a space of 100 feet when going down grade at 15 miles per hour with full load on.

The following are the readings taken on the cars every ten seconds for a distance of 4,200 feet on a rise of 170 feet with continuous curves; time, 5 minutes and 40 seconds.

Volts.	Amperes	Volts.	Amperes.
270	50	255	95
255	80	"	70
"	80	"	80
"	80	"	90
"	85	"	80
"	85	245	95
"	85	"	95
260	80	"	95
27	70	"	95
"	60	"	95
"	50	"	90
"	45	255	85
"	50	"	90
"	60	"	90
"	70	270	85
265	80	"	85
255	85	"	75

Convention of Wiremen.

A press dispatch from St. Louis to the *New York Times* gives the following information: "Henry Miller, formerly president of the Wiremen and Linemen's Union of St. Louis, has returned from an extended trip, during which time he organized unions in Louisville, Ky., Omaha, Neb.; Minneapolis, St. Paul, Duluth, Milwaukee, Chicago, Toledo, Cincinnati and Indianapolis. These unions will send delegates to attend a national convention in St. Louis, Nov. 21st. The electric wiremen are now affiliated as locals with the American Federation of Labor. Unions with a membership of 25 will be entitled to one delegate, unions having 50 members to two delegates, unions having 100 members to three delegates, and each additional 100 members or fraction thereof not below 50 one more delegate. About twenty-eight unions are now organized in the United States."

The franchise for the electric road from San Jose, Cal., to the Almeda county line provides that overhead wires may be used, but that whenever a better electric system is perfected the supervisors of San Jose may require its use, the change being made at the company's expense. The franchise also provides that the gauge shall not exceed 3½ feet; that T steel rails, 35 pounds to the yard, shall be used, and that the road may be used for both the transportation of passengers and freight. A speed of 25 miles an hour may be employed on all portions of the road, except in passing through Milpitas, where only 12 miles per hour is to be permitted. The new road will connect all the towns between Oakland and San Jose that are now isolated from railroads. It is proposed to run cars at least every half hour, and to make the fare from 25 to 30 per cent. cheaper than the present railroad fare. The road, including two branches, one via Alvarado and one via Warm Springs, will be about 48 miles in length, and will cost from $450,000 to $500,000.

Electric Horse Clipper.

The manufacture and sale of power horse clippers is becoming more extensive every day. One of the chief obstacles encountered thus far in exploiting these machines is that of procuring a suitable driving power of small capacity not exceeding, say, one-quarter horse power. A boiler and engine may, of course, be employed when available, but the application of steam power involves an expenditure far in excess of the price of the clipping machine, not to mention the other objection of the experience required in operating an engine.

Electric motors solve the problem wherever a day current is obtainable. But, unfortunately, day circuits do not always run to just that point where the consumer of small power would like to have them. Manufacturers of horse clipping machines fully realize the advantage of electric power, but they have also experienced considerable annoyance in seeking to introduce electric motors to drive their clippers. An officer of the Gillette Clipping Machine company of New York, which has upward of 1,000 hand and power machines in use, recently informed a representative of the WESTERN ELECTRICIAN that the introduction of some "portable generator of electricity" would be a boom to the clipper men. The Gillette clipping machine requires only a one-quarter horse power to drive it. The

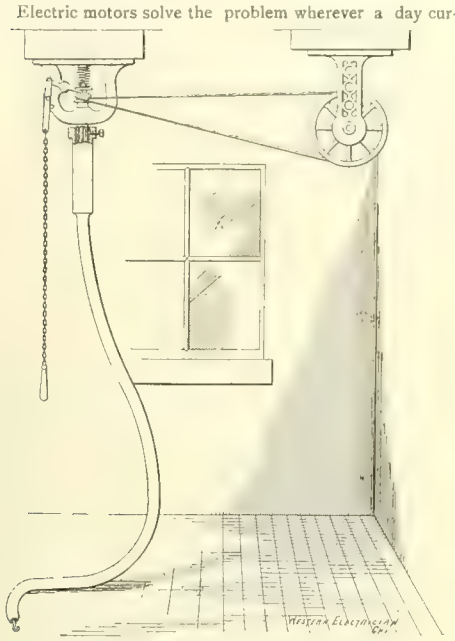


FIG. 2. ELECTRIC HORSE CLIPPER.

FIG. 1. ELECTRIC HORSE CLIPPER.

illustrations will give an idea of the mode of application. Fig. 1 shows a horse clipper operated by an electric motor in use at the Belt Line car stables, Fifty-third street and Tenth avenue, New York. Fig. 2 is a diagram showing the mechanism more in detail. In the clipping machine a reciprocating cutter works over a steel comb, being put in motion by the flexible shaft. The smallest curves and turns of a horse or sheep may be cut over, it is said, with perfect ease.

It is proposed to establish a telephone exchange at Albany, Western Australia.

Rapid Transit in New York.

Advocates of electric traction will be greatly interested in the report of the commission appointed to devise a suitable system for the city of New York, inasmuch as it is recommended that the motive power shall be electricity or some other power not requiring combustion within the tunnel, the motors to be capable of a uniform speed for long distances of not less than forty miles an hour, exclusive of stops.

The commission consists of William Steinway, John H. Starin, Samuel Spencer, John H. Inman and Eugene L. Bushe, and was constituted January 31, 1891, by an act of the legislature. The report was presented to the aldermen on October 21st. On May 27th it was decided to adopt a plan providing for a line under Broadway, and the commissioners say that the public generally approved the choice. Borings revealed the fact that south of Thirty-third street the tunnel must be driven almost entirely through sand. The question of a deep tunnel or one near the surface was one of great importance, and a decision in favor of the latter method was reached only after mature deliberation.

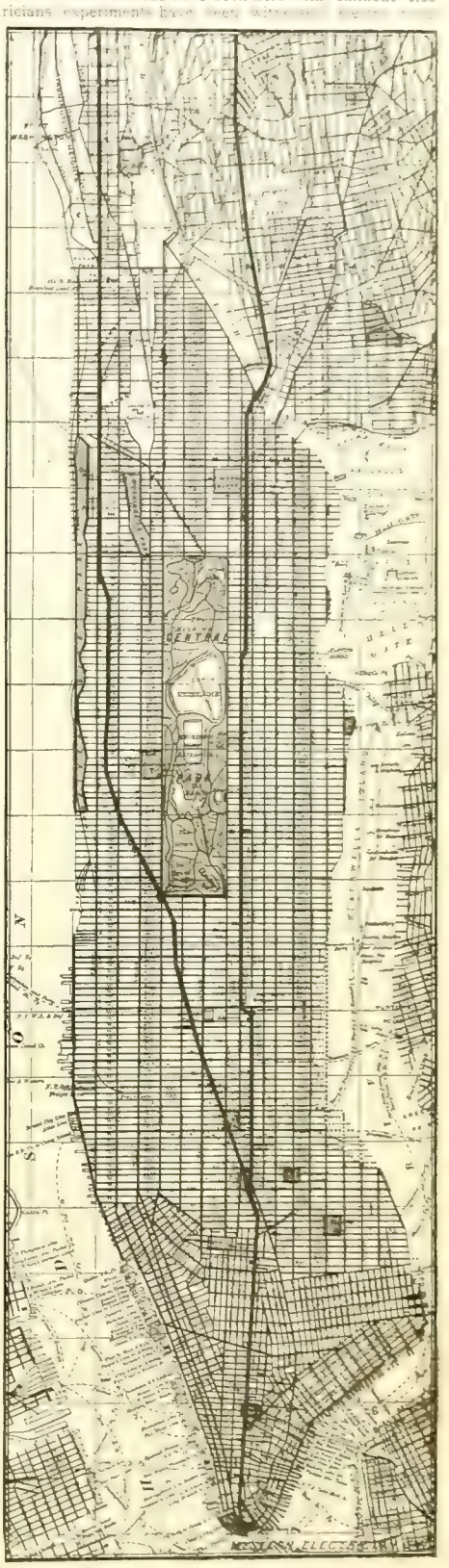
Plans were submitted by William E. Worthen, the engineer of the board, and W. Barclay Parsons, the assistant engineer. Mr. Worthen's plan called for a four-track road on a level, while Mr. Parsons' scheme was for four tracks set in pairs, one above the other, and commonly spoken of as the double-deck plan. These plans were submitted to eminent engineers, and finally the essential features of Mr. Worthen's system were adopted. On the northern portion of the route the line will be partly above ground.

The report describes the route decided upon at considerable length, but a better idea can be gained by a reference to the accompanying map, on which the route proposed is plainly indicated by bold black lines. The plan of construction and the motive power are thus outlined:

The general plan of construction of the loop under Battery Park, State, and Whitehall streets shall be double track; from the Morris street junction to near Vesey street shall be three parallel tracks on the same level, with suitable switches and connections between them; from Vesey street to One Hundred and Ninetieth street on the west side line shall be four parallel tracks on the same level, and thence, across the government ship canal and Spuyten Duyvil creek to the city limits, shall be two parallel tracks on the same level. On the east side line, from Fourteenth street to the Harlem river shall be four parallel tracks on the same level, and thence to the city limits shall be two parallel tracks on the same level. The tunnels shall not be less than 11 feet 6 inches in height in the clear and 11 feet in width for each track. Whenever necessary for the proper support of the surface of the street, the roof of the tunnel shall be of iron girders with solid plate iron covering supported by suitable iron columns between each of the tracks, and supporting walls on the outside. The roof of the tunnel shall be as near the surface of the street as the pipes and underground structures now laid therein and the street grades will permit. Viaducts shall be of masonry or iron, or both combined. The government ship canal and the Harlem river shall be crossed by double-track drawbridges not less than 50 feet in the clear above mean high water mark, with clear spans of not less than 125 feet between the center piers and bulkhead line. North of the Harlem river the construction shall be by viaduct, depressed structure, and tunnel, as the grades of the land upon the proposed routes shall require. The junction of the tracks near Fourteenth street shall be effected by dividing them around Union Square, raising one pair and depressing the other, so that trains going in opposite directions shall not cross on the same level.

The motive power shall be electricity, or some other power not requiring [illegible] the motor or motors shall be capable of uniform speed for long distances of not [illegible] forty miles per hour, exclusive of stops.

When the commission decided to adopt an underground [illegible] without combustion in the tunnel. Much attention has been devoted to the consideration of electricity as a motive power. Consultations have been held with eminent electricians, experiments have been [illegible]



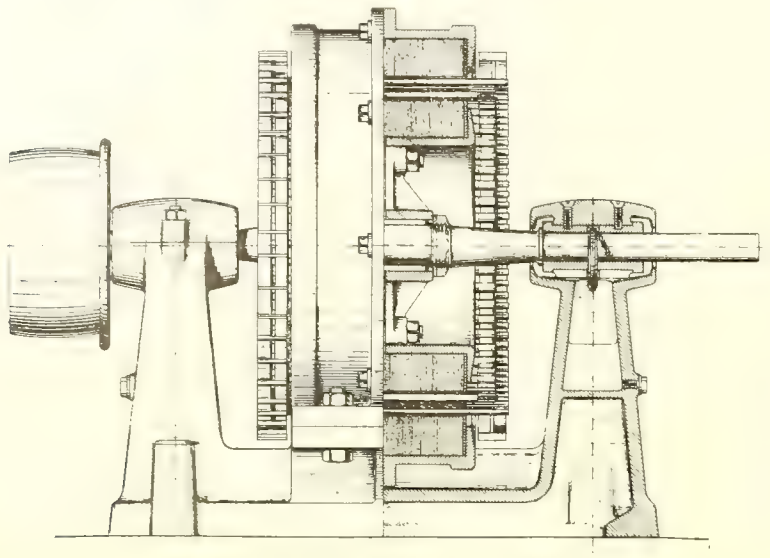
RAPID TRANSIT IN NEW YORK.

in operation have been examined. While the board is convinced that electricity as a motive power is available for the purposes of the railway recommended by this report, it is not deemed wise at the present time to exclude other forms of power answering the essential conditions of speed and non-combustion in the tunnel, or to attempt to direct the exact method of application of such power as shall finally be adopted.

On October 28th the report was adopted by the aldermen, and the plans then came before Mayor Grant for his approval. Engineer Worthen said that the road could be built in eighteen months, provided the capital could be raised, and that its construction would not interfere with street traffic in the least.

Brown's Three Phase Alternate Current Motor.

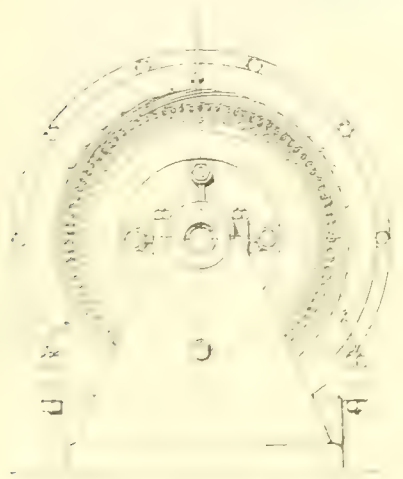
[illegible] Brown, who for several years was identified with the Oerlikon Works at Zurich, in Switzerland, is so favorably known in Europe and this country, that any production of his is examined with much interest by the entire electrical fraternity. This will be the case with the 20 horse power three phase alternate current motor, which is herewith illustrated from drawings furnished the WESTERN ELECTRICIAN by Mr. Brown, whose present address, by the way, is Baden, Switzerland.



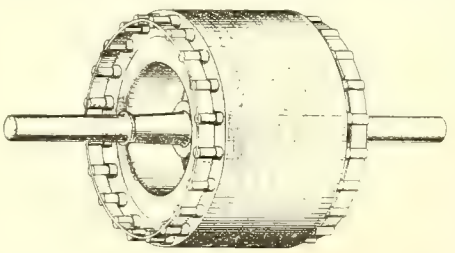
BROWN'S THREE PHASE ALTERNATE CURRENT MOTOR.

Mr. Brown took up the study of the multiphase current in the middle of last year, guided by the intention to avoid sliding contacts at the motors, as, in his opinion, only in this way it is possible to approach the ideal of an industrial power producer. At the same time it was reported that the Allgemeine Electricitaets Gesellschaft in Berlin had worked on this line, and had obtained satisfactory results. In consequence of this the managers of the Oerlikon Works put themselves in communication with the Berlin firm. The result was that both firms united to develop the multiphase system. In August, 1890, a two horse power motor having no sliding contacts was finished in Oerlikon after Mr. Brown's design. This motor was the first commercial multiphase current motor constructed up to that date. In this motor for the first time a hole armature, in connection with Gramme winding, was employed in the multiphase system.

During the same month Mr. Brown applied the hole



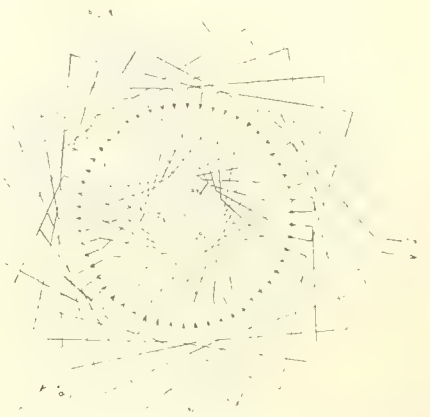
[illegible] the 300 horse power generator mentioned above. In consequence of the smaller size the armature contains more than three wires per pole. The three armature circuits are connected in a manner similar to a Thomson-Houston armature, and the winding is so arranged that there are produced four rotating poles. With forty cycles the motor makes about 1,200 revolutions per minute. The normal tension for the motor is 80 volts; a reduction to 50 or an increase to over 100 will make practically no difference in the speed. Of course, in the first case the heating in the armature wire is a more considerable one; in the second case the iron heating is increased. The rotation of the magnet field is produced by the armature reaction, avoiding in this way all sliding contacts. The magnet field is composed of a laminated ring, with holes, in which are placed isolated copper bars. The free ends on both sides are connected by copper rings. This produces the whole field, the construction being simple.



BROWN'S THREE PHASE ALTERNATE CURRENT MOTOR.

The armature has 90 wires of about 40 millimeters section. The mode of winding and connecting up is shown in the diagrams. The copper weight is 20 kilogrammes, and the weight of the iron is about 100 kilogrammes. The armature is 200 millimeters wide, the outer diameter about 500. The rotating magnet carries 54 copper bars with a section of 100 millimeters. The weight of the copper here [illegible] and that of the iron 70 kilogrammes.

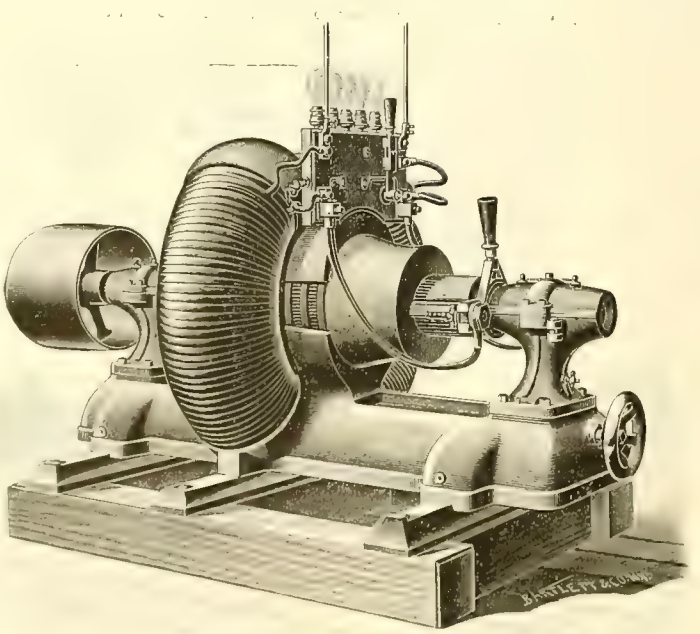
[illegible] Recent trials in Oerlikon with this motor showed that it [illegible] horse power. The heating, even with [illegible] no part of the motor [illegible] than [illegible] degrees centigrade [illegible] temperature of the test room. It may be [illegible] that the rotating part [illegible] practically [illegible]. The difference of speed between no load and full load is only three per cent. The torque of the motor at starting is considerable. The motor can carry also a considerable overload, and runs without noise. The starting of the motor is similar to that of a continuous current motor controlled by a resistance in series with the armature circuit. Regarding the commercial efficiency no accurate tests have been made as yet. The losses are about as follows: In armature copper and iron they amount to about four per cent.; in the magnet copper and iron, including friction, to four per cent. This shows an efficiency of 92 per cent. A commercial efficiency of 90 per cent. is said to be absolutely sure. That the losses are very small is further clearly shown by the very moderate heating in spite of the small size of the motor, and the disregard of ventilation. A further advantage is that the commercial efficiency remains high, even if the motor is considerably underloaded. The weight of the motor is 420 kilogrammes, a trifle over 20 kilogrammes per horse power. It is said that, for locomotive purposes, the weight could be reduced to 300 kilogrammes without affecting the solidity of the machine.



BROWN'S THREE PHASE ALTERNATE CURRENT MOTOR.

New C. & C. Dynamo.

During last summer a new generator, especially designed for power circuits, was put upon the market by the C. & C. Electric Motor company of New York. It is rated at 50 horse power and wound for 500 volts. As will be seen by referring to the engraving the design of the new machine is similar to that of the well-known circular field and consequent pole motor manufactured by this company. For long transmission of power this machine can be specially wound to give automatic regulation under the greatest possible variation in load. A substantial terminal board is bolted to the upper pole piece and is provided with a heavy knife switch for opening the main circuit. This board also carries the field and armature connections, all of which are of solid metal and in plain view. The commutator is of the most substantial construction, being built up of heavy copper bars, insulated with mica, and with proper care it will last for years. The armature is wound to carry a much greater volume of current



NEW C. & C. DYNAMO.

than the nominal capacity of the machine requires, thus making it practically impossible to burn it out by overheating. The circular shape of the magnets gives them great development of power with comparatively light weight, and every part is so constructed as to make solidity and permanence the first consideration.

The 100 horse power dynamo made by this company is of exactly the same form as the dynamo illustrated herewith and is especially suitable to be used as a power generator for street railway circuits.

New Alternating Dynamos.

A new type of alternating current dynamos is shown in the accompanying illustrations. These machines, which are made by the Royal Electric company of Peoria, Ill., are distinguished by the fact that the field magnets are in the center, surrounded by the armature coils. A central supporting casting holds these parts in position. It is claimed that the iron of the portion that contains the armature coils, in which the magnetism changes from maximum to minimum, is laminated and without joint; hence that the loss from hysteresis is small.

These dynamos are operated at slow speed, and there is a total absence of brush holders and sliding contacts. The revolving part consists of cast iron, and thorough ventilation is secured, as will be seen by referring to the illustrations, Fig. 1 representing a 300 light machine and Fig. 2

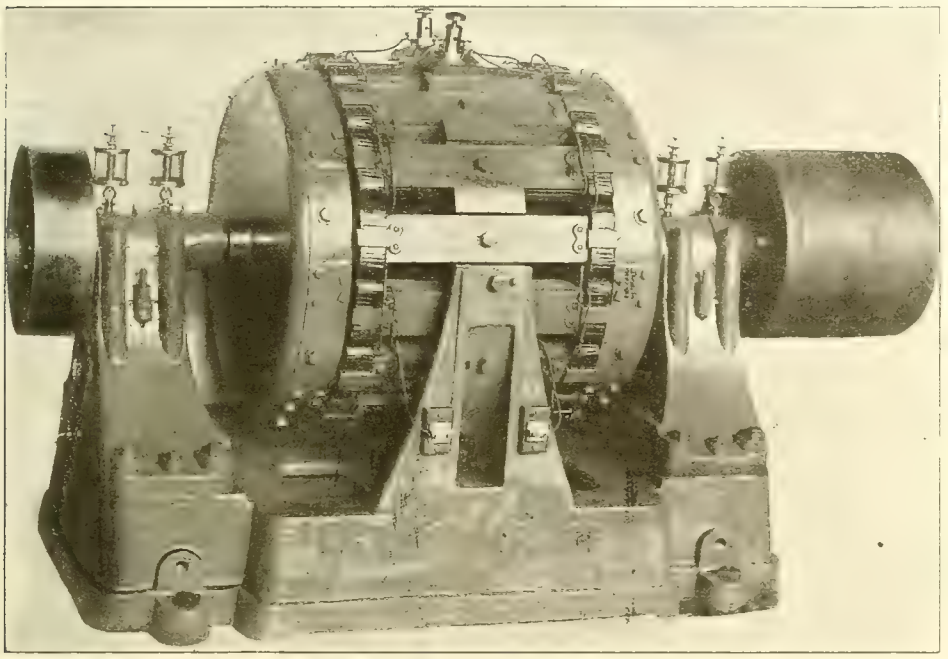


FIG. 2. NEW ALTERNATING DYNAMOS.

one of 650 lights capacity. It is also claimed that the compactness and ease of repairing are meritorious features, it being possible to insert new coils in a few minutes.

Electricity at the World's Fair.

At last week's meeting of the World's Fair executive committee Col. Clowry, as chairman of the committee on electricity, entered another protest against the way his committee is being ignored. Mr. Clowry believes that all matters pertaining to electricity should, as a matter of course, be referred to his committee before being decided by the grounds and buildings committee. Contracts for electrical supplies, however, have been made without the consent of Col. Clowry's committee. A temporary arrangement was made to the effect that hereafter the two committees should act jointly in the purchase of supplies and in settling other questions. This action is rather strange in view of the fact that the executive committee had before adopted a resolution recognizing the rights of the committee on electricity in this respect and directing that its consent be obtained before any action pertaining to electricity be taken by the grounds and buildings or any other committee.

At present there does not seem to be much likelihood that electricity will be made use of to convey people to the fair grounds from the center of the city, unless, possibly, in the way of lines connecting with the cable roads. The engineers are now figuring on the carrying capacity of the Illinois Central steam railway and the Cottage Grove avenue and State street cable lines. Engineer Wallace has presented an array of figures calculated to show that the State street, and Cottage Grove avenue cable lines could carry many more people to Jackson Park than had been previously estimated. He thinks that both of these lines could carry 24,000 people an hour, barring break-downs. Mr. Wallace then showed that under the most favorable conditions imaginable the Illinois Central road could not take more than 15,000 people to Jackson Park every hour. There is no reason why electric lines could not do at least as well as the cables, but it looks as though they would have to be shown inside the park.

One of the applications for space received by the department of electricity is from a Chicago woman who asks for fifty square feet in which to show "living samples of taking out wrinkles by electricity."

At a recent meeting of the committee on electricity, the following names were decided upon as those of eminent electricians not now living to be placed on the electricity building at the exposition:

Franklin, Galvani, Ampere, Faraday, Ohm, Sturgeon, Morse, Stevens, Davy, Volta, Henry, Oersted, Coulomb, Ronald, Page, Weber, Gilbert, Davenport, Suemering Don Silva, Arago, Daniell, Jacobi, Wheatstone, Gauss, Vail, Bain, De la Rive, Joule, Seussure, Cooke, Varley, Steinnell, Guericke, La Place, Channing, Priestley, Maxwell, Coxe, Thales, Cavendish.

Electric Railroad Poles on Streets.

In the case of Halsey vs. Rapid Transit Street Railway company, the Court of Chancery of New Jersey used the following language in speaking of the principles governing the use of streets for electric railways: "Where no method is prescribed by law in which a municipality shall exercise its powers, but is left free to determine the method for itself, it may act either by resolution or ordinance. Placing poles in the middle of the street, for the purpose of using electricity for street car propulsion, does not impose a new servitude on the land in the street—the poles facilitate the use of the street as a public way. The question whether a new method of using a street for public travel results in the imposition of an additional burden on the land or not, must be determined by the use which the new method makes of the street, and not by the motive power which it employs in such use."

A Peculiar Accident.

An accident which happened in Cincinnati several days ago, resulting in the death of a street car horse, will be of interest to practical electricians, owing to the peculiar conditions which brought it about, and the fact that it was caused by a double trolley system. It occurred on the Mt. Adams and Eden Park electric road at the foot of Mt. Adams inclined plane, and was the result of two heavy grounds. By referring to the accompanying diagram and noting the conditions the reader will readily understand how the trouble occurred.

In the diagram *A* and *A'* represent the inclined plane trucks at the foot of the incline; *BB* the street railway track crossing the electric road tracks at right angles; *Z* is the electric car moving toward the inclined plane truck *A*; *CCC* are broken joints in the track work filled in with dry dust; *LL'* shows the position of the horse when killed.

The sections of rail *M N* and *O P*, owing to the broken

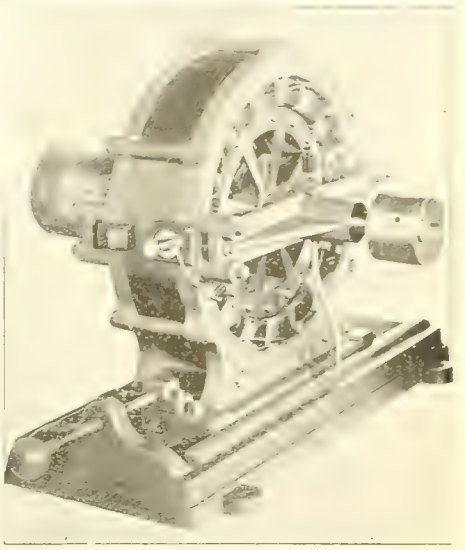


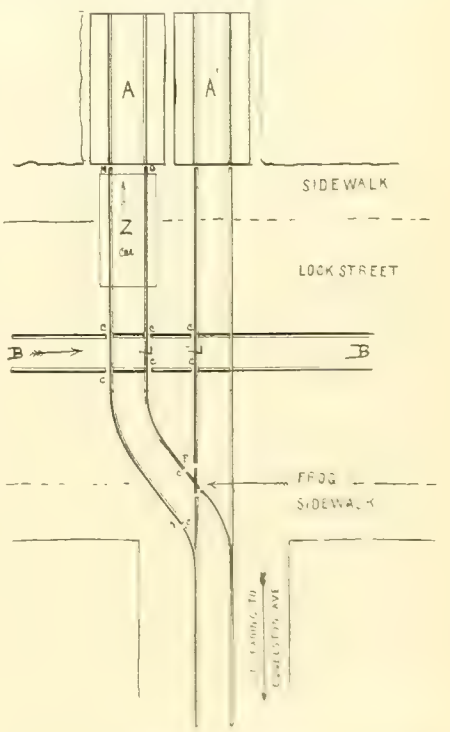
FIG. 1. NEW ALTERNATING DYNAMOS.

the of day the accident almost totally insulated from the

and about to enter the truck *A*, the positive pole at the commutator on the car in some way became grounded through the car trucks to the rails on which the car was resting, which checked the moving car owing to the leak

realizing that something was wrong, immediately stopped the car just as he was about to enter the truck of the inclined plane. At this moment along came the ill-fated animal in the street railroad tracks, moving in the direction of the arrow In crossing the electric railway tracks the horse completed the circuit and received the consequent shock by placing his feet on the tracks at *L* and *L'*, result ing in the animal's instant death.

At a test made at night a day or two after the accident, the above description and cause of the trouble was found



to be correct. A voltmeter inserted between the points and , when the test was made, showed a pressure of volts. The voltage between these points on the day of the accident undoubtedly reached very nearly the maximum pressure of the circuit. that day everything in the neighborhood was perfectly dry, and consequently well insulated, while during the test there was considerable moisture in the ground and mud on the tracks

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

A. KREIDLER, - - - Editor and Publisher
J. B. O'HARA, }
C. L. PERRY, } Associate Editors.
W. E. KEILY, }
J. L. BAKER, - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT. -Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers, in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE
T[illegible] Lighting and Power Plant at the World's Fair. Illustrated. . . . 271, 272
American Institute of Electrical Engineers 272
[illegible] 272
A [illegible] Light Contract 272
[illegible] Storage Battery Car at Sioux City, Ia. Illustrated 272
Convention of Wiremen 272
[illegible] Illustrated 273
Rapid Transit in New York. Illustrated 273
[illegible] Three Phase Alternate Current Motor. Illustrated 274
New C. & C. Dynamo. Illustrated 274, 275
New Alternating Dynamos. Illustrated 275
[illegible] World's Fair 275
A P[illegible] A[illegible]. Illustrated 275
[illegible] 276
Magnetic Reluctance. By A. E. Kennelly. Illustrated. (Amer. Ins. Elec. Eng.) 277, 278, 279, 280
[illegible] Illustrated 280
[illegible] Illustrated 280
[illegible] Illustrated 280
[illegible] 280
[illegible] Illustrated . . . . 28[illegible]
[illegible] Illustrated 281
[illegible] London Electric Railway 281
[illegible] Engine. Illustrated 281

DEPARTMENTS.

[illegible] . . . . [illegible], 282
[illegible] 282
Electric Light 282, 283
[illegible] Railways . . . . [illegible]
[illegible] . . . . [illegible]
[illegible] . . . . [illegible], 284
[illegible] 284

[illegible] of an interesting experiment in the way of [illegible] for the furnaces of an electric power plant comes [illegible] Oregon is a state of fisheries and saw-mills, and if the waste product of the latter can be utilized to make steam to operate dynamos, the hint may be [illegible] station managers in Michigan and [illegible].

[illegible] on the World's Fair grounds, [illegible] another portion of [illegible]. By [illegible] during the work of construction, the directors have indicated the sincerity of their declared intention of making electricity as prominent [illegible].

[illegible] expressly specified in the report. The plans are par[illegible] as many eminent engineers unite in pronouncing the [illegible] that electricity will solve the problem of rapid transit for the metropolis.

IN view of the varied opinions held regarding the multiphase current Mr. Brown's new 20 horse power motor, described in detail on another page, will be examined with much interest. An alternate current motor with a guaranteed efficiency of 90 per cent will be a notable addition to the equipment at the disposal of the electrical engineer.

MR HORNSBY, who returned last week from his trip to Europe in the interest of the electrical department of the World's Fair, comes back with cheering news. He reports that many firms of electrical manufacturers in the countries that he visited have promised to make exhibits at Chicago in 1893. He has also obtained many valuable suggestions at Frankfort and elsewhere, that will be of value in arranging the electrical exhibit at the World's Columbian exposition.

WHILE it is probable that Mr. Kennelly's able paper on "Magnetic Reluctance" will appeal to a comparatively small number of readers, its author has nevertheless reason to congratulate himself on the fact that those who do thus avail themselves of his researches will be men who will appreciate his treatment of this abstruse subject. American electricians have been accused of neglecting the investigation of abstract principles, merely evincing alertness in turning to practical account the work of others possessing a greater devotion for pure science. To refute this assertion it is only necessary to point to the labors of Mr. Kennelly and many others not less distinguished for learning and acumen. The paper on "Magnetic Reluctance" is a worthy contribution to the permanent literature of electrical science.

"FROM a Trolley Wire" is a startling headline that appeared in a recent issue of the *St. Louis Globe Democrat*. It did not, however, as might be expected, precede an account of some disastrous fire or horrible fatality caused by the destructive trolley wire, but headed a dispatch from Omaha giving a description of the lynching of a negro by being hanged from the "deadly" overhead conductor of an electric railroad. This is surely a new use for trolley wires, and is a certificate of the substantial character of overhead construction in Omaha. We shall be surprised, however, if some New York paper does not come out with the statement that if the trolley wire had not existed it would not have presented itself to the view of the frenzied mob with such fatal opportunity, and thus the hanging might never have occurred. Such a statement would be consistent with many of the attacks that have already been made on the trolley system.

STATISTICS were presented at the Pittsburg convention showing that there were 5,443 miles of horse railways in this country and Canada, 3,009 of electric railways, 1918 operated by steam, while there were only 660 miles of cable road. More than double the number of cars are operated by electricity than those on the cable lines, although the latter had secured a firm foothold in such cities as Chicago, Philadelphia, San Francisco and Kansas City before street railway men could be induced to invest in or even consider electrical equipment. There are 412 companies to-day operating electric roads, and 54 depending in part at least upon the cable. Since November last there has been a falling off in the number of horses employed on street railways from 116,795 to 88,114. This change, it is needless to say, is due largely to the introduction of electric railways. Philadelphia, Chicago and New York lead the cities of the country in the order named in the number of miles of track of street railways. Brooklyn is only four miles behind New York, and Boston has two miles less to her credit than the city of churches.

WRITING in the *Electrical Engineer* of London, H. Cuthbert Hall protests against what he considers the insufficient salaries of electrical engineers in England. An instance is given of a young man who spent over $6,000 and six years of time to fit himself for the profession, only to receive at the end of that period a salary of $500 a year. "And this," comments Mr. Hall, "is no exaggerated case, but quite as good, if not better, than is the fate of nine out of every ten." It is added that positions in England worth over $2,500 per year are decidedly exceptional. To prove that low salaries are paid not merely to young and inexperienced men, the writer cites the case of a central station company in an important town in the west of England that advertised for an experienced electrical engineer to take charge of a large plant at a salary of $1,000 per annum. In advancing a reason for this state of affairs, Mr. Hall says: "The primary cause of the low salaries which are paid is undoubtedly to be found in the fact that no test is imposed by any responsible body on those who wish to enter the profession. In fact, anybody can call himself an 'electrician', from the local ironmonger upward. The consequence is that the profession is crowded with a number of incapables, whom a very elementary examination would probably be the means of weeding out. Of course these men do not often obtain responsible positions but the fact of the supply, although of an inferior quality being so large, seriously detriments those who are really competent to hold positions of trust." While the situation in the United States is not so bad as that complained of in England, much that the *Electrical Engineer* contributor says can be read with profit in this country.

CONTROVERSY over technical disputes appears to rage much more fiercely in England than with us—at least such is the case when questions of electrical theory or practice are involved. Let some electrical engineer read a paper or publicly advance an opinion on a subject admitting of varying methods of treatment, and the English electrical papers are directly flooded with forcibly worded letters from the gentlemen holding views opposed to those of the original essayist. The latter, of course, defends his position with vigor, not forgetting to include in his argument a few sharp words calculated to bring the intelligence and professional standing of his opponents into contempt. The critics return to the attack with great ardor and virulence; other electricians enter the fray, taking sides with one side or the other; personalities are exchanged; and thus the paper war goes on, with much sound and fury, until the participants are exhausted, or, what is more likely, until the editor of the paper becomes tired of the din and summarily declines to grant the privileges of the arena to the doughty gladiators. In the great majority of instances nothing whatever has been accomplished, save the expenditure of much time and energy which, it would seem from this distance, might have been much better employed in other directions. An instance in which one of the disputants admitted the convincing truth of the arguments of his adversaries would be very rare indeed, while it is fair to assume that the general readers merely smile at the amusing exhibitions of temper.

A case in point is the controversy in the columns of the London *Electrical Review* caused by the address of A. R. Bennett on "Telephoning the Great Cities" before the British association. Among those who criticised the paper was H. Goodwin, and, judging from the acrimony of Mr. Bennett's reply, in the issue of October 16th, he must have clothed his ideas in language of uncommon asperity. This letter of Mr. Bennett's is an example of the silly intemperance of language to which we have referred. Mr. Bennett begins in this apologetic strain: "I had hoped that the task of replying seriously to Mr. H. Goodwin would not be forced upon me; but he has mistaken forbearance for fear, and has returned to the charge with so much assurance and appearance of self-gratulation that I shall waive my natural impulse to refrain from hitting such a very obvious 'little 'un,' and deal with his statements on their merits." The writer picks Mr. Goodwin's grammar to pieces with great gusto, after incidentally remarking that "the amount of intellectual activity displayed by Mr. Goodwin during all these, his long years of experience, cannot have been very great, since, familiar as I am with matters telephonic, I never heard tell of his name before, nor can I find any telephonist who has been more fortunate." The conspicuous modesty of this is delicious. This trait also crops up in the following sentences: "With reference to my being copied in London. The fact is notorious, and I shall not give any proofs at the bidding of a man of Goodwin's calibre." Mr. Bennett concludes his letter thus: "I think I have said enough to reconsign to their resting place the shovelful of discredited crudities, culled from Mrs. Morgan Malaprop's telephonic dust-bin, that were allowed to pass as adequate criticisms on my paper. Only this I will add: If you would really opine that I have avoided discussion, I invite you to put in a series of concise paragraphs, numbered 1, 2, 3, &c., the points you desire elucidated. I will then answer them seriatim and number my replies to correspond. My difficulty at present lies not in replying, but in understanding what I am expected to reply to. We appear to have studied English in different schools, your critic and I; but, perhaps, if he follows the plan I suggest, we may get on better in future. Only let us have something more to the point than the trash evolved by this poor simple fellow, Goodwin."

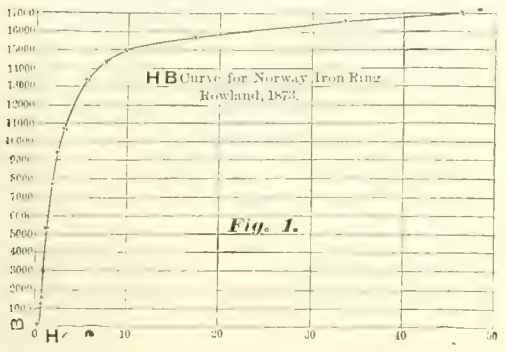
It is a matter for congratulation that American engineers have neither the inclination nor the time to emulate effusions of this sort.

Magnetic Reluctance.[1]

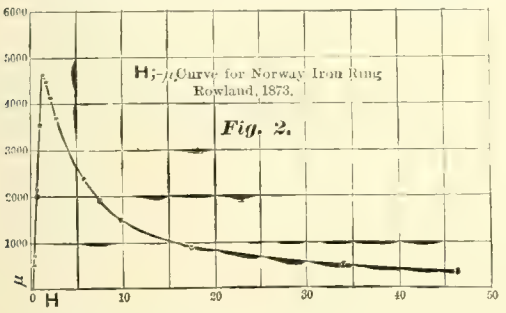
By A. E. Kennelly.

The science of magnetism was a collection of facts concerning magnets until Coulomb first brought to light a quantitative relation between a few of its phenomena, and thus entitled it to appear among the exact sciences. He determined by measurement that the forces of attraction or repulsion between the poles of long thin bar magnets were proportional to the strengths of those poles and inversely to the square of their intervening distance.

In one respect, it has since been shown that the discovery was unfortunate, for it served to depress rather than to stimulate further inquiry into the laws of quantitative magnetic relationships. The application of Coulomb's law soon brought into use a conception of magnetism, suggested perhaps by the analogy the law bears to that of

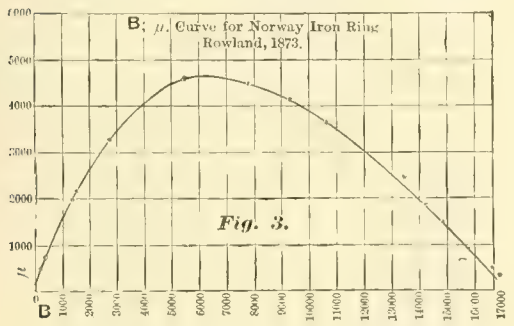


gravitation force. This was the hypothesis of a layer of fluid or imponderable matter resident on the surfaces of magnetic bodies and endowed with attractive and repellant forces on all portions of such fluid, in exact similarity to the two fluid theory of electricity. Each element of surface magnetism would exert according to Coulomb's law a definite force upon every other element of its own, or of other magnet surfaces, and when the distribution of the magnet matter or fictive layer was known, the total forces active between the magnets forming the system could be determined by the summation of all the elementary actions. This was the polar conception and mathematical theory of magnetism. It was not only artificial, it was also misleading. It assumed that definite action could be exerted at a



distance, ignoring the action of the intervening medium. Nevertheless, a slight modification of the polar theory rendered it capable of expressing a mathematical theory of magnetism with apparent success, and exhibits in this respect, like the theories of gravitation, the remarkable construction of purely artificial frame-works of thought, void of all attempt at reality, yet capable of affording useful applications and exact quantitative results, while beneath their foundations, the real and active natural forces still lie in undiscovered concealment.

It was soon apparent that magnetism considered as a fluid could not be confined to the surface of bodies, since it was only necessary to break a bar magnet asunder in order that new poles and new magnetic fluid should be ex-



hibited. The amendment to the original theory was then framed that a condition of molecular magnetization extended, veinlike, throughout the substance of the magnet. The termination of each vein at the surface exposed a definite quantity of polarized magnetic matter, while within the veins, the polarity was neutralized by the successive layers of opposite molecular poles. This was a great stride beyond the original theory for it ascribed magnetism not alone to a fictive superficial layer, but to the combined effects of all the molecules in the magnetized body, whose substance, no longer a mere frame for supporting the layer, became invested throughout with a definite condition.

The amendment in time became classical, and subverted the original conception, for the polar theory only recognized superficial magnetism, while the vein theory did not make any such reservation. It was only necessary to assume that the veins varied in richness at different parts of the magnet, or that they might be subjected to faults and partial discontinuities, to introduce unneutralized polarity within the mass which might be capable of exerting external influence, a condition neither the simplest nor most usual, but which the experiment of superposed magnetizations in steel has rendered familiar. This irregularity of vein structure would add a volume distribution of magnetic fluid through the interior of the magnet to the surface distribution on the outside.

On the vein theory, the intensity of magnetization at any point of the magnet would be defined as the amount of magnetic matter cut through in the veins per unit area by a plane section perpendicular to their direction, at the point in question.

A unit magnetic pole situated in free space, at the end of a very long thin bar magnet would by definition repel with unit force a similar pole one centimeter distant, that is resident on the surface of a sphere one centimeter radius, of which it occupied the center. The surface area of this sphere would be 12.57 (4π) squ. cms., and over all this surface the pole would thus establish a magnetic field of unit strength and exert a magnetic stress equal to unity. Each square centimeter of the surface bounds an area of stress which emanates from the pole, and consequently the latter must emit 4π units of stress flux. In the language used by Faraday it would throw off 4π lines of force. This stress flux has somewhat unfortunately received from Maxwell the name of induction, and the induction through the surface surrounding the pole would be 4π units.

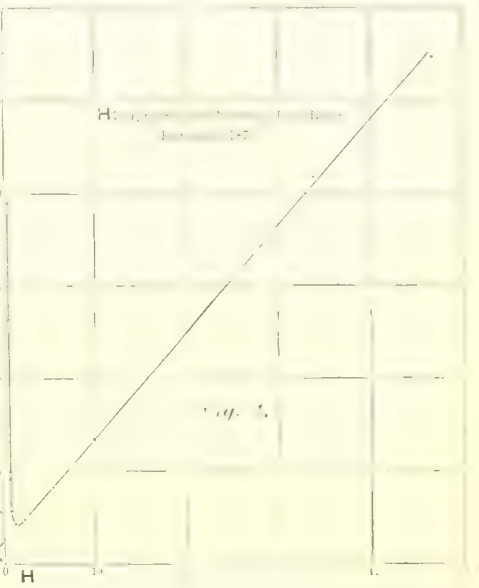
The interest connected with the nature of this stress demands a moment's pause at this point. While its real character is still as great an enigma as the real character of magnetism itself, some of its laws are well understood. There exists along the direction of the stress a tension accompanied by a general pressure at right angles, just as in the case of stimulated muscular fiber, which tends to shorten and to expand laterally, or as it is generally expressed, the lines of force tend to contract while repelling one another. Since the time of the discovery that the plane of undulation in polarized light waves twists in passing through certain magnetized substances it has been supposed that the stress might be of a rotary character. Like an incompressible fluid it can neither accumulate nor vanish locally, and as much stress flux must leave any region as enters it, if no magnetic pole exist within the confines. Its intensity is very remarkable, for it is far in excess of any stress that we can exert without the aid of cohesion in matter. This may be judged by comparing the quantities of energy that can be stored in a given volume of space—say air space. It is of course easy even without the assistance of iron to magnetize a cubic centimeter of air to a flux density of 5,019 C. G. S. lines when it will possess an energy stored up in magnetic stress of one megalerg (1,000,000 ergs or 0.0737 foot-pound) while if this magnetization be alternated 227 times per second the average rate of absorption and discharge would be 45.5 watts, and one cubic inch of this air would store and release energy with the average activity of one standard British horse. Under electrostatic stress, air not in the immediate neighborhood of a conductor appears to break down when the E. M. F. per linear centimeter exceeds 32,000 volts or 110 A. E. S. U., so that the maximum electrostatic energy that one cubic centimeter will hold without rupture is about 500 ergs or two thousand times less than that resident in air stressed magnetically to 5,000 lines, while a cubic centimeter of air near the earth's surface illumined by bright sunlight does not hold more radiant energy than about 50 micro-ergs.

An alternating current transformer is a device in which the secondary coil absorbs the energy out of air and iron, pervaded by the stress flux from the excited primary coil. Unfortunately while magnetically stressed air yields so far as we know all its stress energy back into either the primary or secondary circuit, stressed iron fails to do so entirely, and absorbs energy at every cycle, a process known as absorption by hysteresis. The iron directly converts the magnetic stress energy into heat energy, just as a spring absorbs some of the energy imparted to it during every cycle of compression and recoil.

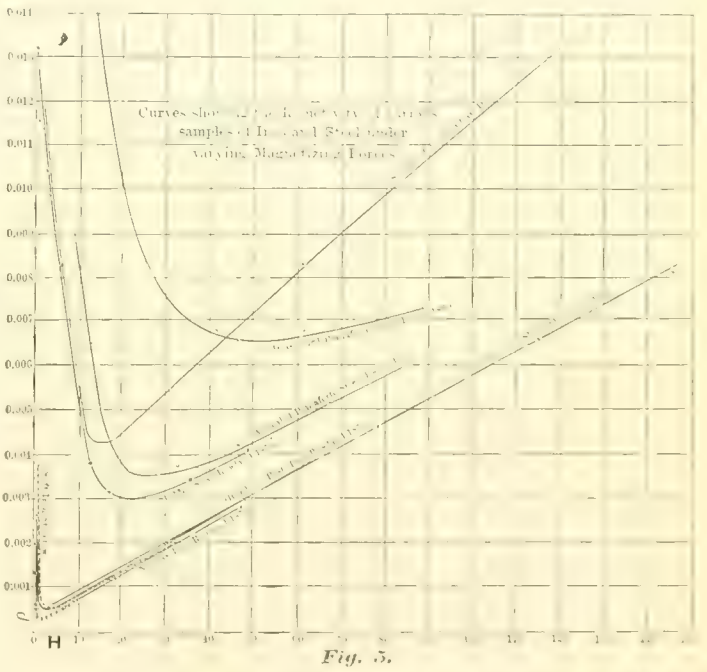
These 4π units of stress flux are not confined to a spherical surface of one centimeter radius, but would be found by summation over any enveloping surface containing a single unit pole, just as the delivery of material liquid must be the same in a steady stream at any section of its course independent of the channel area there existing; for at ten times the distance, the spherical area would be 100 times greater and the stress by Coulomb's law 100 times less, leaving the total area of total stress unchanged, and it follows in fact that the stress flux over any boundary is always 4π times the strength of pole inclosed, no matter whether the pole is one of a number of magnetic systems, in molecules or in masses

the quantity of magnetic matter on its surface, assuming that the veins meet it perpendicularly, or it is the aggregate

through each unit of polar surface is 4π times the intensity of magnetization. This is true not only for the polar surfaces, but also for the interior [illegible] vein of magnetic polarized matter carries associated with



The magnet may itself be situated in a field of force so that its substance may be pervaded by a stress flux independent of that in its veins. It may and generally does happen that part of this separate stress flux issued from its own poles, in which case it will enter in the opposite direction to the vein or internal flux and will tend to reverse the molecular polarity of the vein structure, but whenever such additional flux is present, the resultant total flux at each point will be the geometrical resultant of that in the veins compounded with the external flux by the parallelogram of forces. In the important case of a long bar of homogeneous soft iron submitted to the influence of a uniform magnetic field acting in the direction of its length there will be a uniform induced molecular polarization or magnetization set up along the bar. Suppose, for instance, a bar of iron five square centimeters



in uniform cross section pointed in the direction of the dipping needle near Paris. The earth's field there being 0.46 unit, or its stress flux 0.46 unit over each normal square centimeter, that stress would be active in setting up polarity in the molecules of the iron along the bar. The degree of magnetization would be also influenced by its [illegible] polar stress unless this effect could be rendered insensible by sufficiently extending the length and [illegible] poles out of the field. With a very long bar magnet the magnetization would be everywhere [illegible] strength of field, or numerically 18.4 units, and on the vein theory there would therefore be 18.4 units of magnetic matter exposed on the surface of each square centimeter in a slice made across the bar at [illegible] over the whole section. The polar surfaces would also be covered by 92 units of positive and negative matter respectively. Associated with [illegible]

1. Paper read before the American Institute of Electrical Engineers, Oct. 27, 1891.

[illegible] stress flux, giving a total [illegible] which would emerge from the polar surfaces and unite in the surrounding space. The whole induced system would, however, be immersed in the earth's field that evoked it and which would be superposed upon it throughout. There would thus be 1156+2.3 or [illegible] ordinary phraseology 1158.3 lines of induction through the bar, a density of 231.6 C. G. S. units per square centimeter. The law that the whole flux is the field flux compounded with the induced flux of 4π times the magnetization, which holds uniformly at all points throughout the bar in this simple case, is true at any individual point in the most complex case, however variable the field or magnetization may be.

The fact that the stress flux has the same total value over any envelope surrounding a magnetic pole, however widely the stress may be diffused and rarified, that it follows curves in space whose existence can be rendered evident by iron filings and curves that form closed loops through the substance of the magnet itself gradually suggested the notion of a magnetic circuit in which the circulation was neither a fluid nor an energy-exchanging condition like a current but a stress.

This conception once firmly established proved of great advantage. Not only has the dynamo been greatly aided [illegible] and the question as to their relative [illegible]

is the simpler for general purposes of theory and particularly for dealing with the phenomena of electro-magnetism. The vein theory, on the other hand, while very artificial is often more convenient in dealing with the magnetic behavior of the three metals, iron, cobalt and nickel, and it is the natural accompaniment of Ewing's modern theory of magnetization which at present appears to best represent the facts.

On the circuit theory the magnetic conductivity of all substances is very nearly the same as that of an air-pump vacuum, and constant, notably accepting the three magnetic metals whose conductivity is enormously greater, but variable with the conditions of the circuit.

The existence of magnetic conductivity known as "permeability" necessarily involved the inverse quality of magnetic resistance.[1] Some debate has taken place as to the validity of this term or its application for the reason that the resistance which usually enters into practical magnetic circuits is generally far more variable than that found in the metallic circuit of electricity. It is now generally admitted, however, that the term magnetic resistance is fairly applicable in virtue of analogy if not of exactitude. The term magnetic reluctance then suggested by Heaviside, has, however, the advantage that "reluctance" as one word is less cumbrous than "magnetic resistance," and for that reason only it is advantageous to retain it. Similarly the reluctance per unit volume of the magnetic resistance of one cubic centimeter has been called "reluctivity" and is perfectly definite if not quite euphonious under that title. It is this quantity which will occupy our further attention.

The magnetic circuit differs from the galvanic in one important particular. In the latter we most frequently meet with a conductor carrying the flux or current through an insulating medium such as air in which no current—certainly no measurable current—passes. In the magnetic circuit this condition of things while approximated to and often for practical purposes assumed in dynamos or electro-magnets [illegible] only realized in one actual instance that of a closed Faraday ring uniformly wrapped with wire carrying a current. In every other real case the flux is diffused [illegible] through the surrounding substance and does not follow a simple passage. Magnetic flux in fact is not to be enchanneled because there is no known magnetic in[illegible] by complication the quantitative grasp of the subject.

[illegible] of the magnetic circuit is like Ohm's law that [illegible] magneto-motive force divided by [illegible]

For any one point of the circuit the law is that the flux density is equal to the drop in magneto-motive force per centimeter, there existing, divided by the reluctivity—corresponding exactly to the case of Ohm's law at any point in an electric circuit. This "drop" is called the magnetizing force, denoted by H, and is the strength of the magnetizing field at the point. Owing, however, to the great variation that exists in the reluctivity of iron which enters into nearly every practical magnetic circuit, the law is of much less service than Ohm's electric law. The reluctivity depends not only on the magnetizing force but also on the degree of purity of the iron, and iron possessing 12 per cent. of manganese is almost non-magnetic.[1]

A number of attempts have been made by different observers to establish a definite relationship between the flux density and the magnetizing force or the permeability in order to so amend the magnetic Ohm's law as to give serviceable results for even pure iron. The results obtained, excepting the formulæ of Frolich and Lamont, have generally been regarded as unsatisfactory. They have usually been expressed graphically as curves in one of three types.

1. H—B or curves of magnetizing force and flux density.

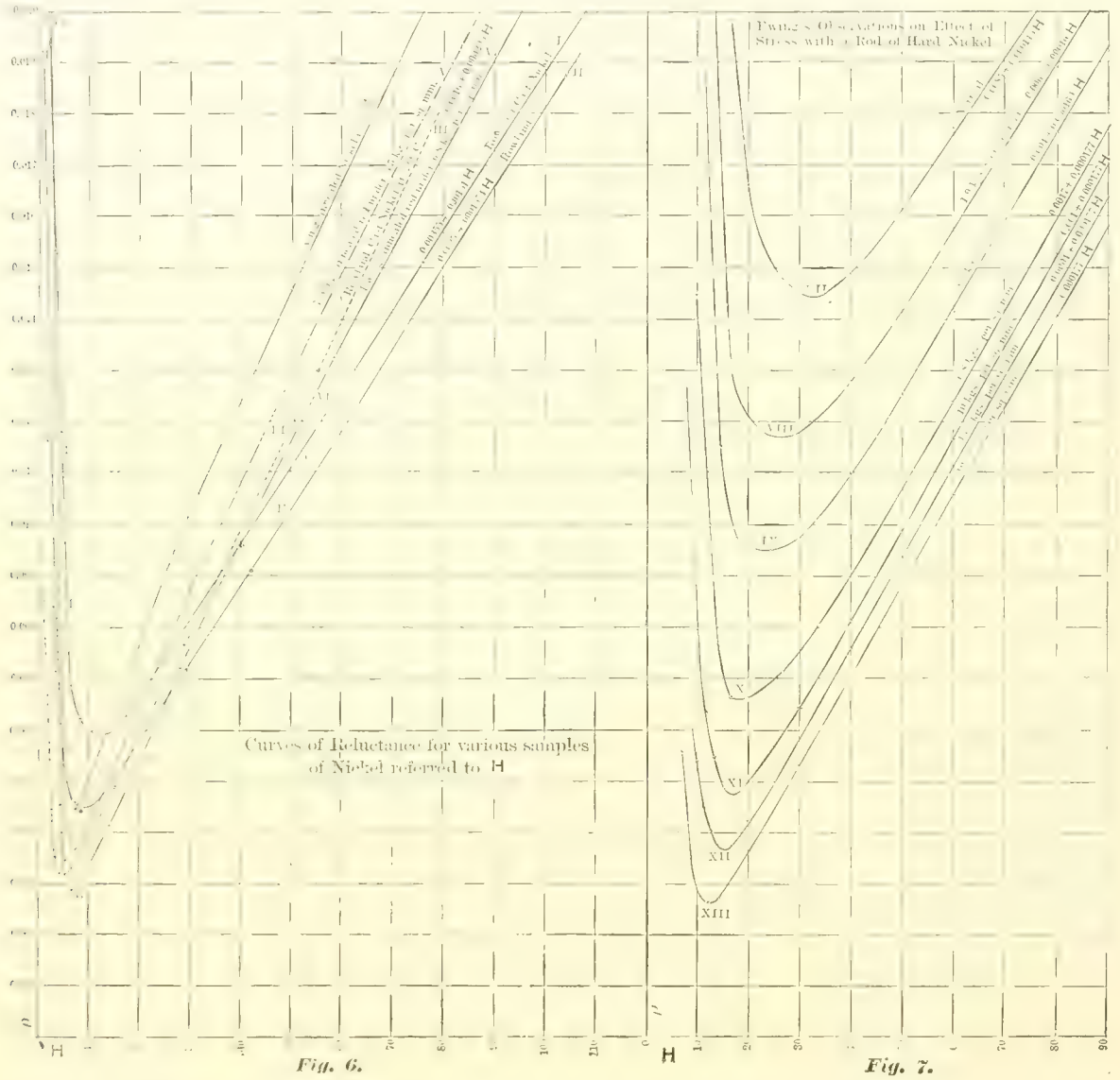


Fig. 6. *Fig. 7.*

2. H—μ or curves connecting permeability and magnetizing force.

3. B—μ or curves connecting flux density and permeability.

It is the object of this paper to show that there is a fourth relation that has not reserved the attention it seems to deserve—namely, the curves connecting the reluctance with the magnetizing force.

As an example of the comparative forms of these well-known curves types 1, 2 and 3 are represented in Figs. 1, 2 and 3 for a sample of Norway iron whose results are among the first on record, being published in 1873.[2] The curve connecting the reluctivity with magnetizing force is shown in Fig. 4 and exhibits a greater degree of simplicity than any of the others. Curve 4 consists in fact of two lines that are very nearly straight, united by a rounded elbow; and these outlines express the fact that the reluctance of this sample of iron was very nearly a linear function of the magnetizing stress brought to bear upon it. The ordinates for this curve are given in thousandths of an absolute reluctant unit, a quantity we may call provisionally a milli unit abbreviated M/U. The reluctance of 1000 M/U in series would be that of one cubic centimeter of air. Reluctivity curves

[illegible]

plotted from various sources, all of which are duly given in the Appendix appear in Fig 6 for various samples of iron and steel. The general type consists of two lines nearly straight, connected by an elbow which is sharper and more defined as the iron is softer and more nearly pure. With hard steel the change from the descending to the ascending line is very gradual. The reluctivity of iron appears from these curves to commence at a certain definite and moderately large value which we may denominate its initial reluctivity, descends very rapidly and nearly on a straight line to what may be called the critical reluctivity at the critical magnetizing force, turns abruptly, and then advances along a nearly straight line. Before the turning point in Fig. 4 the reluctivity may be expressed approximately by the equation $\rho = 2.9 - 3.5H$ while beyond the bend the equation becomes $\rho = 0.1 + 0.058H$. The flux density existing in this sample of Norway iron can be calculated by the Ohm's law formula for any value of H when the corresponding value of the reluctivity is taken from one or the others of these two equations and the resulting curve of B—H will practically coincide with that of Fig. 1 except in the immediate neighborhood of the critical value of H. This relation also exhibits the foundation that exists from the Frölich formula which has long been known to be practicably valuable and even very accurate in application to dynamo-magnetic circuits although, both the method by which it was arrived at and the light in which it has since been regarded appear to have been empirical rather than fundamental.[1]

Fig. 6 shows that the minimum reluctivity for soft iron is about 0.15 MU. while its initial reluctivity is about 3.0 MU. The critical value of H is also in the neighborhood of 2. If any critical H can be said to exist for glass hard pianoforte wire would be in the neighborhood of 35 units, and every description of hard or impure iron met with in practice not containing much manganese appears to have its critical H between these limits. These reluctivity curves also illustrate perhaps more clearly than any others the leading features of Ewing's theory of magnetization. There is first the initial stage of diminishing reluctivity during which the imaginary molecular magnets are being deflected from their original configurations, then a short critical range of magnetizing force in which nearly all the original groupings are disrupted at the point of lowest reluctance, and finally a steady increase of reluctance as the molecules are gradually forced by increasing magnetic stress into parallelism.

This bilinear characteristic curve of reluctivity is not confined only to iron. Fig 6 shows the same general outlines in the case of nickel taken from the observations of Roland and Ewing. Here the initial reluctivities are higher. and the descent to the critical points much sharper than in iron while the ascending lines are also steep but nearly straight.

Taking the equation $\rho = a + bH$ in the ascending curve the first term a only disappears in one known instance—that of nickel under a mechanical stress of 19.8 kilograms per square millimeter or 28,160 lbs. per square inch—as seen in Fig. 7 taken from Ewing's result. The lowest ascending curve prolonged downward almost meets the

Curve showing the Reluctivity of a sample of Norway Iron under feeble magnetizing forces. Ballistic Method, Increasing mag[illegible]

FIG. 9.

origin. Consequently the flux equation for such nickel would be

$$B = \frac{H}{bH} = \frac{1}{b} = \frac{1}{0.000177} = 5650$$

and this flux is practically constant for any magnetizing force within further considerable limits, representing early saturation. The influence of compression in diminishing the reluctance of the nickel is clearly shown in Fig. 7. The critical reluctance is gradually diminished by the stress applied from [illegible] at [illegible] to [illegible] at [illegible] 12

Fig. 8 gives the corresponding curves for cobalt. The same features are again observable. Only in one case that of cast cobalt at 230° C, is there any considerable deviation from a straight line in either rise or decent from the critical segment of the curve, and this represents a series observed by Rowland under some experimental difficulties and alluded to as somewhat doubtful.

We have now examined the reluctance of the three magnetic metals collected from all the best known experimental observations. In addition to these it appears that every reliable series of tabulated result for iron, pure, impure, cast or forged, exhibits the same types of bilinear reluctance referred to H between O and 150, although in very hard or impure specimens there is no clear indication of a critical point. This assumes, however, that the observations are not vitiated by residual magnetism. For example, the curve obtained by plotting the reluctivities of cast iron as quoted by Silvanus Thompson from Hopkinson's observations[1] differs conderably from this type but the difference appears to be accounted for by taking the mean between ascending and descending values. The ballistic method of measurement with anchor rings, in which the progress of the magnetizing force takes place by extending reversals gives reluctances that appear to be as nearly linear as those which are obtained by a single increasing amplitude of magnetization, the influence of hysteresis being apparently nearly uniform in ratio.

An examination of reluctivity curves naturally suggests the question as to whether there is really a strict linear relationship between H and ρ. In other words whether the divergencies of the observation curves from geometrical straight lines can be fairly ascribed to errors of observation, allowing for the influences of residual magnetism.

First confining the inquiry to the ascending reluctivity line—that which is geometrically consequent upon Frölich's formula and also under special interpretation with Lamont's formula—the agreement of the plotted observations with a straight line between the neighborhood of the critical H and $H = 150$ is often so good as to intimate the existence of a definite linear relationship. It is generally to be found, however, that beyond 150 C. G. S. units of H, the line bends downward until all hope of rectilinearity is lost. That is on the simple circuit theory of reluctance. If, however, we introduce an amendment into the definition of reluctance borrowed from the vein or polar theory, the rectilinearity appears to be nearly sustained for a much greater distance. Experimental observations of the reluctances in circuits of the magnetic metals under powerful magneto-motive forces are yet very scanty, but judging from the results of Ewing and Low[2] the reluctivity of wrought and cast iron on the amended definition appears to be a linear or at least nearly linear function of the force as far as H 25,000 and H 11,000 respective'y, the limits of the quoted measurements.

The graphs of these measurements are given in Fig 10. The observations run from H 3,030 to 11,200 for wrought iron with an isolated observation at H 24,500 in a separate instance, the similar series for cast iron running from 3,900 to 10,610 units of H. The linear relationship is very fairly maintained and the lines prolonged downward nearly strike the origin. It is to be observed that at the limiting observation for wrought iron its reluctivity is nearly 20 per cent. greater than that of air or of the air pump vacuum.

According to the simple circuit theory, the reluctance is of course the ratio of the magneto-motive force to the flux and the reluctivity this quantity locally reduced to the unit of volume. On the vein theory, however, which as we have seen distinguishes the vein flux from the magnetizing flux superposed thereon, the conductivity of a mass of iron [illegible] space it occupies, and consequenty applying the vein theory to the magnetic circuit we have the apparent reluctance of [illegible] ple arc, one through the iron itself and what might be called its metallic reluctance the other through the reluctance of the space occupied by the iron, and the removal of the iron would leave this latter unaltered. The difference between the apparent and [illegible] able while the latter remains small, that is generally speak-

Curves showing the reluctivity of Co with varying magnetizing forces.

Fig. 8.

ing when H is below 150, a limit rarely exceeded, and consequently the question does not present itself under practical conditions, but for large values of H, the difference is considerable and the metallic reluctance approaches the linear relationship with H, while the apparent reluctance deviates considerably from it.

These assumptions from the vein theory while they may be convenient are somewhat artificial, for they postulate that the space reluctance of a given volume of air is not altered when the volume is occupied by iron. This may not be impossible but it is difficult to imagine any reluctance mechanism of either that would remain undisturbed by the introduction of a massive substance. On the other hand while the vein theory imposes this principle not touched upon by the circuital hypothesis, it explains very satisfactorily the fact now apparently beyond dispute, that while iron can be saturated there is no limit yet attained to the flux density that can be made to pass through it. Ewing's results give no limit at the observed flux density of 45,350CGS. nearly three times the flux density at which iron is commonly worked in practice, while at the same time they indicate a limiting value of magnetization long before that density is reached. Following the vein theory, the polarization of the iron is then complete and the intensity of magnetization or magnetic matter per unit cross section of

Fig. 10.

veins finds its maximum so that while the total flux can go on increasing indefinitely, it can only do so by adding to the permeating field flux, the vein flux having reached its full limit. It is not impossible to represent the observed condition of affairs by the simple circuit theory, but the mental picture is not so clear. It would be possible for instance to imagine that the molecules of all substances transmitted the stress flux with the same or almost the same facility as the ether surrounding them, but that in the magnetic metals they exalted the stress in transmission. Maxwell supposed that the iron molecules were so constructed that they could take part in the ether [illegible] might constitute the stress and [illegible] momentum of revolution they could augment its value. There would be then, perhaps at a certain stress, a speed of revolution which the iron [illegible] then reinforcement would [illegible] stresses enormously greater than this the molecular augmentation would [illegible] field and the iron [illegible] almost like the motionless transmitters of other substances. The [illegible] even more [illegible]

[illegible] between the initial and critical values, closer examination

1. Frolich, [illegible], pp. 00, [illegible] 1881, p. 73, 1882.
Silvanus Thompson, "Dynamo-Electric Machinery," p. [illegible]. "Lecture on the Electro-magnet," I, p. 74.
Ayrton & Perry, *Phil. Mag.*, 1888, vol. xxv, p. 50[illegible].

1. Silvanus Thompson, "Dynamo Electric Machinery," [illegible]
2. [illegible], London, 18[illegible] July 2, and Aug. [illegible]

will show that here at least the linear relation is only an apparent one. The descent is so steep that on the scale of projection it appears nearly straight, but when magnified it has a distinct curvature. Raleigh[1] and others have shown that for very small degrees of H the permeability commences with a definite steady value and this being the case it would be impossible for the reluctivity—the reciprocal of that permeability—to be linear toward H. Series of observations covering with sufficient detail the range of H from zero to unity are apparently few, and Fig. 9 gives the plotted values of the reluctivity on an enlarged scale observed by the writer for a sample ring of Norway iron. The descending line has a marked curvature approximately logarithmic, that would be almost inappreci-

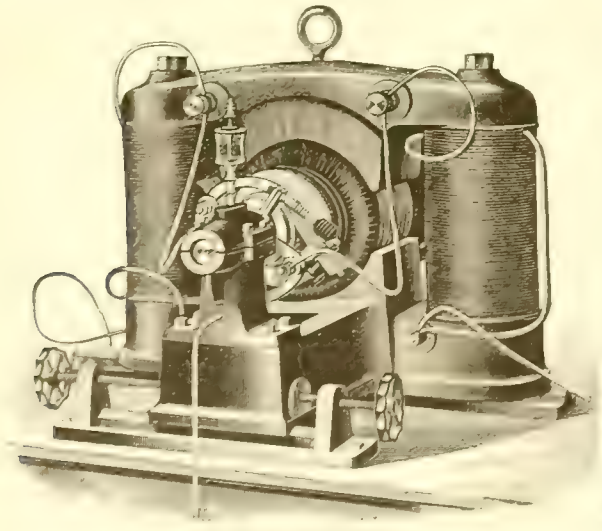
FIG. 1. NEW PUSH-BUTTON SWITCH.

able however on the scale of the other reluctivity diagrams.

Even however if we admit that there exists a linear relationship between H and ρ beyond the critical point, that is to say if the experimental results justify the belief that Frölich's formula is not merely an empirical one, we are scarcely entitled to attribute to this relationship an intrinsic physical signification. It may enable us to grasp the salient features of the magnetic circuit by the re-establishment of Ohm's law, but the relationship is more likely to be the consequence of a more remote fundamental agency than to be significant of any physical condition resident in metallic reluctivity itself. This is for the reason that the increase of flux under M. M. F in a magnetic circuit due to the presence of iron is probably owing to an assisting M. M. F. set up in that iron under stress than to any change in the latter's reluctance and the removal of the initial source of M. M. F. from the circuit still leaves some M. M. F. active as residual magnetism.

The case is similar to that of an electric circuit containing a polarizing electrolyte. It might be more simple to ignore the counter E. M. F. of polarization and to regard the resulting diminution of current as the result of an extra resistance whose value might be tabulated or possibly even reduced to simple laws. So again in alternate current circuits it is often more convenient to speak of a resistance coil with inductance as possessing an impedance greater than its ohmic resistance and to determine the flow of current on the basis of impedance calculated to the original E. M. F. whereas the direct and fundamental method would be to keep the resistance at its true value and determine the current by allowing for the counter E. M. F. of inductance in quantity and in time.

Retaining then the latter analogy, we may say that flow in an electric circuit is subject to Ohm's law simply when the E. M. F., is constant, but when the effective E. M. F.



a definite way depending on the quality of the metal and on the magnetizing force in or to obtain the corresponding true flux density. The change in reluctance is the ideal connection of a shunt metallic circuit in parallel with the air circuit, and the reluctivity through the metal is nearly a^1-b^1H for values of H below the critical and $a+bH$ for values beyond, with a little uncertainty in the vicinity of the critical point itself.

La Roche Arc Dynamo.

The La Roche Electric Works at Philadelphia have turned out several arc light dynamos of the type illustrated in the accompanying cut. They are 50 light machines and are furnished with an excellent regulator, also made by the La Roche company. It is claimed that the machine will regulate within ten per cent. The armature core is built up of small pieces of annealed iron wire and, it is claimed, runs perfectly. The dynamo is mounted on an insulated sub-base which admits of adjusting the machine.

It is supplied with self oiling bearings and automatic adjustable brush holder. Carbon brushes are used. The manufacturers have built quite a number of these machines and are now building an arc light dynamo having a capacity of 150 2,000 candle power lights. This dynamo will be shipped to Australia when completed.

The Porter Motor.

The little motor illustrated in the accompanying cut, and called No. 1, by the Porter & Leavitt Electric Motor company, Providence, R. I., which manufactures it, is designed to run on one cell of acid battery. The machine weighs only one and one-half pounds, and occupies a space three inches square. It is self-starting, and de-

PORTER MOTOR.

velops quite a large amount of power for so small a motor. The motor is capable of running a 5-inch fan, small music-boxes, models, mechanical toys, etc. The machine is finished in fine enamel with brass trimmings. Three sizes, of which the motor illustrated is the smallest, are made at present, but larger machines to be designated, No. 4 and No. 5, wound for either battery or incandescent circuits, are shortly to be placed on the market.

New Push-Button Switch.

A new departure in incandescent switches is soon to be offered to the trade by the Cutter Electrical & Manufacturing company, Philadelphia, Pa. In the subjoined illustrations, Fig. 1 shows the switch open while Fig. 2 shows it closed. This switch is of the single-pole, double-break class, with the brushes and switching mechanism mounted upon a porcelain base, which is in turn, inclosed in a casing of the same material. The copper terminal brushes are set one over the other, the end of the switch-baracting as a bridge between them when the switch is closed, and giving a break of one-quarter inch on each side when open, or, an actual break of one-half inch The switch-bar is operated entirely by a flat semi electrical spring, which acts eccentrically in such manner that, until the switching lever brings the spring to center, there is no movement whatever of the switch-bar; consequently when it is moved past the center, the full tension of the spring is brought to bear for the break, which is absolutely instantaneous, so that with ten amperes current this size of switch exhibits but the faintest indication of a spark.

The switch is operated by two push buttons set into a face plate, which is set in place [illegible] the face or surface of the switch board, the portion containing the switch mechanism being recessed into the wall, so that nothing is presented to view but the face plate, which may be so ornamented as to correspond with its surroundings. One of the push buttons is white, the other black. By pushing the white one the circuit is closed, while by pushing the black one it is opened, and in case the light governed by a particular switch is in a distant room, the condition of that light, as to whether it is "on" or "off," is indicated by the relative positions of the push buttons. If the white button is flush with the surface of the face plate the light is "on;" if the black one is thus flush with the plate, the light is "off."

The peculiar construction of this switch permits of a convenient method of placing a number of switches in "gang" on the same face plate, in a manner similar to that adopted in electric gas lighting. For instance, a gang of ten

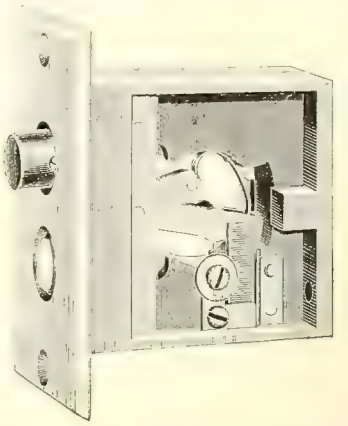


FIG. 2. NEW PUSH-BUTTON SWITCH.

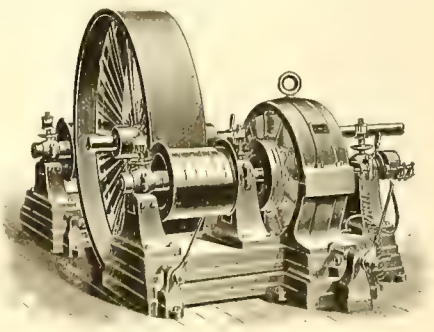
switches would exhibit only a face plate fifteen inches long by three and one-quarter inches wide. The switch is also modified so as to be able to control one or more lights from two or more places.

Electric Motors in England.

At present there appears to be but a small demand for electric motors in London, says an English contemporary, and doubtless the main reason for this is the low price of gas. A horse power can be produced in a gas engine at about 1d. per hour, whereas if current be used from the electric supply companies' mains the cost per horse-power will reach about 4½d. This of itself is sufficient to preclude the use of motors on anything like an extended scale at present. The great desideratum of the electric supply companies is to increase their load factors, and this could be done easily were the current required for the supply of motive power. The use of gas for illuminating purposes is without doubt doomed, but there is before the gas companies a great future for the supply of gas for heating and for driving gas engines.

Evans Friction Cone.

An interesting method of transmitting engine power to dynamos is shown in the accompanying illustration. How to realize the highest percentage of the power produced in the steam engine or water wheel on the armature shaft with the greatest economy of space and the maximum of convenience is a problem that has long engaged the attention of engine builders and manufacturers of electrical machinery. The device shown in the cut is the solution advanced by the Evans Friction Cone company of Boston,



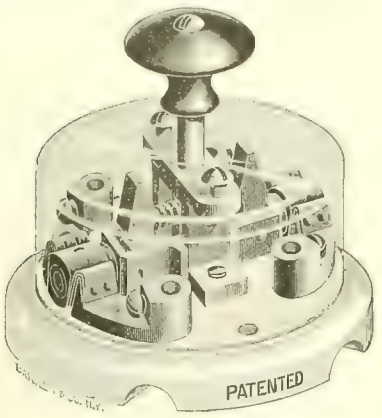
EVANS FRICTION CONE.

Mass. As shown, the friction cones press directly against the fly-wheel of the engine shaft, and the method of operation can be seen at a glance. The cut represents two 650 light incandescent machines that the Thomson-Houston Electric company is building for the electric light station of the Clinton Gas Light company at Clinton, Mass. The dynamos will be driven by the Evans Friction Cone.

The new Manchester, Eng., electric lighting station will occupy a site covering 25,000 square yards. The system of distribution recommended by Dr. Hopkinson is on the five-wire system, with pressures of 400 volts in the extreme conductors down to 100 volts in the service mains.

New Double Pole Switch.

In the accompanying cuts is shown a new double pole switch just put upon the market by the Union Electric company of Bridgeport, Conn. As will be seen by a reference to the illustrations, the switch is shown open and closed. In alluding to its merits the company manufacturing it says: "The switch has been brought out to meet



NEW DOUBLE POLE SWITCH.

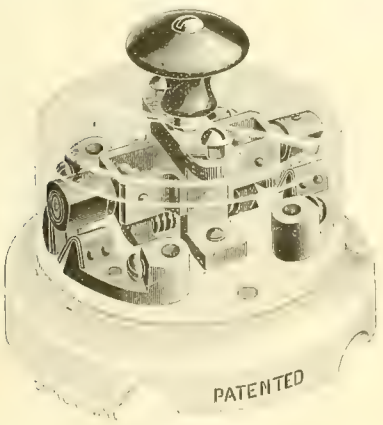
the wants of the trade for a perfect article—a trade which, owing to the great advancements made in recent times in such articles, has grown to be a very discriminating one." It is claimed that the new switch meets these requirements.

Advantages of the City and South London Electric Railway.

An interesting discussion has been carried on in the New York newspapers in relation to the merits of the City and South London railway, which has many admirers in New York, and which an influential p rty desires to see reproduced in Gotham. This railroad is laid in a tunnel constructed after the plans of J. H. Greathead, an English engineer, and the motive power is electricity. In the last two months there has been much discussion as to the real worth of the Greathead scheme by partisans of one side or the other. It has been contended, for example, that the road now in operation in London is an ideal one, and exactly suited to the demands of New York. Those opposed to it have insisted on the other hand, that it is ill adapted to the needs of that city, and that it is by no means good even where it is in operation. George C. Holt belongs to the latter class and in a recent letter to the *Evening Post* of New York he criticised the London road for a number of alleged defects, concluding with this statement: "Upon the whole, it was the most disagreeable public conveyance I ever rode on. The old London underground is, in my judgment, much preferable, and I heard that opinion expressed by every one I talked with on the subject in London. Compared with our elevated roads, the London electric road was immeasurably inferior, as far so the comfort of the passengers was concerned."

The underground electric road does not lack able and vigorous defenders, however, and one of these, a gentleman signing himself H. L., published in the *New York Times* of October 16th a long letter in reply to Mr. Holt's objections. Premising his statements with the assertion that he had traveled over the line in question a number of times last month, the writer proceeded to take up Mr. Holt's criticisms in the order in which they were originally presented.

The *Times* correspondent first asserted that the tunnel is well ventilated and perfectly dry. Each train of cars



NEW DOUBLE POLE SWITCH.

acts like a piston in a cylinder, pushing ahead a column of air and followed by an inrush of outside atmosphere

The lighting of the cars, it is admitted, is open to criticism, but it is urged that this difficulty can be easily obviated in the projected tunnel in New York by arranging to have the lighting and power circuits independent and distinct.

As to safety, it is pointed out that of the millions thus far carried on the railway not one has been injured. It is not supposable that the tunnel itself would cave in. The construction is too strong for that. If the train were to stop from a failure of the current or the breaking of an axle, there would be no danger. In either case the block signals would show the fact at once to the following train, and there would be no danger of collision.

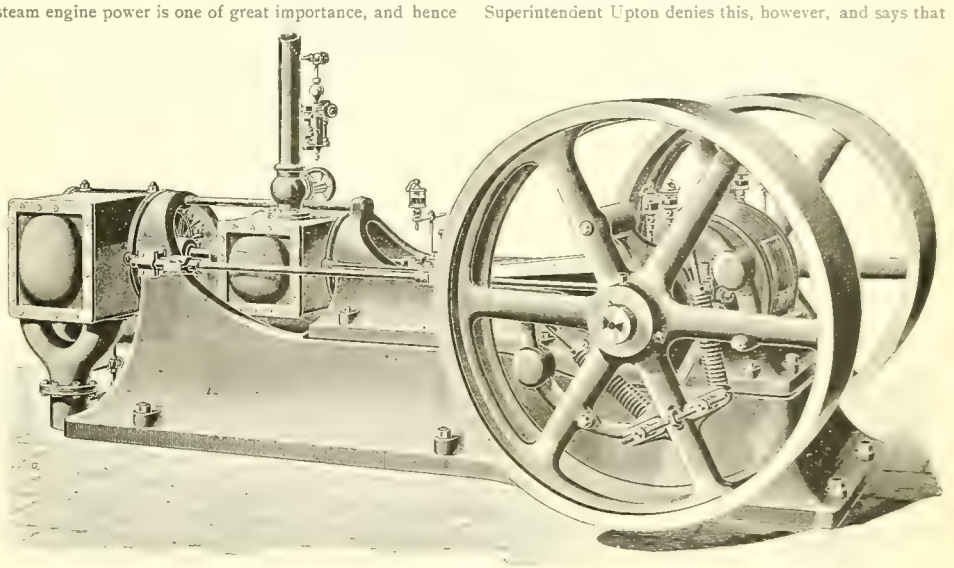
In speaking of speed the *Times* correspondent says: "The writer timed the speed of the trains over the whole road and between various stations. The entire road is about three and one-quarter miles long, and the time consumed in going from end to end, including stops, is a little over fifteen minutes. The average speed, including the stops, is about twelve miles per hour. This is not, however, an altogether fair way of judging the capabilities of the railway. In the first mile and a half, including the portion between the Monument and the Elephant and Castle, there are several short curves, and even a place where one tunnel goes parallel to and right above the other. This construction was necessary in order to avoid conflict with certain property rights, which would have delayed construction and have added vastly to the cost of the undertaking. When the Elephant and Castle station is passed, and from there on to Stockwell, the terminus of the line, a distance of a mile and three-quarters, a speed of nearly twenty-five miles an hour is attained. This is much better than even the so-called express trains on the Ninth Avenue elevated road."

In conclusion, "H. L." says that the electric road is in every way superior to the "smoky, dirty, foul-smelling and altogether disgusting London Underground or District railway." He adds that the smell of that tunnel would abide in one's clothes and other belongings for hours after a journey, and it was always necessary to wash one's face and hands after riding in it for any length of time." In very many ways the City and South London road is said to be superior to the "L" roads of New York. So successful has it been that another and larger tunnel for an electric line is to be built.

A detailed description of the City and South London system was given in the New York *Sun* of October 18th. Here, also, the underground electric road was praised.

Weston Compound Engine.

In the great majority of electric plants the question of steam engine power is one of great importance, and hence



WESTON COMPOUND ENGINE.

central station managers evince much interest in the relative merits of engines recommended to them as particularly adapted for driving dynamos. One of this class is the Weston compound engine, built by the Weston Engine company of Painted Post, N. Y., for which Julian Scholl & Co., 40 Cortlandt street, New York, is agent. In this engine the sub-base is made a part of the engine proper by extending it and projecting a neck in front of the high pressure cylinder for the attachment of the large or low pressure cylinder. This arrangement, it is claimed, has several advantages, principal among which is the accessibility of the low pressure cylinder for inspection. As leakage from this cylinder represents the most serious loss, it is obvious that the practice of making the low pressure cylinder practically inaccessible is disadvantageous as, if no opportunity is given for examination of the piston, the loss from this item may be great. As arranged in the Weston engine there is every opportunity for inspection. Another advantage of this form is in the elimination of cylinder vibration, indicating great rigidity and securing permanent alignment.

These engines have a balanced four admission valve on each cylinder, and both valves are attached in a direct manner to an automatic governor, thus keeping the load evenly divided between the two cylinders. Owing to the variation of load constantly occuring in some lines of service, such as electric lighting, electric railways, rolling mills, etc., the hand adjustment is of little value, as the engine must be set for the entire run, before starting, to

[illegible] within range of its capacity and without disturbing any of the [illegible]

[illegible] ceived under any circumstances and where strict economy of fuel is necessary its value is apparent.

CORRESPONDENCE.

New York Notes.

[illegible] York Electric club was the scene of one of those enjoyable entertainments for which the organization is noted. Secretary Stephen L. Coles [illegible] "Wurzburger Nacht," and all who attended found that it meant passing a very pleasant evening. Mr. Coles "did himself proud," and there are many who remember with pleasure the last meeting of the club.

A telephone war is on in Baltimore, Md. From recent dispatches it looks as if the subscribers would come out ahead in their fight against high prices. The telephone company would like to compromise with a reduction of 25 per cent. and no restrictions as to the use of the instruments. But the Subscribers' association unanimously declines to accept the offer, and has decided to contest in the legislature for a regular charge of $50 a year. The present rate is $125. It may be stated that the telephone company was at first inclined to ridicule the efforts of its subscribers. It has a different feeling, however, at the present time.

It is reported that the Edison Lamp Works at Harrison, N. J., were closed yesterday on account of a strike. Superintendent Upton denies this, however, and says that the works were closed to take an account of stock, and that work will be resumed on Monday next.

The Columbia theater, now in course of erection in Brooklyn, is to be a model as far as the ventilation, lighting and heating appurtenances are concerned. This theater is to occupy the rear half of Leibman Brothers" building on Washington, Tillary and Adams streets. There will be about 1,500 electric lights used, exclusive of the stage. In the square ceiling, a magnificent dome will be built, with sunken panels around it, on which will be painted bold figures. Each panel will represent a special subject in the arts, and the numerous incandescent lights are to illuminate these figures and make them perfectly visible from the auditorium. A number of elegant windows, glazed with rich stained glass and illuminated by electric lights in the back, will be placed in the foyer. The heating will be by low pressure steam, direct and indirect, and the ventilation will be by the blower system. Parfitt Brothers are the architects. It is expected that the Columbia will be completed about March 1st.

It is stated that the electric road in Saratoga, N. Y., will be extended to [illegible]

Word reaches here from Boston to the effect that Harvard university was refused permission to [illegible] board of aldermen to lay electric wires for furnishing the institution and grounds with electric lights.

As a Market street hill car on the electric line in Amsterdam, N. Y., was making its [illegible] morning last week, the brakes failed to let go. The right hand caused

the wheels to slip. The car became uncontrollable. It [illegible] the hill [illegible] speed and struck a wagon. No one was hurt.

Louis May, a judgment creditor of the North American Underground Telegraph and Electric company, has brought sequestration proceedings against it, and Judge O'Brien has appointed Alvah Trowbridge, cashier of the Bank of North America, receiver of the corporation. The company is insolvent, having only office furniture and some patent rights for underground conduits as assets. Mr. Trowbridge is directed to sell the property and make a distribution of the proceeds.

Those who read the article entitled "How the Western Union Telegraph Company Obtained Its Racing News" in the WESTERN ELECTRICIAN of October 10th will be interested in the statement that the persons who carried out this in genious plan for the Western Union company are now engaged in scheming of another sort. It seems that Detective Pinkerton accuses them of assaulting him, and the whole party is now held to answer in the courts. The counsel for the defendants has been endeavoring to have the case go to the grand jury, and he has at last been permitted to file the necessary certificate.

The magnificent statue of "Diana" which now surmounts the lofty tower of Madison Square Garden building, will be illuminated by electricity for the first time Sunday evening.

It will be remembered that, in one of last summer's New York letters, an account was given of the brilliant electrical decorative display at the Vanderbilt ball at Newport. Electricity was supplied to the lamps in the ballroom by the Edison Electric company of Newport from a plant specially set up for the occasion. A lady, Miss Dresser, was injured the night of the ball in an accident due to the scaring of her carriage horses by the engine in temporary use on the Vanderbilt grounds. She is now instituting a suit in the United States circuit court for $50,000 against the electric light people.

The democrats up in Harlem had a great time last week. They opened their campaign with a rush and a roar; but to make their display complete they had, of course, to resort to electricity. There was the usual procession, with transparencies innumerable, but the Stuyvesants carried off the palm as far as the production of the most original display was concerned. The Stuyvesants were in the rear, but a dynamo and incandescent lamps on a wagon enabled them to astonish the simple minded natives. As the wagon passed along "Flower and Sheehan Stuyvesant Club, 1891," appeared spelled out in electric lights.

The Sims-Edison torpedo is soon to be given another trial in foreign waters. This time the exhibition will be made in English waters before the Lords of the Admiralty. The Sims-Edison people state that on this occasion the torpedo will be manœuvered from a steamer.

Articles of incorporation for the Edison Illuminating and Power company of Newark, N. J., have been filed in Trenton. The company is capitalized at $500,000. This is the company about which there is a rumor to the effect that it is to eventually exploit an electric street car system devised by Edison. The system is said to be one in which only the two rails will be employed and the current furnished through them at the low rate of 20 volts. General E. Burd Grubb, United States minister to Spain, is said to be interested in this new company. F. L. P.

Milwaukee, Wis.

[illegible] President Hare of the common [illegible] a resolution author[illegible] contract with the Badger Illuminating company to light the streets with [illegible] per year, the price which [illegible] year. A few [illegible] Illuminating company appeared before the special council committee on [illegible] [illegible] [illegible] police [illegible]

are artificial articles of commerce. Water is indispensable to the city itself in order to extinguish fires, but gas and electricity are not. Mr. Wall also contended that it had not been demonstrated that electric lighting could be applied as cheaply by a city as by a well organized company. The management of municipal affairs, he declared, was necessarily controlled by men who were not paid to devote their whole time to the city, and with increased patronage came danger of rings and corruptions. He asserted that the claim of Prof. Barrett of Chicago that electric lights only cost Chicago $73 each per annum was misleading. To support his assertion he quoted from a speech made at Cape May a year ago by Mr. Francisco, and stated that the report of the Chicago Board of Public Works for 1890 (page 29) gave the cost at $83 per lamp. He continued that the statement had been made, and seemed to be borne out by the facts, that in arriving at the cost per lamp the Chicago electrician had failed to make allowance for lamps running only part of the year, but had divided the total cost by the number of lamps used during the year, those used part of the time as well, as those used all of the time. Mr. Wall stated that the president of the Chicago Arc Light & Power company had written to him that the cost of electric lights in Chicago was really $145 per lamp per year. Mr. Wall claimed that Mr. Barrett had admitted time and again that his estimate did not take in the interest on the money invested nor make any allowance for loss by reason of the wear and tear of machinery. The underground system, Mr. Wall argued, cost eight or nine times more than the overhead system, and the cost per mile of maintaining an underground system is more than half of the cost per mile of building an overhead system. He asserted that it is cheaper to build an entirely new overhead system every two years than it is to maintain the underground system for one year. He wound up by saying that the science of electricity is still in an experimental stage, and that all the machinery in use is patented. Improvements are being made all the time. The city, therefore, might to-day invest $500,000 or $1,000,000 in an electric light plant, and in five or ten years have nothing of value to show for its money.

At the office of the Badger Illuminating company the special committee spent more than two hours looking over the company's books, no information bearing on the subject being withheld. All such knowledge, however, was imparted in strict confidence. Then the Badger plant was inspected. Here the committee found four boilers with a total of 1,100 horse power, four engines of 900 horse power, and twenty dynamos with a capacity of supplying 930 arc lights. From the Badger plant the committee went to the establishment of the Milwaukee Power and Lighting company and inspected the books and machinery.

Judge Rose, who represents the Milwaukee Power & Lighting company, insists that the city should possess its own electric lighting plant. That company was willing to show by its books that the city, by investing $200,000, could furnish its own lights at $65 each a year. The company's plant would be sold were a satisfactory price offered.

Chief Engineer Meyer of the Villard street railway system states that new street railroads are being built here at the rate of four miles a week. Thirty-two miles have been built, leaving forty-eight to be constructed.

PERSONAL.

Clinton B. Osgood, agent for the railway department of the Westinghouse company at Atlanta, Ga., was in Chicago last week.

Herbert E. Goodman, secretary of the Sperry Electric Mining Machine company, is just recovering from a severe attack of scarlet fever.

C. E. L. Brown, the famous Swiss electrical engineer, is now the senior member of the firm of Brown, Boveri & [illegible] of Baden, Switzerland.

J. Allan Hornsby, secretary of the department of electricity, World's Fair, returned home from his European trip on October 30th. He expresses himself as well satisfied with the results of his journey.

W. A. Stadelman, manager and electrical engineer, and S. Ashton Hand, vice president and mechanical engineer of the Equitable Engineering & Construction company of Philadelphia, were in Chicago last week.

Among the visitors to the Frankfort electrical exhibition [illegible] superintendent [illegible] of the Thomson-Houston works. He expresses the belief that Europeans are [illegible] electric railway work.

[illegible] has been appointed general superintendent of the [illegible] Park [illegible] company, of Sioux City, Ia., vice C. W. Rickard, resigned. He will take full charge of everything pertaining to the operation of [illegible]

NEW INCORPORATIONS.

Lake Erie Electric Light company, Elyria, O.; capital stock, $20,000; to manufacture electric light and gas; Lester McLean, Elyria, O.

Heisler Electric company, Gloucester, N. J.; capital stock, $250 000; to manufacture and sell electric apparatus; E. H. MacMorris, Philadelphia, Pa.

McLeod Electric Manufacturing company, Brooklyn, N. Y.; capital stock, $3,000; to manufacture electrical machines, implements and specialties.

Pascagoula Ice company, Scranton, Miss.; capital stock, $15,000; to manufacture electric lights, furnishing cold storage, etc.; W. M. Denny, Scranton, Miss.

Electro Novelty company, Pontiac, Me.; capital stock, $60,000; to manufacture and deal in all kinds of electric novelties; Clarence Hale, 39 Exchange street, Pontiac, Me.

Springfield Light & Power company, Springfield, O.; capital stock $200,000; generating and distributing electricity for light, power, etc.; J. H. Miller, Springfield, Ohio.

Acme Light, Heat and Power company of Illinois, Chicago, Ill.; capital stock, $2,000,000; to furnish light, heat and power; N. Whitman, 820 Chamber of Commerce, Chicago, Ill.

Wampa Electric Light & Power company, Wampa, Idaho; capital stock, $24,000; to construct and operate a plant for the distribution of light and power; J. M. Jones, Wampa, Idaho.

Spher-Electro Power & Development company, Portland, Me.; capital stock, $2,500,000; to manufacture and deal in machinery, apparatus and appliances of all kinds; Clarence Hale, Portland, Me.

Atlantic Electric Light & Power company, Atlantic City, N. J.; capital stock, $50,000; to manufacture, produce, supply and distribute electricity for electric lights; C. L. Cole, Atlantic City, N. J.

Gray Electric company, Chicago, Ill.; capital stock, $100,000; to manufacture and use telautographs, electrical and other instruments and appliances; Elisha Gray, Auditorium building, Chicago, Ill.

New York Electric Construction company, Jersey City, N. J.; capital stock, $100,000; to build, construct, enlarge or complete electric light plants and electric light devices; John H. Hapgood, New York, N. Y.

Mott Visual Telegraph company, Jersey City, N. J.; capital stock, $500,000; to manufacture, construct, complete, repair and sell electrical bulletin instruments; Truax & Vail, 136 Liberty street, New York.

Mifflingburg Electric Light & Power company, Mifflingburg, Pa.; capital stock, $1,000; to supply light, heat and power by means of electricity to the public at Mifflingburg; John A. Beard, Mifflingburg Pa.

Central Electric Railway company, Paterson, N. J.; capital stock, $30,000; constructing, maintaining and operating a street railway for public use; Barkalow, Pennington & Beam, 148 Ellison street, Paterson, N. J.

Gothenburg Water Power & Investment company, Milwaukee, Wis.; capital stock, $2,500,000; to construct and maintain irrigating ditches; construct electric street railways; build factories; maintain systems of waterworks.

San Bernardino Street Railway company, San Bernardino, Cal.; capital stock, $10,000; to construct and operate lines of street cars in San Bernardino by horses, mules, electricity or steam; W. S. Hooper, San Bernardino, Cal.

Union County Electric company, Roselle, N. J.; capital stock, $30,000; to construct, acquire, maintain, operate, purchase and sell works and machinery of all kinds for transmitting electricity; Frank Bergen, 68 Broadway, Elizabeth, N. J.

European American Electric corporation, Chicago, Ill.; capital stock, $2,000,000; to acquire, manufacture and deal in electrical patents, inventions, devices, improvements and machinery; Dupee, Judah & Hillard, Adams Express building, Chicago, Ill.

Columbus & Westerville Railway company, Columbus, O.; capital stock, $100,000; constructing and operating a street railroad between Columbus and Westerville, Franklin county, O., to be operated by electricity or other power; F. W. Merrick, Columbus, O.

National Electraprise company, New Orleans, La.; capital stock, $250,000; to purchase and sell the electraprise and similar instruments in the states of Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa, Missouri, Minnesota, North Dakota, South Dakota and Kansas.

ELECTRIC LIGHT.

A group of Belgian capitalists has obtained from the government of the Shah a monopoly for gas and electric lighting in Persia. The concession is granted for 99 years.

The City Electric Light company of Charlestown, W. Va., has been organized with B. D. Gibson, president; Gustav Brown, vice-president; William Campbell, secretary and treasurer, and Charles C. Caldwell, superintendent. The Warfield Manufacturing company of Baltimore is putting in the plant at a cost of $15,000. The station is to be in operation December 20th.

There is some talk in Pittsburg of a municipal electric light plant. A resolution has been adopted by the select council requiring that, inasmuch as the present contract for street lighting would expire in six months, the chief of

public works report to the councils within thirty days the total number of arc and incandescent lights in use by the city, and the annual cost of each light. This official is also required to report what would be the probable cost of a plant capable of supplying the city with electric light; also report what the cities of St. Louis, Detroit, New York and Philadelphia pay per year for electric light.

The electric light has been made to serve a new purpose in England, according to the London *Daily Telegraph*. The gamekeepers on an estate near Bournemouth found that poachers were in the preserves, and by the aid of occasional flashes from the search lights at Hurst Castle, they were able to recognize two men who ran away, leaving behind them a net a hundred yards long. The men were afterwards arrested, from the description given by the keepers, and brought before the Bournemouth magistrates, who sentenced them to two months' hard labor and to find security for good behavior during twelve months, or in default suffer six months' additional imprisonment. Hurst Castle is several miles distant from the place where the men were discovered.

The lighting of the dome of St. Paul's Cathedral by electricity is now being canvassed in London. The redecoration of the interior of the magnificent dome is now progressing, and the artistic work which is being done will soon be spoiled if submitted to the ravages of the rows of gas jets which are at present placed immediately below the paintings. In a few years the colors must inevitably lose their brightness and become as gloomy as other parts of the structure where gas flames have had their murky way. The lighting of the other parts of the cathedral is miserably inadequate, and although there is a large section of the community who would preserve the "dim religious light" at all hazards, and who would think that the introduction of the electric light would have "a theatrical tendency," there are others who realize that nothing is lost by adding to the cheerfulness of the house of worship, and that a good deal of destruction and disfigurement is saved by the use of a bright, clean and harmless light.

ELECTRIC RAILWAYS.

The municipality of Genoa proposes to establish several electric tramways in that town, and a request has been forwarded to the Italian Parliament asking that such lines should be declared of public utility.

The Citizens' Traction and the Duquesne Electric Railway companies of Pittsburg are contending for a right of way on Penn avenue.

An electric railroad from Napa, Cal., to Calistoga, a distance of 28 miles, is projected. It is proposed to construct the road early in the spring. Cars will be used for freight as well as for passengers. When the road is completed, it is proposed to start cars every hour to Calistoga, from which place cars will also leave every hour. The rate of fare at first will be about one cent per mile The cars will carry light freight and produce at a great reduction from the price now charged on the steam railroad.

TRADE NEWS.

Among recent additions to Westinghouse literature are pamphlets on the 'Ironclad Gearless Railway Motor" and "How to Protect Your Generators." In the latter the merits of the company's lightning arresters and circuit breakers are set forth.

The Crocker-Wheeler Electric Motor company will make a large exhibit of its "Perfected" motors and dynamos at the exposition in Augusta Ga., from November 2d to November 28th. George C. Field of that company is now in Augusta, and George W. La Rue will soon join him.

Platinum is an article used so extensively in the electrical business that manufacturers will be glad to learn that a large stock of pure platinum is always kept on hand by Schawel & Co., of 29 John street, New York. They furnish this metal in all shapes and forms required in the electrical trade.

If there is any objectionable feature about that very useful little piece of apparatus, the electric bell, it is the necessity of depending upon some sort of battery for current. Any one who may be curious to know about an electric gong that operates without a battery can learn something by writing to Joseph F. Bray & Co., 221 Eighth avenue, New York.

The Electric Supply & Contracting company, Nevada building, Cincinnati, has been recently reorganized, with F. E. Perry as president, A. S. Schulman secretary and treasurer, John Wolf superintendent. This company deals in C. & C. motors and dynamos, and all kinds of supplies, and contracts for complete plants and incandescent and arc motors making a specialty of mechanical engineering and repairing.

Owing to increased business, H. T. Paiste, manufacturer of electrical specialties, has been obliged to move his factory and eastern office from Twelfth and Market streets, Philadelphia, to the new Fuller building, 10 South Eighteenth street, below Market street, in the same city. He has taken the entire third floor of this fine building, thereby trebling his floor space. It is the intention of Mr. Paiste to largely increase his line of specialties. The western office and storeroom, 341 Rookery, Chicago, remains unchanged.

For the past year a hoist and haulage drum, operated by electricity, has been in use at the Castle Gate mine in Utah. The drum was made by the Lidgerwood Manufacturing company of New York, and the electric motor and equipment was furnished by the Thomson-Van Depoele Electric Mining company. But, perhaps, one of the best electrical tests was that which established the merits of the Clark wire for mining work. This wire, manufactured by the Eastern Electric Cable company, 61-65 Hampshire street, Boston, Mass., was used throughout and is said to have given perfect satisfaction.

The "Hub" needle annunciator is a new electrical indicator to which the attention of the trade is called by the Electric Gas Lighting company of Boston. In it a single magnet operates a gravity needle drop, which is replaced by a mechanical set back. The drops are mounted on a metal base, which cannot warp or shrink to throw the mechanism out of adjustment. It has fewer parts than customary, and occupies the least possible space; the parts are easily accessible, and may be withdrawn from the case for repairs or adjustment. It requires a minimum of battery power, and is warranted to hold its adjustments through all seasons and temperatures and to require little attention.

No one will deny the desirability of electric lighting for steam and street railways, and consequently the little pamphlet just issued by the B. G. Electrical Supply company of 401 Fore street, Portland, Me., exploiting the Jordan system of electric lighting for that purpose will be received with interest. The principal feature of this system is the employment of the Jordan electric light coupler, by means of which, it is claimed, the current can be conducted to an unlimited number of cars, being returned through the same coupler to the ground circuit of the motor or to the negative wire, if the double trolley system is used. The coupler is made of two interchangeable halves, with an insulated shell.

The Columbia Electric company has just installed in the Schuneman & Evans six story building at St. Paul, Minn., a six hundred light plant. It consists of two three hundred light Columbia dynamos operated by a 60 horse power Buckeye engine. The same company started up last week two of its two hundred and fifty light machines and a 60 horse power Westinghouse engine at Sheldon, Ia., in a central station to supersede a two hundred light plant which was installed there a year ago. Among the other plants now under contract are the following: One to light Macalister college, St. Paul; another at Little Rock, Ia., for general lighting; trebling the capacity of the plant which the company put in a year ago for Neal & Johns at Lake City, Minn.; three in mills at Centralia, Port Edwards and Steven's Point, Wis.; opera house, Duluth, and Minneapolis Grain & Feed Co 's elevator. The Columbia company is also doing a considerable business in stationary motors.

Among the largest manufacturers of wrought iron pipe and tubes in the United States is the American Tube and Iron Company of Middletown, Pa. This company distributes its products, it is said, in every state in the Union, the provinces of the Dominion of Canada and in the centers of commerce of the South American republics. The secret of the success of this company lies in the fact that its managers from its first inception were men who had thoroughly mastered every detail of the pipe business. The company started in May, 1880, with about seventy-five men. It now employs at its works at Middletown, Pa., and Youngstown, O., upward of 2,000 men. The daily production of the two mills is said to be 250 tons. Additional facilities are now being added to the plant which when completed will swell the output 75 per cent. This company makes a specialty of pumping columns for mines. The western office and salesroom are at No. 50 South Canal street, Chicago. Eugene B. Ryan has charge of this office.

Many people are now operating short telephone lines, and undoubtedly the number would be greatly increased had the conditions in the past been more favorable. However this may be, not a few will find it worth while to write for a circular from the National Telephone Manufacturing company, 620 Atlantic avenue, Boston. This concern furnishes a short distance telephone outfit, and guarantees excellent service over short distances. The National company writes that it has just displaced Bell telephones, constructing its own services, for Wiley & Russell Manufacturing company, Greenfield, Mass., four stations; Warder, Bushnell & Glessner company, Springfield, O., seven stations. The system is also in use by the Portsmouth Shoe company, twelve stations; Walter M. Lowney company, Boston, ten stations; Henry W. Lamb and Thomas Doliber of Brookline; Palmer Mill of the Otis company, four stations; and the Thomson-Houston Electric company. The Lehigh Valley Coal company has a 1,500 feet line in a coal mine.

BUSINESS.

W. R. Ostrander & Co of New York, manufacturers of bells, annunciators, etc., report a good fall trade.

The Globe Cordage Works of 1002 Arch street, Philadelphia, is compelled to make overtime in order to keep up with orders.

The New York Insulated Wire company, the western office of which is at 80 Franklin street, Chicago, reports an unprecedented trade in Grimshaw white core wire.

The Turner Brass works, 4 La Salle avenue, Chicago, have recently increased their facilities, and are prepared to submit estimates on any kind of brass electrical work.

A recent aluminum souvenir bears the name of the St. Louis Electrical Supply company. One side of the medal calls attention to the Grimshaw wire, for which the St. Louis company is agent.

A recent business card issued by Chas. A. Schieren & Co., New York, manufacturers of belting, bears a complete price list on the reverse side. The Chicago office is at 46 South Canal street

Thos. H. Dallett & Co. of Philadelphia will make a specialty of the Billberg generator, combined with and directly driven by the Triumph valveless compound engine, of which [illegible] branch of the company's business.

[illegible] phia, are preparing a new electrical device which they expect to offer to the trade about the first of the year. They have a large amount of work on hand.

H. A. Cheney, of [illegible] very busy upon special electrical work. He has so many orders in this line that he seriously contemplates the enlargement of his factory to meet his increasing business.

A. O. Schoonmaker, 158 William street, New York, reports the demand for foreign mica as being most excellent. Mr. Schoonmaker [illegible] which is considered by many to be the best for insulating purposes

The Westinghouse Electric & Manufacturing company has issued a little book of testimonials to the efficiency of its electric railway system. All the companies using the Westinghouse motors and generators appear to be delighted with their operation.

Cutter's flexite tubing is meeting with favor in all parts of the country, and George Cutter has reason to congratulate himself in consequence It has all the good properties of the best hard rubber tubing, and yet can readily be bent into any desired shape.

C. F. Cole, who for six years has been the Philadelphia representative of the Thomson-Houston company, has accepted the position of general agent for the La Roche Electric Works of 116-118 N. Sixth street, Philadelphia. Mr. Cole reports business brisk.

A recent order received by James Leffel & Co., Springfield, O., from one firm alone was for 18 large water wheels. A large wood pulp mill, now under construction in Wisconsin, will use these wheels. This new enterprise is situated near large quantities of suitable timber and where ample water power can be obtained.

The Imperial Electric company, 1218 Filbert street, Philadelphia, has just issued a circular describing a new incandescent lamp socket with or without key. The socket is made moisture and heat proof and may be easily wired. The Imperial company already reports the receipt of a large number of orders, many of which have been duplicated.

Wright & Starr, electrical engineers of Philadelphia, are making a test of the well-known Waddell-Entz Storage Battery system, at Chester, Penn. The results, thus far, it is said, have proven satisfactory. This trial is being watched by a number of representatives of the street car companies through the South with a view to the adoption of the system.

The Electric Merchandise company reports shipments of Burton Electric Heaters during the past week to the following named places: Salem, O., Williamsport, Pa., Toronto, Ont., Oswego, N. Y., Ottumwa, Ia., Canton, O., Akron, O., Pottsville, Pa., Troy, N. Y. Numerous orders received from points widely separated show the desire of street railway men to adopt this most desirable method of car heating.

Those requiring a supply of mica for insulating purposes are requested to call upon W. H. Sills, 86 Lake street, Chicago. Mr. Sills is the Western representative for Eugene Munsell & Co, of New York, and carries a full stock of mica, both cut and uncut, for electrical purposes. By having a stock in Chicago, Mr. Sills is enabled to fill all orders with great promptness. This house report an increased demand for mica.

Thomas Wrigley, 85 Fifth avenue, Chicago, reports an active demand for his ingenious toggle bolt. It is proving indispensable to telephone and electric light people, particularly where hollow tile walls are used. The following Chicago companies use this bolt in large quantities: The Chicago Telephone company, the Western Electric company, the Chicago Edison company, the Westinghouse company, the Standard Electric company and many others.

The Engineering Equipment company, 143 Liberty street, New York, with a New England office at 126 Pearl street, Boston, has just issued a neat price list of trolley line construction materials, conspicuous among which are the devices containing the well-known Aetna insulating compound, manufactured by Messrs. Anderson. The list specialties contains the Boston trolley, Syracuse poles, Habirshaw wires and cables, patent hard fibre conduit, Underwood cotton-leather belting and other standard construction supplies.

The C. W. Hunt company of New York has just issued an elaborate series of descriptive catalogues under the following headings "Coal Handling, Conveyors, [illegible] ble Railways," "Wire Ropes" and "Railways," presenting a line of electric locomotives and other appliances of general interest to large manufacturers, coal miners and others having use for "industrial railways." This company also manufactures "stevedore" rope for transmitting power together with a large line of coal machinery, and is closely allied to the electric interests.

A. M. Morse & Co., mechanical and contracting engineers, have located at St. Louis, Mo., as the selling agents for the Ball & Wood company. Mr. Morse is an experienced engineer and a successful salesman, formerly of the firm of English, Morse & Co. of Kansas City. The [illegible] of Mead & Stringham, Hammond building, Detroit, Mich., will act as special agent for the Ball & Wood company.

Both members of the firm are mechanical engineers well known to the trade throughout Michigan. The Ball & Wood company has found it necessary to run the Elizabethport shops all night that it may keep up with its orders. It was represented at the street railway convention at Pittsburg by F. H. Hayward, formerly connected with the Straight Line Engine company of Syracuse.

The Crocker-Wheeler Electric Motor company, New York city, has just issued a revised and extended catalogue. It is an interesting pamphlet of over fifty pages. To those seeking information regarding the electric motor and its numerous applications the Crocker-Wheeler catalogue must prove of great value. The text, which is profusely illustrated, discusses at length the construction of the Crocker-Wheeler motors and their special features, with convenient and valuable tables of dimensions, etc. There are also directions for setting up, connecting and running these popular motors. An interesting chapter on "Windings" engages the attention, also a table of sizes and types of motors manufactured for constant potential circuits. The pamphlet further contains "A Visit to the Crocker-Wheeler Electric Motor Company's Factory," and an interesting paper on "Cost of Electric Power—Comparative Efficiency of Large and Small Motors," by Dr. S. S. Wheeler.

ELECTRICAL PATENTS.

[illegible] 20 [illegible] 27, 1891.

461,420. Spring Cushioned or Suspended Arc Lamp. Charles F. Brush, Cleveland, O.

> The object of this invention is to provide means for preventing the [illegible] effect, to the operation of one or more lamps that are operating [illegible], by reason of jarring or jolting of the lamp's support, and the invention consists in the combination, with an electric lamp, of a spring or yielding cushion for supporting or suspending the lamp, and thereby preventing the lamp from being disturbed or deranged by the jolting or jarring of its support.

461,423. Electric Clock Winder. James W. Laney and Charles F. Laney, Canton, O.

461,424. Circuit Closer for Clock Winding Mechanism. James W. Laney, Canton, O.

461,437. Thermo-Electric Element. Charles W. Iden, New York.

461,452. Electric Wire Connector. George R. Scrughan, Lexington, Ky.

461,456. Electric Switch. Alfred Swan, Orange, N. J.

> The [illegible] of this invention is to provide an improved switch in which both make and break shall be beyond the control of the operator after the operating movement has passed a certain point, and in which it shall be impossible for the circuit to be made or broken by the reverse movement of the switch.

461,464. Non Interfering Successive Signaling System and Apparatus. Frank R. Wood, New York.

461,467. Composition of Matter for Insulating Purposes. Martin O. Farrar and Charles C. Howe.

461,470. Telautograph. Elisha Gray, Highland Park, Ill.

The last claim is presented:

> 25. The combination, with a transmitting pen, of an electric circuit, means operated through said pen for producing [illegible] a receiving pen, mechanism independent as regards its [illegible] moving the receiving pen, and caused to operate thereon through said pulsations, [illegible], when the transmitting pen is [illegible] its movement, the receiving pen is brought into unison with the transmitting pen, as regards [illegible] connections whereby the pen-moving mechanism at the receiving station is at the same [illegible] pen to its [illegible].

461,471. Art of Telegraphy. Elisha Gray, Highland Park, Ill.

461,472. Art of and Apporatus for Telautographic communication. Elisha Gray, Highland Park, Ill.

461,473. Telautograph. Elisha Gray, Highland Park, Ill.

The tenth claim is given:

> [illegible]

[illegible] Elisha Gray, Highland Park, Ill.

[illegible] Boston, Mass.

[illegible] T. [illegible] Brooklyn, N. Y.

[illegible]

The [illegible]

[illegible]

461,549. Conduit and Conductor for Electric Railways. Walter H. Knight, New York, N. Y.

461,552. Field Magnet for Dynamo-Electric Machines. Frank J. Sprague, New York, N. Y.

461,554 Electrical Valve Controller. John V. Stout, Easton, Pa.

461,555. Shunt Magnet for Valve Controllers. John V. Stout, Easton, Pa.

461,560. Snap Switch. Henry P. Ball, New York, N. Y.

461,561. Snap Switch. Henry P. Ball, Brooklyn, N. Y.

461,562. Electric Wire Connection. Henry P. Ball, Brooklyn, N. Y.

461,563. Electrical Connecting Device. Henry P. Ball, Brooklyn, N. Y.

461,568. Coupler for Electric Wires. James H. Delaney, South Orange, N. J.

461,569. Arc Lighting System. Robert S. Dobbie, Brooklyn, N. Y.

461,570. Thermal Cut-out. Lorenzo B. Favor, Gloucester, Mass.

461,573. Telephone System. Claude C. Gould, Buffalo, N. Y.

461,575. Electric Meter. Albert B. Herrick, New York, N. Y.

461,582. Hanger for Overhead Wires. Charles A. Lieb, New York, N. Y.

461,611. Trolley Switch. Charles E. Hudson, Leominster, Mass.

461,631. Insulating Support for Electric Conductors. Robert J. Hewett, St. Louis, Mo.

461,657. Control Apparatus for the Position of Signal Disks. Theodor Weisser, Vohrenbach, Germany.

461,659. Electric Arc Lamp. Alloys Wirsching and Rupert Schefbauer, New York, N. Y.

461,662. Motor Truck for Cars. George M. Brill, Philadelphia, Pa.

461,677. Electrical Conduit. Edwin T. Greenfield, New York, N. Y.

461,685. Electric Railway. Frank Mansfield, New York, N. Y.

461,690. Electric Railway. Sidney H. Short, Cleveland, O.

> This invention consists of the combination, with a car and conducting wires, of an electric motor on said car, two independent trolley poles mounted on the car and adapted to have a vibratory and pivotal movement independently of each other, and contacts carried by said poles, said contacts being connected independently with the motor, so as to place said motor in multiple arc.

461,706. Incandescent Double Key Lamp Socket. William J. McCutcheon, Jr., Pittsburgh, Pa.

461,718. Bell Ringing Attachment. William W. Slater and Harry C. Barnes, Oakland, Cal.

461,745 Engraving Machine. Charles H. Field and Charles H. Field, Jr , Providence, R. I.

461,748. Annunciator. Lambert F. Fouts, Trinity Mills, Tex.

461,760. Electric Block Signal System. John La Burt, New York, N. Y.

461,761. Electric Switch. George R. Lean, Boston, Mass.

461,770. Electric Railway Brake. Augustin I. Ambler, Washington, D. C.

> This invention consists in the application of electricity to the mechanical means employed to operate the brakes of a train of cars, first by the engineer on the locomotive in daily use, second, by the conductor from any car in the train, and third by automatically setting the brakes on each car if the train accidentally breaks apart, and the cars become detached or separated.

461,785. Trolley Wire Support. Leroy S. Pfouts, Canton, O.

461,791. Automatic Electric Switch. Sigmund Bergman, New York, N. Y.

461,795. Armature for Electric Motors or Dynamos. Robert Lundell, New York, N. Y.

461,797. Incandescent Lamp Filament. John T. Marshall, Metuchen, N. J.

461,808. Electric Car Brake. La Motte C. Atwood, St. Louis, Mo.

[illegible] Signaling System. Frank P. Benjamin, New York, N. Y.

[illegible] Signaling System. Frank P. Benjamin, New York, N. Y.

[illegible] Electric Heater. John V. Capek, New York, N. Y.

Of the [illegible] claims the last is given:

> [illegible] conductor and [illegible]

[illegible] Secondary Battery Electrode. Justus B. Entz, New York, and [illegible] A. Phillips, Brooklyn

[illegible] Trolley for Electric Cars. Charles A. Lieb, New York, N. Y.

461,851. System of Distribution for Electric Railways. Sidney H. Short, Cleveland, O.

> The object of this invention is to provide an electric railway with a conductor for transmitting current to the several motors to be operated thereon, said conductor to be composed of independent sections, each section having electrically connected therewith an independent—that is to say, individual—conductor connecting directly with the generator, provided with an automatic cut-out, operated by an abnormally heavy current, and a return conductor, common to all such sections, whereby the short circuiting of any one of such sections will result in automatically open circuiting such sections and preserve intact the remaining sections of the road.

461,858. Secondary Battery. Montgomery Waddell and Justus B. Entz, New York, N. Y.

461,862. Electric Generator. Charles G. Young, New York, N. Y.

461,868. Electric Connection. James H. Fleming, Newark, N. J.

> This invention consists in abutting the wire ends within a tube and simultaneously bending the tube and the abutting ends out of true line.

461,887. Multiple System for Telephone Exchanges. William E. McKivitt, St. Paul, Minn.

> The object of this invention is to provide ready means of determining at any given board whether a line is wanted or called for, is connected or in use, at any of the other boards.

Of the three claims we give the last:

> The combination, with pairs of loop-plugs upon one of several multiple switch-boards, of separate battery included in the strand connecting together the tips or line terminals of each of the pairs of plugs, and a battery common to the other terminals of said plugs, substantially as and for the purpose specified.

461,898. Incandescent Electric Lamp Socket. Cecil P. Poole, Lynchburg, Va.

461,965. Galvanic Battery. Calvin N. Souther, Chicago, Ill.

The last claim follows:

> In a galvanic battery, the combination, with a suitable retaining vessel, of a porous cup located within said retaining-vessel, a carbon electrode located within said porous cup, copper sulphate surrounding said carbon electrode within said porous cup and extending to the inner face of the latter, a zinc electrode applied to the outer face of said porous cup, and a suitable liquid, preferably water, in the space between said zinc and the retaining vessel, substantially as shown and described.

461,969. Electric Railway. William B. Vansize, Plainfield, N. J.

461,979. Dynamo-Electric Machine or Motor. Max Mayer, New York, N. Y.

461,991. Lightning Arrester. Edward W. Van Brunt and William M. Raynor, Scranton, Pa.

462,014 Electric Railway. George W. McNear, Oakland, Cal.

462,020. Automatic Regulator for Dynamo-electric Machines. William L. Silvey, Lima, O.

462,022. Electric Railway Switch. Hollon C Spaulding, Boston, Mass.

Of the eight claims the seventh is given:

> In an electric railway switch, the combination, with a main and branch conductor, of a pivoted tongue for each, and means for moving the said tongues oppositely to bring them into line with each other and allow the trolley to pass over from main to branch conductor, and from branch conductor to main conductor.

462,033 Circuit Controllers. William B. Cleveland, Cleveland, O.

The second claim follows:

> The combination of a casing, a comminuted non-liquid filling therein, a stationary contact above said filling, and a movable contact arranged to be withdrawn into the filling.

462,053. Rheostat for Electric Lamps. Thomas A. Lacey, St Paul, Minn.

Of the nine claims the third is given:

> "A rheostat comprising, in combination wire resistance-coils wound so as to form sidewise-tight cylindrical chambers or central passages through them, confining-disks of suitable non-conducting material, and insulated electric conducting-rods having binding-posts at their upper ends, substantially as described."

462,153. Underground System for Electric Railways. Samuel D. Nesmith, Cleveland, O.

> This invention consists of the combination in an electric railway of a conduit having sluiceway drainage, a longitudinal plate arranged diagonally within said conduit, an electric conductor supported beneath said plate, and a trolley-arm adapted to slide on said conductor, and provided with a branch arm.

462,177. Electric Railway. Charles W. Thomas, New York, N. Y.

Of the seventeen claims the fifteenth is given:

> In an electric railway, the combination, with two tracks at different levels, of an inclined plane supporting an independently propelled [illegible] supporting tracks and conductors which correspond to the [illegible] said levels, and means whereby said track conductors are alternately connected with and disconnected from the [illegible] of the respective levels, substantially as set forth.

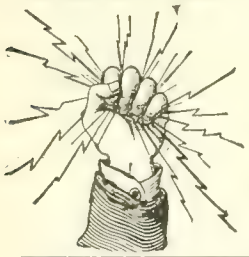
462,207. Method of Welding or Working Metals Electrically. Charles L. Coffin, Detroit, Mich.

> This process consists in connecting the material to be welded with one pole of a generator, placing it in contact with a conductor in proximity to the point of contact between said conductor and a second conductor [illegible] connected with the other pole of the generator, and passing a heating current through the material and said conductor, whereby said material is heated directly [illegible] the current, and also by the heat developed at the point of contact between the two conductors, and [illegible] by pressure.

462,219. Electric Railway Trolley. Rudolph M. Hunter, Philadelphia, Pa.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

CHICAGO. *The Electrical Construction Co.* 23 & 25 S. CANAL ST.

C. A. HARTER, Manager. Telephone, 1718.

REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra heavy weather proof we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation has proved durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are also prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped around a joint and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible cables with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

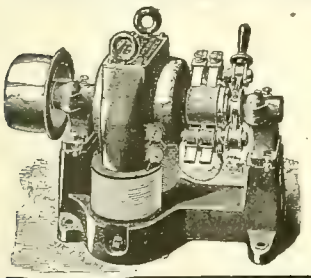
HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

CHICAGO AGENTS: The Electrical Engineering Co., 320 Dearborn St. **TORONTO, ONT. AGENTS: The Toronto Electrical Works.**

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

WANTED.

Position desired by practical electrician in Construction or Testing Departments of Electrical Manufactory. Thorough draughtsman and machinist. Holds B. S. degree from Technical School, and is familiar with best modern practice in engine room or laboratory testing.

Address **B. S.,**
Care of WESTERN ELECTRICIAN.

JAMES LEFFEL WATER WHEELS

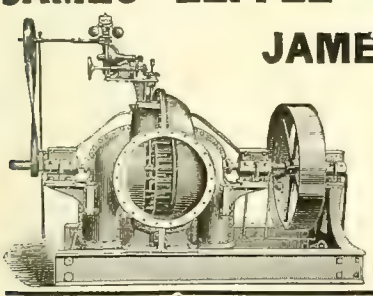
BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.



Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

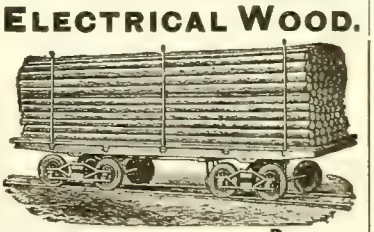
SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., Brooklyn, N.Y.

WANTED.

A salesman for a neutral Electrical Engineering and Construction Company, operating in all kinds of electric lighting and electric power work, in connection with all first-class apparatus. Headquarters, New York. Address "NEUTRAL,"
Care of WESTERN ELECTRICIAN.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Queen's "1891" Portable Testing Set.

For Illustration see THE WESTERN ELECTRICIAN, Sept. 19, page 183.

The galvanometer in this set is made of the D'Arsonval type, and is extremely sensitive, without being affected by *mechanical vibrations*, as on shipboard, or by intense *magnetic disturbances*, as in proximity to a dynamo. It is especially recommended for making tests where a galvanometer with fibre suspension cannot be used.

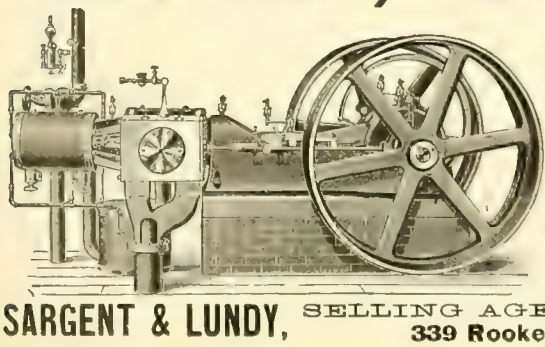
Send for Illustrated Descriptive Catalogue, 1-66.

QUEEN & CO., PHILADELPHIA.

REMEMBER

That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION.
One	12½x12	80	Edison General Electric Co., Groton, N. Y.
Two	18½x17	300	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rio Janeiro, Brazil
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Port. and Street Railway Co., Portland, Me.
One	11 and 19x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Rollins & Co., Chicago, Ill.
One	15 and 23x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Leeds, England
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One	11 and 19x15	150	Fritz Wilen, Helsingfors, Fin and.
One	16x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 26x17	400	Baltimore Electric Refining Co., Baltimore, Md.
One	14½ and 28x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, 339 Rookery Bldg., CHICAGO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

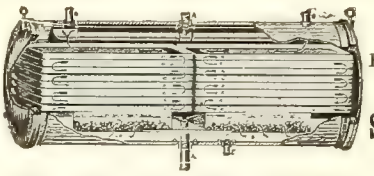
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingots, Slabs, Sheet Wire and Castings at lowest market rates.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.

H WARD LEONARD & COMPANY.

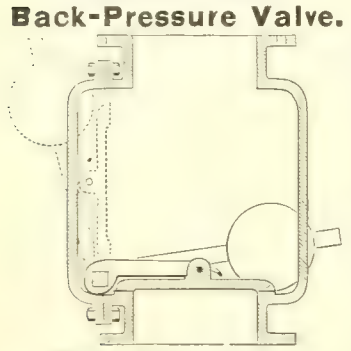
For full information regarding the application of electricity for any purpose, write to us. Ask for our pamphlet. Address,

Electrical Exchange Building, NEW YORK CITY.

THE EXCELSIOR

Straight-Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,

229 S. Franklin St., Chicago.

WANTED ELECTRIC LIGHTING.

Bids will be received at the City Recorder's Office, until Monday evening November 16, 1891, for lighting the city of Big Rapids, Mich., with 32 to 40 2,000 candle power electric lights, according to the following plans.

FIRST: For lights running from dusk until 12 o'clock every night in the year.

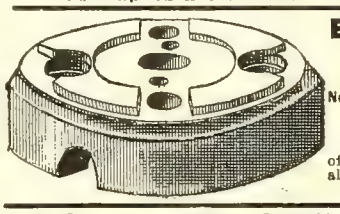
SECOND: For lights running from dusk until daylight every night in the year.

THIRD: Running from dusk until 12 o'clock upon what is known as a moonlight schedule.

FOURTH: Running from dusk until daylight upon a moonlight schedule.

Bids upon each of these propositions to be made for contract running from January 1, 1892 to January 1, 1893, also from January 1, 1892 for a term of three years. The Common Council reserve the right to reject any and all bids.

W. A. FOSTER, Recorder.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician.

50 N. Clinton St., Chicago.

Manufacturers of

OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

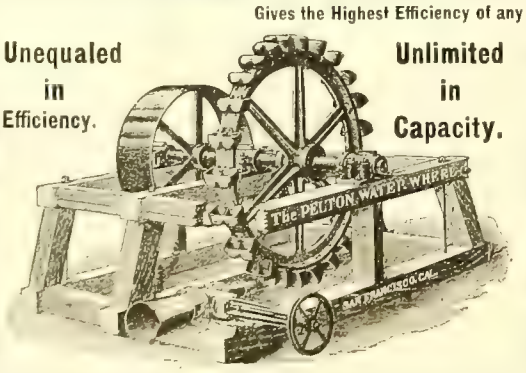
THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 10 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,

121-123 Main St., San Francisco, Cal., U. S. A.

143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

Gleason & Bailey Mfg. Co.,

(LIMITED.)

GENERAL WESTERN AGENTS FOR THE

STEUBEN INCANDESCENT LAMPS,

The best in the Market,

Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.

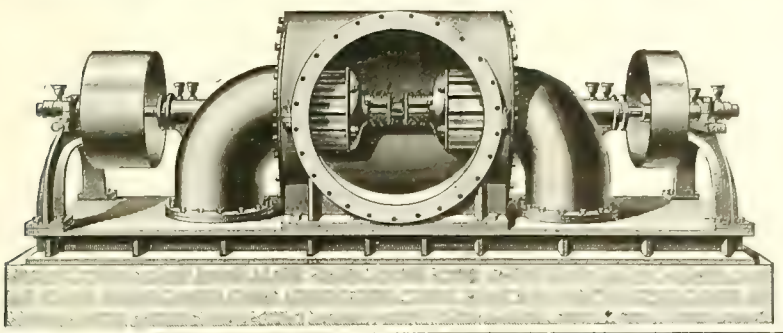
Rubber Covered, Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and catalogues.

BRANCHES: 164 Summer St., Boston, Mass.; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa.; 60 W. Monroe St., Chicago. | **St. Louis, Mo.**

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES [illegible] CELEBRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high speed and great Efficiency,** and **large Capacity** [illegible] diameter, being **double** the **Power** of most wheels [illegible] by a number of the leading electric companies [illegible] economical use of water it is without an equal [illegible] of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents a pair of VICTOR **TURBINES** arranged on a horizontal [illegible] Tubes, End Bearing for Shaft and Bearing [illegible] a substantial cast-iron bed plate. The entire arrangement [illegible] strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO., RAVENNA, OHIO. MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

FOR SALE.

One 3 Horse Power Electric Motor.
One 6 Horse Power Electric Motor.

Both in excellent condition, having been used but little.

ERIE ELECTRICAL SUPPLY CO.,
ERIE PA.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215 **136 Liberty St.,** NEW YORK

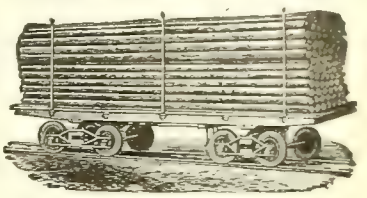
J. C. TEMPLE,
(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,
Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR
FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

CEDAR POLES.
Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,
Consulting and Constructing
ELECTRICAL AND MECHANICAL ENGINEERS.
Complete Equipment of Electric Railways. Steam and Electric Plants.
47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

73-75 W. Jackson St. **RELIABLE**

WE ARE FITTED WITH
RELIABLE Machinery and Tools,
And Employ RELIABLE Workmen.
All Kinds of Electrical Apparatus to Order.
CHICAGO ELECTRIC MFG. CO.

UNION ELECTRIC WORKS,

207 South Canal St., CHICAGO, ILLINOIS.

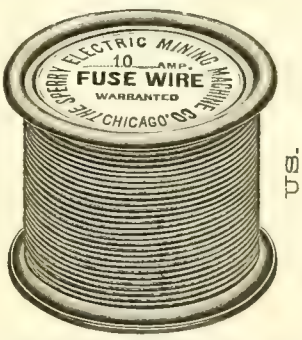
The **Best Electric Bell** in the market; Nickel plated Gongs; Double magnet, Platinum Contacts, side adjustments with set screw. The simplest and most durable Annunciator, all sizes, for elevators, hotels and offices.

WRITE FOR PRICES.

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class work.

EVERYTHING IN
WIRE—FUSE— STRIPS.



WRITE US.

MANUFACTURED BY
The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT
IS MADE ONLY BY THE
Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

TO DENVER VIA
BURLINGTON ROUTE.
Only One Night on the Road.

Leave Chicago at 1.00 P. M., or St. Louis at 8.25 A. M., and arrive Denver 6.15 P. M. the next day. Through Sleepers, Chair Cars and Dining Cars. All Railways from the East connect with these trains and with similar trains via Burlington Route to Denver, leaving Chicago at 6.10 P. M., St. Louis at 8.15 P. M., and Peoria at 5.20 P. M. and 8.00 P. M. All trains daily.

Additional express trains, making as quick time as those of any other road, from Chicago, St. Louis and Peoria to St. Paul, Minneapolis, Council Bluffs, Omaha, Cheyenne, Black Hills, Atchison, Kansas City, Houston and all points West, Northwest and Southwest.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.

BY LIEUT. F. B. BADT AND PROF. H. S. CARHART.

PRICE, POSTAGE PREPAID, 75 CENTS.

This is a very handsome book of 60 pages, printed on fine heavy paper, with neat cloth binding. It contains PORTRAITS and BIOGRAPHIES of Ohm, Watt, Faraday, Joule, Gauss, Weber, Sir William Siemens, Dr. Werner von Siemens, Volta, Ampere, Daniell, von Jacobi, together with a carefully prepared table of the Practical Electrical Units, with their relative values.

In no other Single Volume can this Rare Collection of Portraits be Found.

ELECTRICIAN PUBLISHING CO., - 6 Lakeside Building, Chicago, Ill

C. & C. ELECTRIC MOTORS AND DYNAMOS.

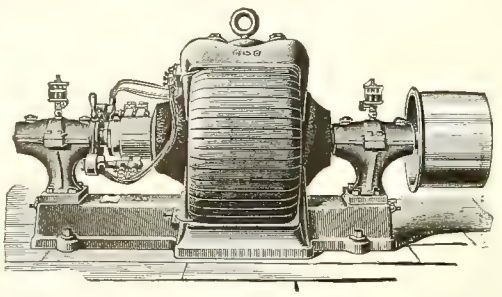
Electric motors in all standard sizes for operating elevators, pumps, printing presses and machinery for general manufacturing purposes.

Electrical Mining Machinery of all kinds, Hoists, Tram Cars, etc.

Electric Blowers for ship ventilation. Fan outfits.

Electric plants for pumping church organs.

Over 10,000 motors in actual operation.



Dynamos in all sizes of same design and dimensions as the standard motors.

Equipment of mines, factories, machine shops, office buildings with complete electrical plants for lighting and power.

New England Office, 63 Oliver St., - BOSTON.
Philadelphia Office, - 38 S. FOURTH ST.
Chicago Office, - - PHENIX BLDG.
San Francisco Office, - 35 MARKET ST.

THE C. & C. ELECTRIC MOTOR CO., 402-404 GREENWICH ST., NEW YORK.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." PATENT "K.K." LINE WIRE TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

GRIMSHAW WHITE CORE INSULATED WIRE TRADE MARK

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC,
All Supply Stores Keep Them.

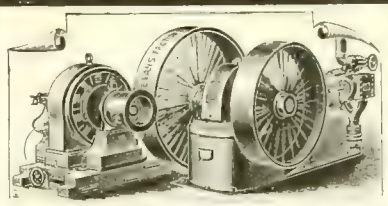
THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,
78-80-82 Franklin Street,
CHICAGO.

MAIN OFFICE,
649 and 651 Broadway,
New York.

Geo. H. Meeker,
Western Manager.

NEW YORK INSULATED WIRE CO. NEW YORK
MOISTURE-PROOF
VULCA
ELECTRICAL
WIRE-DUCT
NON-INFLAMMABLE
TRADE MARK
AND CHICAGO.

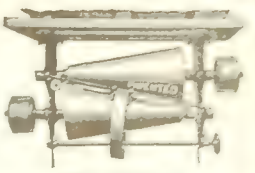


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones, For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

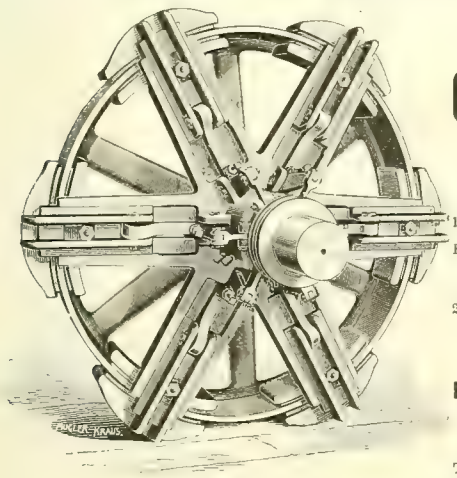
OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

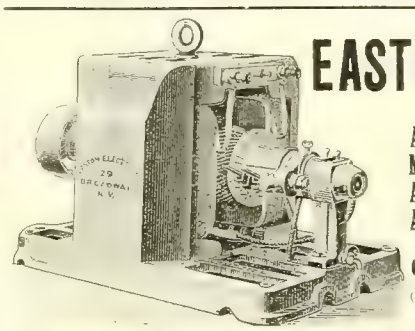
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, Rods, Tubing, Washers, Discs and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.



THE

EASTON ELECTRICCO.,

MANUFACTURERS OF

Arc and Incandescent Dynamos, Motors, Generators and Separators And Arc Lamps adapted for use on Arc or Incandescent Circuits.

ADDRESS:

643 Kent Ave., Brooklyn, N. Y.

(Near Roosevelt, Grand and East [illegible] Ferries from N. Y.)

For Circulars, Prices and Information

REMEMBER That the **Western Electrician** enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

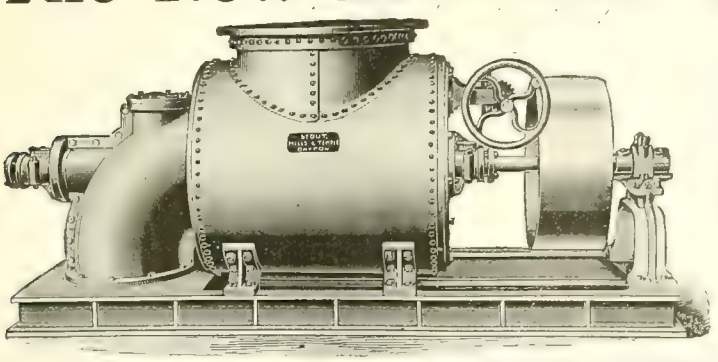
Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

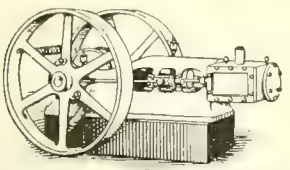
ELECTRIC LIGHT AND POWER STATIONS.

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 447 North Street, BALTIMORE, MD.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

STEAM PLANTS

INSTALLED BY

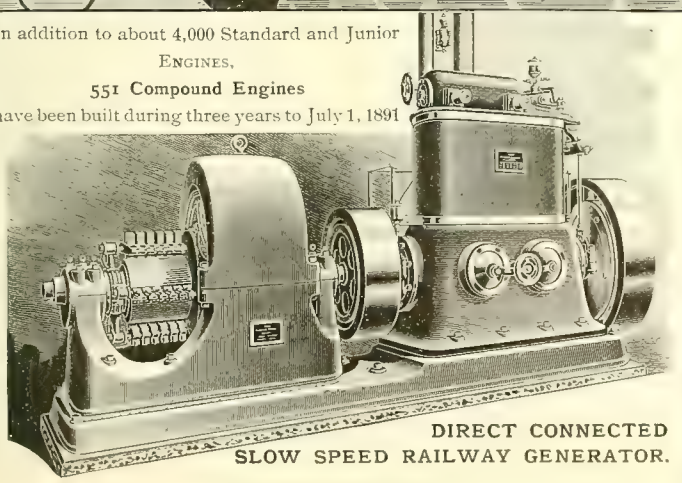
W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

WESTINGHOUSE ENGINES

In addition to about 4,000 Standard and Junior ENGINES,
551 Compound Engines
have been built during three years to July 1, 1891



DIRECT CONNECTED
SLOW SPEED RAILWAY GENERATOR.

125, 250, 500 HORSE-POWER.

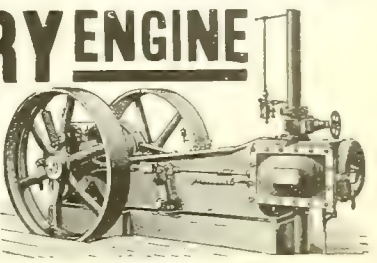
Also Direct Connected Slow Speed Alternating Dynamos of equivalent capacity.

For Circulars and Estimates on Complete Plants, address our Engineers.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application. —
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES: Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST.
HALF TONE PLATE SPECIALTY
CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

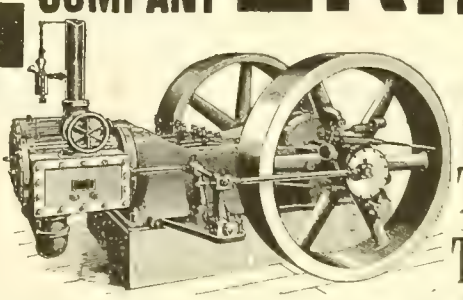
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER & CO., 38 South Fourth Street Philadelphia, Pa; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY Co., Tacoma, Wash.; CROOK, HORNER & CO., Baltimore, Md.; E. G. GILBERT, Atchison, Kan.

BRANCH OFFICE, Room 506 Rookery Building, CHICAGO, ILL. ALBERT FISHER, Manager.

DID YOU SEE IT AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.,

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.

STILL THEY LEAD.

Perkins Incandescent Lamps.

THE KNAPP ELECTRICAL WORKS,

GENERAL WESTERN AGENTS,

54 and 56 Franklin St., CHICAGO.

THE PYRAMID.

Men judge by comparisons. They are unable to estimate the grandeur of an object when there is no standard by which they can measure it. When Napoleon first gazed upon the Great Pyramid, he was surprised to see it so small. It stood alone; there was nothing near from which he could calculate its magnitude, but when the tents were pitched and seemed like tiny specks about its base, he then realized the immensity of that mighty work of Cheops.

In the same manner does Habirshaw's Rubber-covered Wire stand alone. One does not appreciate its qualities until he is led to compare it with other wires, which camp about its base in the vain endeavor to imitate the features which have made it pre-eminent. There is a "Me too" significance to these futile attempts, which serves to amuse, but not deceive those who have investigated the merits of Habirshaw's Wire. To the critical observer it stands high and above its tented competitors.

We will be pleased to quote prices and submit samples for inspection.

We are the Sole Western Agents.

THE WIRT RHEOSTAT.

For many purposes the use of a rheostat or adjustable resistance is indispensable, and consequently the variety of forms in which these are made is very great. The chief difficulty has been to produce a sufficiently gradual increase of resistance and to insure good contact at the successive points, and at the same time have sufficient resistance and ample current capacity within reasonable space.

We are confident that these various points have been well combined in the Wirt Rheostat, one form of which we illustrate here. We can make these in various sizes adapted to any special purpose for which they may be intended, such as photometric testing, stage regulators, etc. They are finished either in hardwood polished, or mounted with marbleized slate. We will be pleased to answer any inquiries relating to these or special instruments.

THE WIRT VOLT INDICATOR.

(PATENTED.)

Is intended to be left in circuit continuously, and can be relied upon for constancy and accuracy under the most trying conditions. The resistance of the instrument is high—making the consumption of energy small. An adjustable index permits *reading at a distance*, indicating variations from normal pressure.

The Electrical Supply Co.,

WESTERN OFFICE AND WAREHOUSES

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

Eastern Office and Factories

Ansonia, Conn.

TAKING THE LEAD.

THOUGH ONLY

ON THE

MARKET

—FOR—

SIX MONTHS,

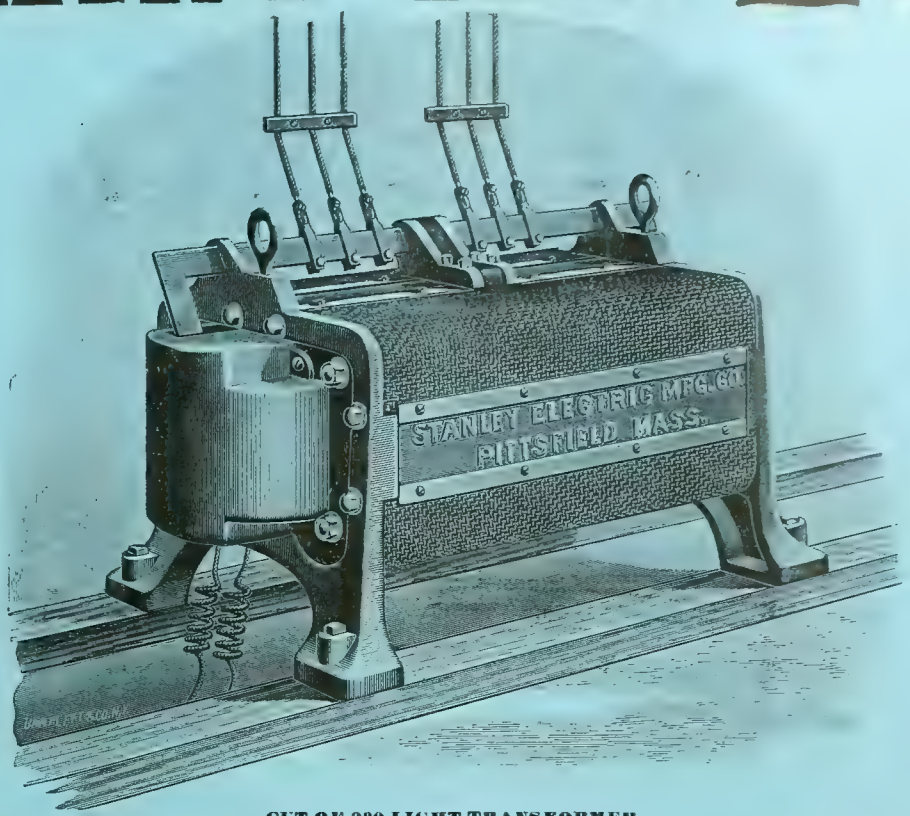
THE

STANLEY

—IS—

NOW KNOWN

—AS—



CUT OF 300 LIGHT TRANSFORMER.

THE

BEST

Transformer.

CORRESPONDENCE

SOLICITED.

STANLEY ELECTRIC MFG. COMPANY, PITTSFIELD, MASS.

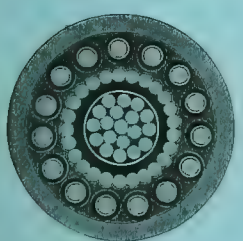
WESTERN AGENTS: The Electrical Supply Co., Corner Randolph St. and Michigan Ave, Chicago, Ill.

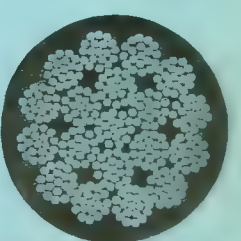
THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.

THE RUBBER USED IN

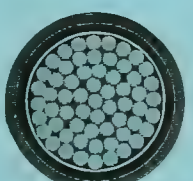
HABIRSHAW INSULATION

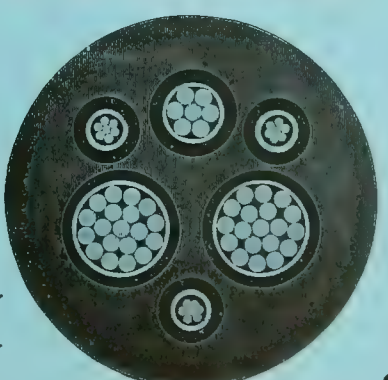
IS PURE PARA.

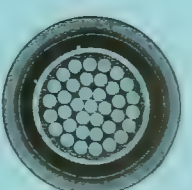

Underground Core.


Feeder Cable, Brooklyn Edison Electric Light Co.

Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.


Naval Core, United States S. S. "Chicago."

Portable Cable, Broadway Theater.

Marine Core, used on Government Cruisers.

Naval Marine India Rubber Covered Wires.

Naval Land India Rubber Covered Wires.

PROMINENT INSTALLATIONS.

STANDARD INDIA RUBBER COVERED WIRES.

Feeder Conductor, "Drypla-es," Grand Central Depot.

Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

SOLID AND STRANDED CONDUCTORS, TAPED, BRAIDED, FLAME-PROOF.

The Habirshaw Insulation fulfills all requirements in places demanding the "Best," and in that field finds no successful competitors.

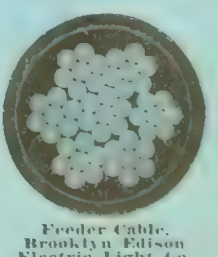
Feeder Core.

FACTORY: GLENWOOD, YONKERS, N. Y.

WM. M. HABIRSHAW, F.C.S., GENERAL MANAGER.

OFFICE: 315 Madison Ave., Cor. Forty-Second St., NEW YORK CITY.

THE ELECTRICAL SUPPLY CO., corner of Randolph St. and Michigan Ave., CHICAGO, ILL.


Feeder Cable, Brooklyn Edison Electric Light Co

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

WE ARE

On the War Path

For business in all kinds of Electrical Supplies for Incandescent Work; Sockets, Switches, Ceiling Cut-outs Edison and Sawyer-Man styles, branches and mains, insulating joints, rosettes, etc.

Read our new Catalogue, and save the

$ $ $ $ $ $

STAR ELECTRIX COMPANY,

639, 641 & 643 North Broad Street, PHILADELPHIA, PA.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, NOVEMBER 14, 1891. No. 20

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building, - - CHICAGO.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE
Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

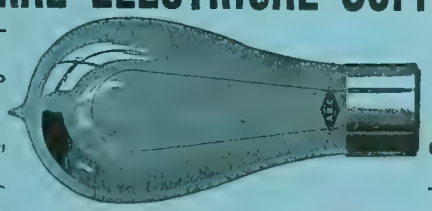
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."



WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

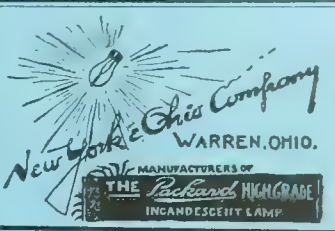
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.



AGENTS:
J. W. Peale, [illegible]
Electric Eng. & Supply Co., Syracuse, N. Y.
The Electrical Eng. & Supply Co., 931 Rookery, Chicago.
The Electrical Eng. & Supply Co., St. Paul, Minn.
St. Louis Electrical Supply Co., St. Louis.

CLOWER, HARRIS & CO.,

CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.
The largest Electrical Supply House west of the Mississippi River. EVERYTHING ELECTRICAL.
289 ELM STREET, DALLAS, TEXAS.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.

The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.

OKONITE TRADE MARK

INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

WM. ROTCH, Prest. CHAS. G. WINTER, Treas.
CHAS. E. BIBBER, Gen'l Manager.

DO NOT
Equip your Switch-board with cheap Switches.
BUY THE
C. E. M. Jack-Knife Switch.
It is a Record Breaker and a reliable Circuit Breaker
Manufactured Solely By
THE CONSOLIDATED ELECTRIC MFG. CO.,
154 Franklin St. and 355 Congress St., BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS.

IMPROVED BALL ENGINES,
BUILT BY THE BALL & WOOD CO., NEW YORK.

AGENTS
W. B. Pearson & Co., Home Insurance Building, Chicago, Ill.
Thos. G. Smith, Jr., 11 Hammond Building, Cincinnati, Ohio
W. A. Day, 128 Oliver Street, Boston, Mass.
A. M. Morse & Co., St. Louis, Mo.
Cooley & Vater, Minneapolis, Minn.
Mead & Stringham, 321 Hammond Building, Detroit, Mich.

The Thomson-Houston ELECTRIC CO.,

MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co.....xv
Alexander, Barney & Chapin.....i
American Electrical Works..... xv
Andrews & Co., A. H..... ... xxi
Baggot, E xvi
Bain Electric Mfg. Co..... x
Ball Engine Co.....xxi
Ball & Wood Co., The i
Beckerleg, Jas. G..... xvi
Beggs, J. E., Mfg. & Supply Co. iv
Bernstein Electric Co..... xvi
Blatz, L..... xv
Borden & Selleck Co..... xvii
Braun Illustrating Co xxi
Brownlee & Co.....xiv
Brookfield, Wm..... ... xiv
Brush Electric Co..... ... xix
Burton Electric Co..... vii
Butler Hard Rubber Co.....vii
Buxton, Geo. B xi
C. B. & Q. R. R.....—
C. & N. W. R. R.....xvii
C. & C. Electric Motor Co....xviii
Card E. Motor & Dynamo Co....xi
Central Electric Co..... v
Chicago Electric Mfg. Co.....xix
Chicago Electric Motor Co.....—
City of Big Rapids, Mich..... xiv
Clower, Harris & Co.....i
Chicago Insulated Wire Co.... xix
Colburn Electric Mfg. Co.....xii
Columbia Electric Co..... vii
Consol. Elec. Mfg. Co., The.....i
Cowles Elec. Smelt. & Alum. Co.xvi
Crocker-Wheeler Elec. Mo. Co. xv
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co..xxi
Delaware Hard Fibre Co.....xix
Detroit Electrical Works.....xxvi
Densmore Typewriter Co.....—
Eastern Electric Cable Co.....xv
Easton Electric Co..... .....—
Edison General Electric Co..... vi
Edison General Electric Co., Cable and Wire Department..... vi
Electric Construction & Sup. Co.. x
Electric Merchandise Co.....vii, xii
Electric Secret Service Co.....xii
Electrician Pub. Co.....xx
Elec. Construction Co., The..... xv
Electrical Engineering Co..... xiv
Elec. Eng. & Supply Co., The. xv
Elec. Supply & Contracting Co..xi
Electrical Supply Co., The... xxiv
Elektron Mfg. Co.....iv
Empire China Works.....xviii
Erie Electrical Supply Co.....xvi
Evans Friction Cone Co..... xix
For Sale.....iv, xiv, xvi
Foster, O. A.....—
Fort Wayne Electric Co..... xxvi
Gleason & Bailey Mfg. Co. Ltd. xvi
Globe Carbon Co.... xvii
Great Western Elec. Supply Co.. xi
Greeley & Co., The E. S.....i
Goodrich-Coleman Elec. Wks..—
Heisler Electric Co.....—
Hill Clutch Works.....—
Hine Eliminator Co.....xiv
Holmes, C. H..... xv
Holmes, Booth & Haydens... . xxi
Hood, Wm..... ..xii
India Rubber & Gutta Percha Insulating Co.....—
Interior Conduit & Insulation Co. xii
International Okonite Co..... i
Kartavert Mfg. Co..... xvi
Keller & Degenhardt..... xiv
Knapp Electrical Works..... xxiii
La Roche Electric Works..... iv
Law Telephone Co..... xv
Leonard & Co., H. Ward..... ..xix
Leffel & Co., Jas..... xv
Loud, H. M. & Sons Lumber Co.. xvi
McLaughlin, James xiv
Mason, James H..... xv
Milliken Bros.....iv
Monitor Electric Co.....xii
Mosher Arc Lamp Co..... xiv
Munsell & Co., Eugene..... . xv
Murphy, T. J..... xvi
National Carbon Co.....iv
National Electric Mfg. Co xxv
N. Y. Belting & Packing Co.....xiv
New York Insulated Wire Co..xviii
New York & Ohio Co..... i
N. W. Elec. Specialty Co..... xi
Nuttall Company, R. D..... i
Ostrander & Co., W. R.....xii
Paiste, H. T..... xiv
Page Belting Co.....—
Partrick & Carter Co.....—
Payne & Co., Geo. W..... —
Pearson & Co., W. B.....xxi
Pelton Water Wheel Co.....xvi
Phoenix Glass Co..... —
Pond Engineering Co xxi
Powell Co., The Wm.....xviii
Queen & Co..... xv
Ries Elec. Specialty Co., The.. xii
Rockford Electric Mfg. Co....—
Royal Electric Co..... xiv
Samson Cordage Works. xiv
Sargent & Lundy..... i
Sawyer-Man Electric Co.....xvii
Schawel & Co., Jas..... xiv
Schieren & Co. Chas. A.....xiv
Schoonmaker, A. O xiv
Schuyler Electric Co..... iv
Sealed Proposals .....xiv, xvi
Short Electric Railway Co xiv
Schultz Belting Co.....—
Sperry Elec. Mining Mach. Co..xix
Standard Underground Cable Co....i
Stanley Electric Mfg. Co.....—
Star Electrix Co.....x
Stearns Mfg. Co.....xxi
Sterling, W. C.....xvii
Steuben Elec. Mfg. Co., The.... xi
Stilwell & Bierce Mfg. Co..xvi, xvii
Sunbeam Incand. Lamp Co .viii, ix
Taussig, S.....iv
Temple, J. C.....xvii
Thomson-Houston Elec. Co.ii, xxii
Union Electric Mfg. Co., The..xviii
Union Electric Works.....—
Union Hardware Co.....xiv
U. S. Electric Lighting Co..—
Van Nuis C. S.....—
Vulcanized Fibre Co.....xvii
Wanted.....xiv, xv
Western Electric Co xviii
Westinghouse Elec. and Mfg Co. xiii
Westinghouse Machine Co.....xxi
Weston Electrical Instrum't Co.—
Williams Engine Works.... ...xxi
Woodbridge & Turner Eng. Co. xvii
Woodhouse & Rawson, Ltd.....xvi
Worthington, Henry R.....—

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelt. & Alum. Co.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Columbia Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Samson Cordage Works.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Law Telephone Co.
Mason, Jas. H.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co. The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Castings, Brass.
Blatz, L.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Steuben Electric Mfg. Co.
Temple, J. C.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Columbia Electric Co.
Detroit Electrical Works.
Easton Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Burton Electric Co.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Columbia Electric Co.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co., The.
Star Electrix Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E. Mfg. & Supply Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Columbia Electric Co.
Detroit Electrical Works.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Erie Electrical Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co. The.
Star Electrix Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables.
Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Columbia Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Steuben Electric Mfg. Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Mining Apparatus, Electric
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Card Electric Motor & Dynamo Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Columbia Electric Co.
Eastern Electric Co.
Edison General Electric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Elektron Manufacturing Co.
Erie Electrical Supply Co.
Foster, O. A.
La Roche Electric Works.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Goodrich-Coleman Elec. Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors
Woodhouse & Rawson, Ltd.

Packing.
Burton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co.
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Leffel & Co., James
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Type-Writer Co.

Valves
Beckerleg, Jas. G.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

CLEVELAND, OHIO. **THE NATIONAL CARBON CO.** CLEVELAND, OHIO.

MANUFACTURERS OF

ELECTRIC LIGHT CARBONS AND BATTERY MATERIAL.

NOW THEN! FOR SALE CHEAP!!

Six 400 light Thomson Houston Incandescent Dynamos, 110 volts. Perfect order.
Three 25 light 2,000 candle power American Arc Dynamos. A 1 order.
Two 25 light 2,000 candle power Sperry Arc Dynamos. A 1 order.
700 Goos-Necks, Sockets, Lamps, etc., complete, good.
50 miles No. 10 American Electric Co. Wire, good order, used one year. In ½ mile reels.
Two 400 light Thomson-Houston New Armatures.
70 American Single Carbon 2,000 candle power Arc Lamps. A 1 order.
Two 70 H. P., 700 volts, Edison Generators, used six months.
Ten 5 H. P. Sprague Motors, used six months.
Two Edison Electric Mining Rock Drills, used six months.
High Speed Engines and Full Station Equipments, Poles, etc.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

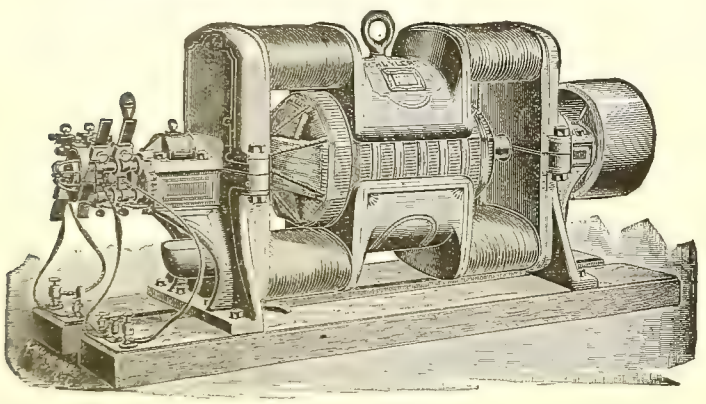
Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK. MANUFACTURED BY MILLIKEN BROS. 59 DEARBORN STREET, CHICAGO.

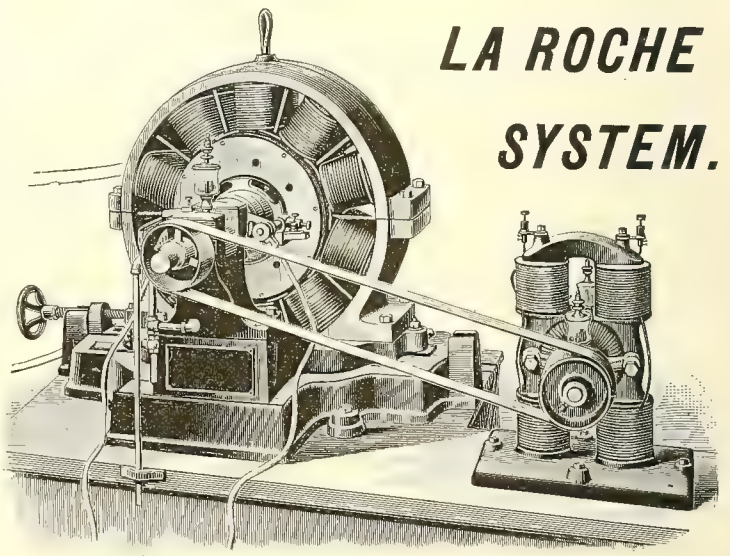
Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,

FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

YOU GET THE BEST

WHEN YOU BUY

PERRET ELECTRIC MOTORS AND DYNAMOS,

— Manufactured Only By —

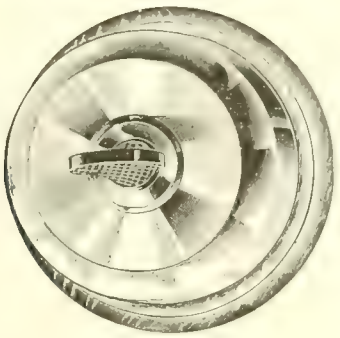
The Elektron Manufacturing Co.,

NEW YORK OFFICE, 89 Liberty St. **SPRINGFIELD, MASS.**

SELLING AGENTS:

Washington, D. C., [illegible] & Co., 1400 New York Ave. **New Orleans, La.,** George Baquie, 140 Gravier St. **Chicago, Ill.,** The Electrical Engineer- [illegible] **St. Paul, Minn.,** F. J. Renz, 95 East Fourth St. **Philadelphia, Pa.,** Pennsylvania Machine Co., 29 North Seventh St.

BARGAINS IN PAISTE SWITCHES.



5 Ampere Paiste Switches, Porcelain Bases, 30c.
10 do. do. do. do. do. 35c.

ST. LOUIS BRANCH.

OKONITE
TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

KANSAS CITY BRANCH.

OKONITE
TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OMAHA BRANCH.

OKONITE
TRADE MARK.

WESTERN ELECTRI AL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

DENVER BRANCH.

OKONITE
TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
1722 Lawrence St., Denver, Colo.

There is only one really high grade insulated wire in the market. Ask any one who has ever used Okonite, which it is.

OMAHA AND COUNCIL BLUFFS RAILWAY AND BRIDGE COMPANY.

GENERAL SUPERINTENDENT'S OFFICE.

COUNCIL BLUFFS, IOWA, April 27, 1891.

WM. H. MCKINLOCK, Prest., Chicago, Ill.

Dear Sir:—Yours of April 24th received, and contents noted. I certainly can have no objections when the article referred to is Okonite. You will undoubtedly think that the wire received rather hard usage to be burned out in the manner shown, but the cause was a motor man put in about a 25 ampere fuse on a piece of No. 18 Okonite wire, when the lamp circuit was grounded, and something had to give, and it seemed wonderful that the wire could be completely fused without destroying the insulation. I will also add that in the Blue Vitriol Shop of the Omaha & Grant Smelting & Refining Co., where five different brands of wire were tried, the acid fumes attacked and destroyed all of them except Okonite, that has stood the test for about two years, and we burn the lights there every night in the week for twelve hours.

Yours very respectfully, ISRAEL LOVETT, [illegible]

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

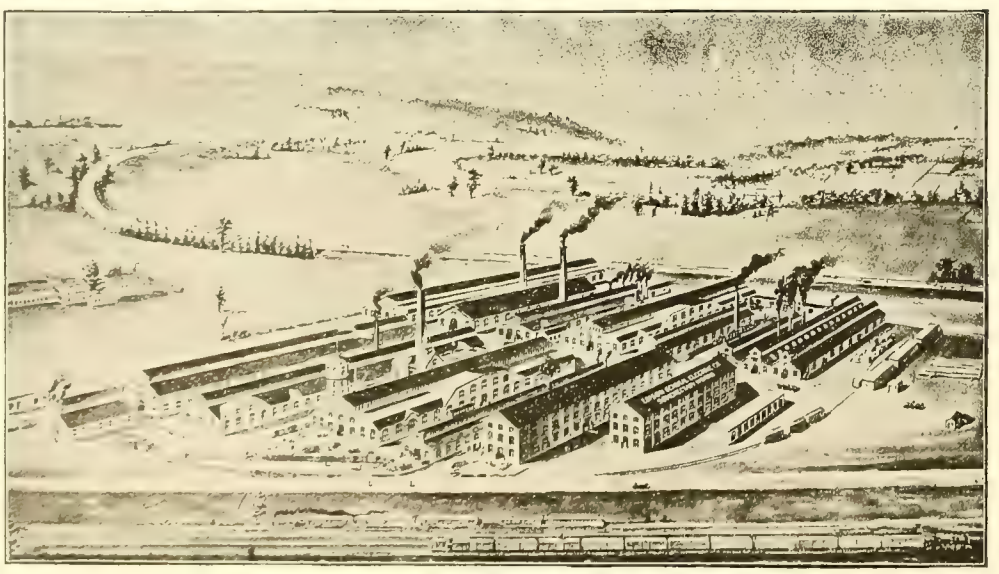
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

ELECTRIC HEATING.

BURTON ELECTRIC CO.,

RICHMOND, VA.

WONDERFUL IN ITS EFFICIENCY.

THE BURTON ELECTRIC HEATER costs less to operate than a stove, and requires **NO REPAIRS.**
THREE YEARS' SERVICE has demonstrated its practicability.
Circulars upon application. Information furnished.

WRITE TO THE SELLING AGENTS:

ELECTRIC MERCHANDISE COMPANY,

11 ADAMS ST., CHICAGO, ILL., U. S. A.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

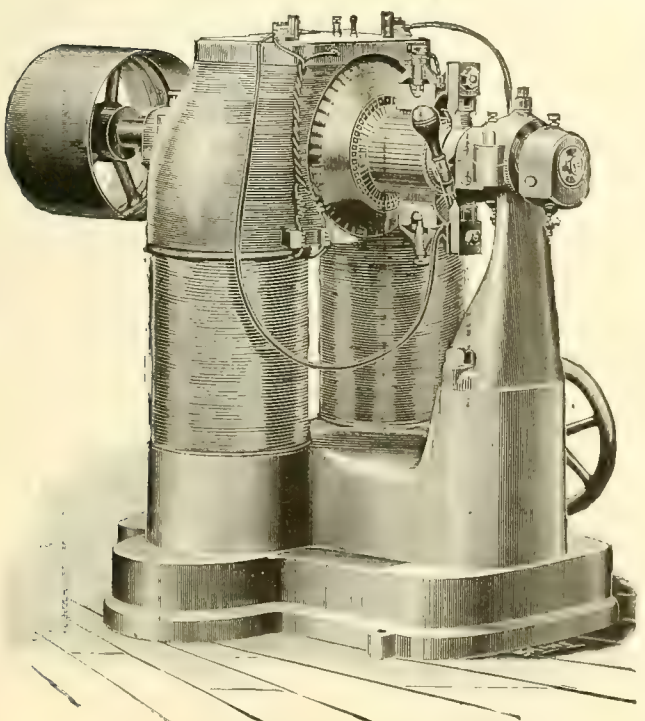
HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

COLUMBIA ELECTRIC CO.,

MANUFACTURERS OF



Large Stationary Motor, Columbia Make.

MOTORS, GENERATORS,

DYNAMOS, LAMPS,

SUPPLIES AND SPECIALTIES.

ALL GUARANTEED MECHANICALLY, ELECTRICALLY AND LEGALLY.

ST. PAUL, - - MINN.

BELLE PLAINE CO

,. No. 6. BELLE PLAINE, IOWA, OCTOBE

MR. BURLEY EXPLAINS

Our Reporter Interviews the Well-Known Inn Keeper and Erstwhile Lamp Expert.

Such wide spread local interest has been excited recently by the published claims of rival manufacturers of Incandescent Lamps, that, to satisfy the curious as the true merits of the case, a reporter of the BELLE PLAINE COMMERCIAL was detailed the other evening to seek the fountain head of information in the person of our well known citizen and local Thomson-Houston expert, Mr. B. B. Burley, proprietor of a fashionable hotel bearing his name.

The young man of the COMMERCIAL was confronted by a lighted cigar upon the porch of the house on the evening in question, which seemed strange, as the night was cold and dark, and did not offer special inducements for the enjoyment of smoking. A knock on the front door of the Burley House disturbed the sleeping bull dog, and after a considerable time brought Mr. Burley, the one time genial proprietor, in his *robe de nuit* to answer the summons. We might add, parenthetically, that a marked change has taken place in Mr. Burley within the last year. Formerly rotund and round faced, with an ambitious crop of chin whiskers, he was a living exponent of his own good cheer. The other night, however, unless for previous acquaintance, recognition would have been difficult. No longer the happy and obese inn-keeper of a year ago, he is now a haggard, sallow faced man, with a hacking cough, sunken eyes, and with the once luxuriant chin whiskers tucked despondently under his shirt front.

Suppressing all indications of pained surprise, the reporter stated his business at once.

"Mr. Burley," he said, "so much interest has been excited in the recent published test of the Thomson-Houston lamp that is said to be burning on your porch, that I have been detailed to come to you to learn full particulars for publication."

With a groan, Mr Burley led the reporter to an obscure corner of the veranda and said in a hoarse whisper, "There it is."

"Where? What?"

"32 C. P. lamp that is causing all this discussion."

The reporter remarked that he was unable to see it, at which Mr Burley seemed somewhat disappointed. The ambitious young man of the COMMERCIAL, to fully [illegible] himself, struck a match and holding it high above his head, was indistinctly [illegible] a black mass about the size of a duck's egg, through which shone a faint [illegible]. He thereupon re[illegible] the cigar that had confronted him upon his first appearance at the Burley House, and connected the two as one and the same.

Mr. Burley was in a high state of excitement.

[illegible] a [illegible] Ain't that a [illegible] "That 'ere lamp has [illegible] now over [illegible] and hours, b'gosh, an' she hain't out yit."

[illegible] asked "do you consider [illegible] and [illegible]

[illegible]

Why, thar's a new fangled lamp they call the Sunbeam across the street, that's only been burnin' eight hundred hours or so and she's li'ble to go out any minute."

Mr. Burley's attention was called to the fact that the Sunbeam lamp in question seemed to be burning quite brightly, however, and could be readily distinguished several blocks away, while the lamp on Mr. Burley's porch was undistinguishable except through a telescope, like a star of the tenth magnitude.

"Now Mr. Burley, give me an account of how all this discussion occurred."

"Wal'," said Mr. Burley, resting his shattered constitution against the house, "ye see this 'ere feller named Tingley out in Manitou Springs, Colorado, says that he has a Thomson-Houston lamp as has been burnin' now over ten thousand hours. Some time ago, one o'them Thomson-Houston fellers from the Chicago office comes out to Belle Plaine and puts up at my house. He sees this 'ere lamp a burnin' on my porch, and he says, says he:

"Mr. Burley how long has that thar' lamp been a burnin'?"

"And I says, says I. 'That thar' lamp was put in my porch September 20th, 1889, and has been a burnin' ever since.'

"Now," says he, "Mr. Burley, we in the Chicago office are a tryin' to sell a great many lamps by a tellin' people that they'll burn longer 'n any other lamp on airth, and I want you to see how long you can make this 'ere thing burn. Mr. Tingley at Manitou Springs, has been a burin' some of his'n for ten thousand hours and they are still a goin'. Now we fellers in Chicago want you to bust the record. See?"

"Was there any financial consideration in this, Mr. Burley?"

"Wal' now, I don't deny that thar' may have been a leetle somethin' in order to stimoolate interest, as it were, and you just bet that I'll get thar' if coal and water hang out at the central station."

"But, Mr. Burley, I see that Mr. Randall, the lamp expert of the Thomson-Houston Company at their factories in Lynn, has written a book, in which he says that long lived lamps are neither economical nor commercial. What have you to say to that?"

"Wal', young, man, all I can say is that on that point me and Randall don't agree. You can't tell me, I know how it is. Randall's one of them men with a soft job and nat'ally he wants to sell all the lamps he can, for of course if lamps don't last, they sell more of 'em and that's all thar' is to it. You can't talk to me, young feller. Them Thomson-Houston people in Chicago knows the lamp business, and no mistake. Why, I've been out to look at this 'ere lamp with my old lantern, every night in the week for the last year and a half, and its made me what you see me--kind o' weak, but still on deck. I'm much obleeged for all the advertisin' them Chicago papers has been a' givin' me. Why, I've sold as many as ten extra twenty-five cent meals to people that has come to see me an' my lamp since the papers took me up. Yes, you bet. I'll win, an' some of these days you'll see a big picture of me and my house in the 'Western Electrician,' an' a record for this 'ere lamp of twenty thousand hour. I hear tell that the Manitou Spring lamp is about giving out [illegible], I telegraph 'em every day, an' of [illegible] pay for the telegrams."

Mr. Burley [illegible] the reporter asked the [illegible] months so [illegible] of the incandescent lamps formerly [illegible] Belle Plaine had been taken out and were being replaced by kerosene lamps.

"Wal', you see," said Mr. Burley, "this 'ere station of the Wm. A. Hunter Electric Company can't be takin' care of this lamp out here on my porch and the other lamps 'round town at the same time, an' so the central station is devotin' its energies to my lamp. They do say it takes a heap o' coal, and two or three extry men to feed the furnace, but I don't know as how that makes any odds, so long as my lamp's kept a goin'."

"Well, Mr Burley, what is to be gained by keeping alive a lamp that looks like the one hanging on your porch, and that we have to take your word for its burning? What good is it any way?"

Mr. Burley seemed staggared for a moment, and before replying picked up brick and threw it reflectively at the Sunbeam lamp across the street.

"What good is it? That's a blamed fool question, that is. Ain't she a burnin' and demondstratin' to the world that a Thomson-Houston lamp may burn perhaps for twenty thousand hours? What good is it? Go and ask the Thomson-Houston people in Chicago, and find out."

Evidently the interview, so far as Mr. Burley was concerned, was concluded, but as he was about to slam the front door behind him, a messenger boy appeared in hot haste with a telegram in his hand.

Mr. Burley was visibly excited.

Tearing open the telegram he glared wildly at it for a moment, and seizing his lantern returned nervously to an inspection of his lamp. His face was working convulsively, and his hands trembling with excitment.

Something seemed to be wrong with the appearance of the lamp.

Mr. Burley groaned aloud.

Another inspection, and all doubt was removed; the lamp was extinct.

His face pale as the recent light of his own lamp, Mr. Burley returned to the office of the hotel, and was soon absorbed in figuring. The result was too much, coming after the terrific mental strain of the last few moments.

"Only 4,620 hours. Lost, by gum!" he murmured, and fell fainting to the floor.

Taking up the message which had recently arrived, the reporter read these words:

"*Manitou lamp not discernible, but burning still. Sunbeam lamp out after 800 hours, no good on earth.*

C. F. TINGLEY."

Truly Mr. Burley was unfortunate.

As the reporter returned to his office, he stopped en route at the much talked of central station. The picture there presented was unique—three or four grim visaged men incessantly throwing coal into a seething furnace. The belt was whirring in a determined manner, and the poor old dynamo was spluttering and sparking in its endless effort for demonstration, while out through the darkness two small wires ran from the station up to Mr. Burley's lamp. Truly long-lived lamps have been demonstrated as commercial necessities, and Mr. Burley's tireless efforts, attenuated frame and mental exertions are vindicated.

Duplicates of the SUNBEAM LAMP, which was so vindictively broken by Mr. Burley, may be obtained with *reasonable* life and efficiency and HIGH candle power.

Try Gebhardt's soda water—always delicious and refreshing. Pure fruit juices used exclusively.

Splendid stock of souvenir spoons at Bunde & Upmeyer's.

THE NEWS (

Eastern and Midd

John C Burchell died in with a bullet in him, fired b mond, who also killed his wif

John Sullivan, repair fore Reading Company, at Gordon Penna. was run over and kille.

Eliza Kelly, one of the childr jured by jumping from a win at a fire in Boston, died. Th and other child are in a critic tion.

A row of frame houses at Br Penna., were destroyed by fire, James McGuire was burned to de

The rescuers of the Richardson liery at Glen Carbon, Pa., have g up all hope of rescuing the entomb miners alive. The work is very haz ous, owing to the treacherous cond of the roof

By the overturning of a car Erie, Pa., Mrs. Joseph Jo killed and Mrs. J. D. Clark Johnson were painfully injur

Daniel Chilcoat, aged 14 Orbisonia, Pa., fell from a tre nutting and instantly killed. ing of the accident "the kid became a raving maniac."

Ex-Mayor Bole, of committed suicide in is stated that he was despo cent unsuccessful investm

The tugboat McCaldow New York harbor by a co the engineer and a boy passe drowned.

The schooner M. M. M which left New York for Sa cargo of gas coal, went to Chatham, Mass., but the saved.

Attorney Bloch, of New appealed to the State Co. Lunacy to release Mrs. Bloc spiritualistic features got Bloomingdale Asylum.

Farmer Henry Hoch, aged Schoenersville, Lehigh county, dropped dead of heart disease at breakfast table.

An Albany and Susquehanna jumped the tracks near Oneonta, and Engineer James Patters stuck to his post and put on brakes, was killed. Fifty were wrecked. Loss, $150,0

The bodies of the six mi oned in the Richardson Glen Carbon, Pa., were men died of suffocation

Brakeman John Shi foot in a frog in fron bury, Pa., and stru himself, but lost a

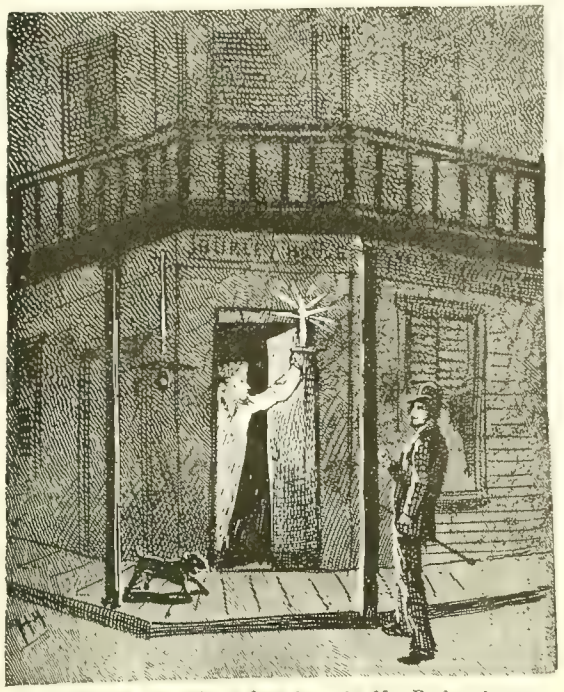
in his cell in Sunb wall and escaped.

An unknown found dead on the ata, at Tyrone, P clasped tightly to

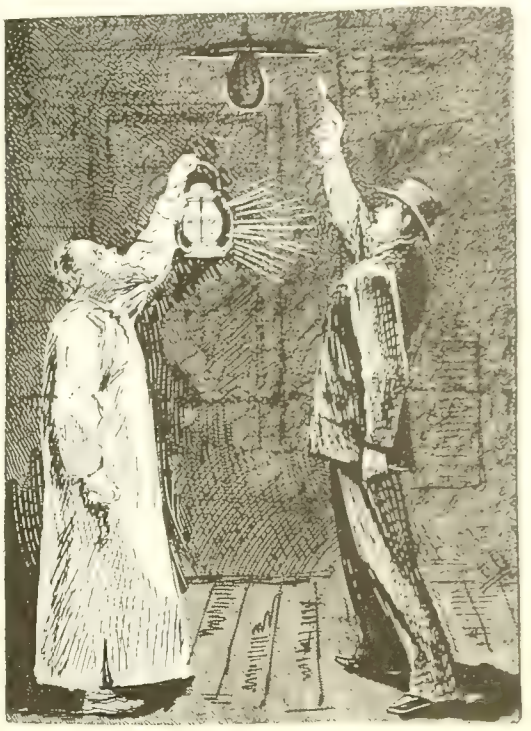
Engineer Robert anon, Pa., ran en car four ab Cornw

THE SUNBEAM INCANDESCENT LAMP CO.,

Office, 805 Chamber of Commerce Bldg., CHICAGO, ILL.



"A knock at the front door brought Mr. Burley the one-time genial proprietor"—



—"to fully satisfy himself, he struck a match."—

"—Do you consider that lamp commercial and practical?"

"Only 4620 hours, lost by Gum! he murmured and fell fainting to the floor."—

"They do say it takes a heap o' coal, and two or three extry men to feed the furnace."

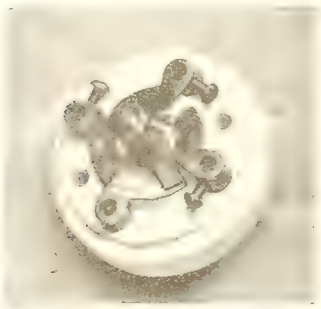
For the previous chapters of this interesting narrative, we refer to the T.-H. advertisement in Western Electrician, issues of Sept. 12, 19, 26, Oct. 3, 10 and 17. Also our own advertisements in same Journal, issues of Sept. 26, Oct. 3, 10, 17, 24, 31 and Nov. 7.

— THE —

Sunbeam Incandescent Lamp Co.,

805 Chamber Commerce.

CHICAGO.



ELECTRIX

3 POINT SWITCH

NOW READY.

ALSO ALL SIZES AND KINDS OF SINGLE AND DOUBLE POLE SWITCHES.

STAR ELECTRIX CO., PHILADELPHIA.

Redding Electric Co., BOSTON.	Illinois Electric Material Co., CHICAGO.	St. Louis Elec. Supply Co., ST. LOUIS.	Mountain Electric Co., DENVER.

You can	Lights	Thoroughly		Send
Put	Are Standard	Reliable	Prices	For
It up	And	And	Reasonable.	Illustrated
Yourself.	Full size.	Practical.		Pamphlet.

BAIN ELECTRIC MANUFACTURING CO.,

47 So. JEFFERSON STREET,

CHICAGO.

"WARD" ARC LAMPS.

The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

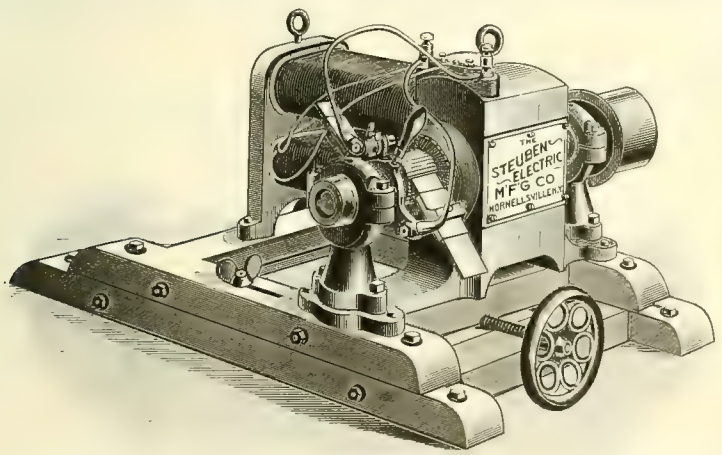
GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

THE STEUBEN ELECTRIC M'F'G CO.

HORNELLSVILLE, N.Y.

DO YOU want a first-class DYNAMO with which to DRIVE your competition? If so, DIRECT your inquiries to us.



ELECTRICAL AND MECHANICAL ENGINEERING AND SUPPLIES.

REPAIRING ELECTRICAL MACHINERY

The Electric Supply & Contracting Co.,
Nevada Building,
S. E. Cor. 5th & Sycamore Sts., CINCINNATI, O.

The Card Electric Motor and Dynamo Co.,

CINCINNATI, OHIO.

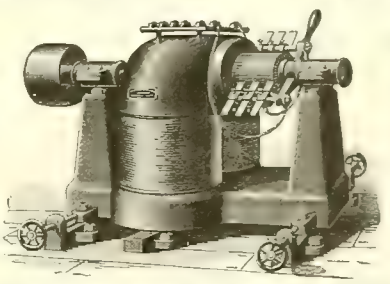
MANUFACTURERS OF

ELECTRIC MOTORS AND DYNAMOS.

Incandescent **Dynamos** from 20 to 350 Lights.

Arc or Incandescent **Motors** from ⅛ to 30 Horse Power.

Motors for the Arc Circuit a Specialty.

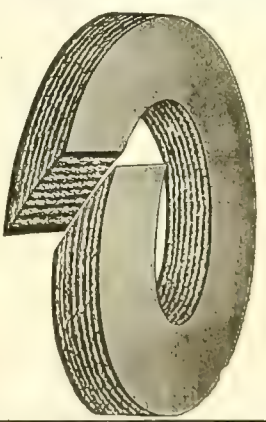


These Motors have the Highest Efficiency, Low Speed and Self-Oiling Bearings.

AUTOMATIC, SIMPLE, DURABLE AND CLEAN.

Correspondence Solicited.

AGENTS.—Boston: The Eastern Electrical Supply and Construction Co., 65 Oliver Street. Chicago: The Thos. L. Johnson Co., 312 Dearborn Street. Milwaukee: Henry Ramien, 641 Third Street. Washington, D. C.: J. Geo. Gardner, 1005 H. Street. St. Louis: Siegl Electrical Engineering Co., 11 Pine Street. Montgomery, Ala.: W. F. Murphy. Detroit, Mich.: The Michigan Electric Co., 212 and 214 Griswold Street. Minneapolis, Minn: J. M. Lennon, 22 Loan and Trust Building.



Buxton's Universal Packing.

Established 1882.

The Engineers' favorite. Leads, but is imitated by many, equaled by none. If you have any doubts as to the genuine, send direct to us. We are sole manufacturers of this packing. Send for samples and catalogue on packings. We have the largest assortment.

For Piston Rods and Valve Stems of Steam Engines and Pumps—self-lubricating, steam and water tight. Fifty per cent. less friction than any other. Never grows hard, but will remain as soft and as flexible as when first adjusted in stuffing box. Every package fully warranted. **Fine Oils a specialty.**

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

GEORGE B. BUXTON,
17 VIRGINIA ST., EAST SOMERVILLE, MASS.

"BE YE THE JUDGE."

HAVE YOU TRIED THE

ECONOMIC INCANDESCENT LAMP?

If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again.* Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

GEO. L. KIRKHAM, Manager. **1017 Chamber of Commerce, CHICAGO.**

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

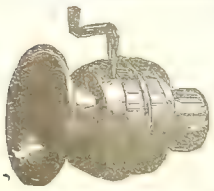
Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

Something Entirely New. NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED. Simple, Efficient, Economical.

Indorsed by the Electrical Press, and Prominent Electrical Engineers and Electricians. For Particulars and Prices write to

THE RIES ELECTRIC SPECIALTY COMPANY, PATENTEES AND SOLE MANUFACTURERS

Baltimore and Eutaw Sts., BALTIMORE, MD. REGULATING SOCKETS.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

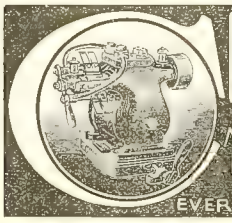
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.



OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.

FITCHBURG, MASS., U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

SUBSTANTIAL, NEAT, ECONOMICAL.

ELECTRIC RAILWAY SUPPLIES

EXCLUSIVELY

OUR BUSINESS.

ELECTRIC MERCHANDISE COMPANY,

CHICAGO,

11 ADAMS STREET. ILL. W. R. Mason, Gen. Mgr.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

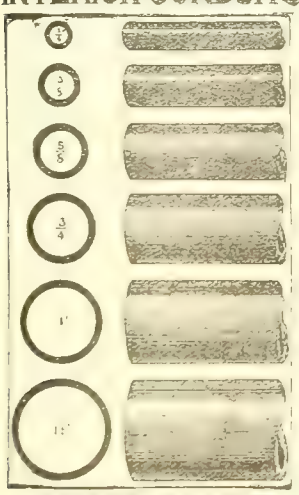
16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Thos Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 226 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

G. A. HARMOUNT,

MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

ESTABLISHED 1820.

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

THOMAS STURGIS, Prest. Wm. C. LANE. Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

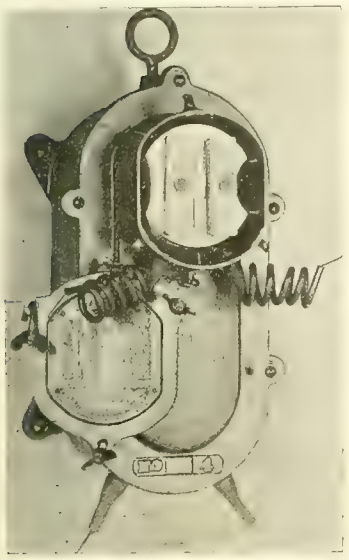
This System Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

Westinghouse Electric & Mfg. COMPANY,

Pittsburg, Pa., U. S. A.

☞ **Makers of Electric Light and Power Apparatus for all Purposes.** ☜

PIONEERS OF THE ALTERNATING SYSTEM.



CONVERTER.

OUR **Converters** COMBINE

HIGHEST EFFICIENCY,
ABSOLUTE SAFETY,
PERFECT REGULATION,
LOW PRICES.

OUR **Meters** ARE

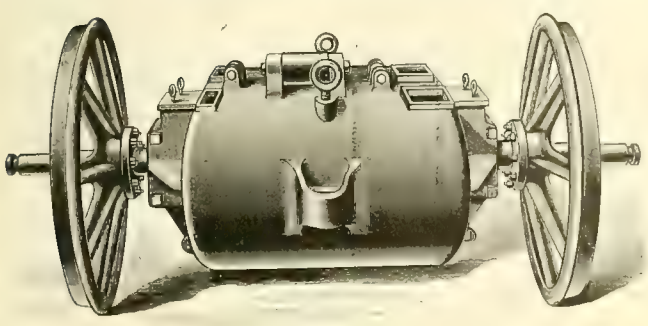
SIMPLE,
ACCURATE,
RELIABLE,
DURABLE.

OVER **700,000** 16 C.P. Lights' Capacity of METERS IN USE.

METER.

The Westinghouse Meter is the only A. C. Meter which has been adopted as standard by the London England Board of Trade. Synchronous System for the Long Distance Transmission of Power in large units claims the attention of every one having available Water Power within twenty-five miles of a market.

RAILWAY DEPARTMENT.



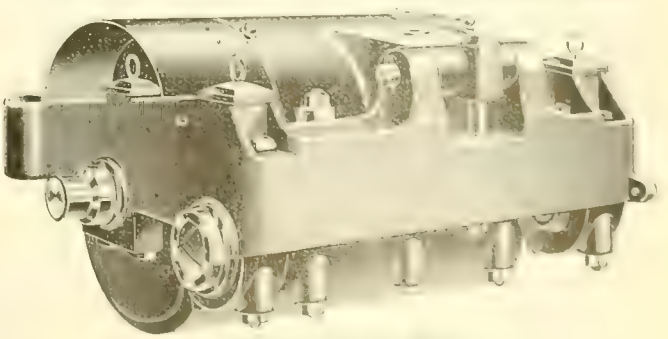
IRON-CLAD GEARLESS MOTOR.

YES, WE MANUFACTURE AND SELL GEARLESS and SINGLE REDUCTION

RAILWAY MOTORS,

MULTIPOLAR AND 2-POLE GENERATORS.

and all Station Appliances for Street Railway Work.



SINGLE REDUCTION MOTOR.

Percentage of increase in roads using our apparatus greater than that of any other company.

Send for Latest Catalogue.

OFFICES IN ALL OF THE LEADING CITIES. Correspondence Solicited.

Address,

WESTINGHOUSE ELECTRIC & MFG. CO.,

Pittsburg, Pa., U. S. A.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

BUY THE BEST!

The Mosher Arc Lamp.

DIRECT INCANDESCENT CIRCUITS.

READ THE FOLLOWING TESTIMONIAL:

NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS., October 5, 1891.

Mosher Arc Lamp Co., Chicago, Ill.

GENTLEMEN.—Replying to your inquiry of the 3d inst. we beg to state that the lamps you sent us some time ago are giving us better satisfaction than any other lamp we have ever tried to burn on an incandescent circuit. We inclose herewith an order for 10 of them to be shipped to Elgin, Ill. Yours very truly,

NATIONAL ELECTRIC MFG. CO.

Noted for Simplicity and Steadiness.

500 to 5,000 candle power, making superior lamp for photo-engraving purposes.

Write for price, circular, and sample lamp.

MOSHER ARC LAMP CO., 125 Ontario St., CHICAGO,

Or to F. P. Little & Co., Buffalo, N. Y.; Creaghead Engineering Co., Cincinnati, O.; Chas. F. Lindner, San Francisco, Cal.

MICA.

For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

WANTED ELECTRIC LIGHTING.

Bids will be received at the City Recorder's Office, until Monday evening November 16, 1891, for lighting the city of Big Rapids, Mich., with 32 to 40 2,000 candle power electric lights, according to the following plans.

FIRST: For lights running from dusk until 12 o'clock every night in the year.

SECOND: For lights running from dusk until daylight every night in the year.

THIRD: Running from dusk until 12 o'clock upon what is known as a moonlight schedule.

FOURTH: Running from dusk until daylight upon a moonlight schedule.

Bids upon each of these propositions to be made for contract running from January 1, 1892 to January 1, 1893, also from January 1, 1892 for a term of three years. The Common Council reserve the right to reject any and all bids.

W. A. FOSTER, Recorder.

KNOW WHAT YOU'RE GETTING!

HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

In a test of the best known "Separators" recently made at Cornell University this ELIMINATOR demonstrated percentages of efficiency over ALL competitors ranging from 11 to 59 per cent. The full report of test with drawings, etc., sent free. Address

HINE ELIMINATOR CO.,

106 Liberty Street, NEW YORK.

THE ELECTRICAL ENGINEERING CO.,

322 DEARBORN ST., CHICAGO.

Contractors for all kinds of ELECTRIC WORK.

GENERAL WESTERN AGENTS FOR

The Clark Wire.
The Interior Conduit and Insulation Co. of New York.
The Elektron Manufacturing Co.
Perret Motors.
The Standard Dynamo, Manufactured by the Fairbanks Scale Co.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

Royal Electric Co.,

911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURERS OF

Alternating and Continuous Current Dynamos and Motors,

AND ELECTRIC MACHINERY.

THE ROYAL COMPLETE ALTERNATING SYSTEM NOW ON THE MARKET.

Agents Wanted for Exclusive Territory.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

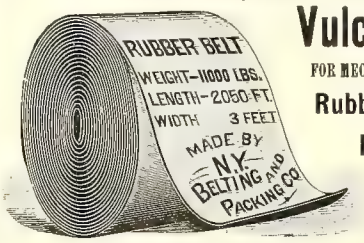
Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

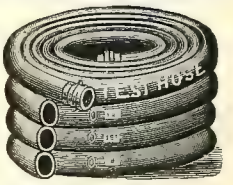
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601 1611 17th Street.
CHARLESTON, 16) Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 16-20 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

PLATINUM.

JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

FOR SALE.

New 10 and 25 Light

Arc Dynamos and Lamps.

HIGH TENSION. CHEAP.

JAS. McLAUGHLIN, Mfg. Electrician,

50 N. Clinton St., Chicago.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 10 So. 18th St., Philadelphia, Pa.

See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

THE

UNION HARDWARE CO.,

PUSH-BUTTON

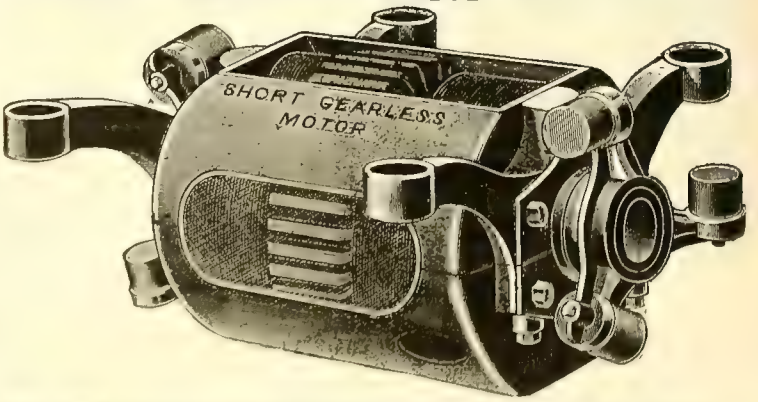
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

The Gearless Motor



Is now a result to hundreds of street railway officials who visited Pittsburgh during the Street Railway Convention. It is pronounced by all **"A Brilliant Success."** Buy no equipment until you have examined Short Motors, and obtained prices from

THE SHORT ELECTRIC RAILWAY CO., CLEVELAND, OHIO.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, NOVEMBER 14, 1891. No. 20

The Frankfort Exhibition and the World's Fair.

Official reports are not usually regarded as interesting reading, but the charge of dullness is one that cannot be brought against the formal account of Secretary Hornsby's mission to Europe as a representative of the electrical department of the World's Fair. The report is as graphic and sketchy as though written for a popular periodical, while no detail of exact statement is sacrificed. Mr. Hornsby left Chicago on September 17th and made his reappearance at the headquarters of the World's Columbiam Exposition on October 30th. During this brief period the energetic secretary collected much valuable information and labored with marked success to secure promises of exhibits at Chicago. His official report is dated November 3d. It deals mainly with the electrical exhibition at Frankfort and is divided into four subdivisions—financial, architectural, physical and scientific.

The illustrations that accompany this article represent some of the most interesting features at Frankfort. Fig. 1 shows a bit of detail work in the temporary Victoria theater. A portion of the gallery, festooned with electric light cables and dependent incandescent lamps, is represented. This picture gives a good idea of the beautiful interior decorative effects attained by the artistic Germans.

Fig. 2 shows Schuckert & Co.'s light tower, which was a conspicuous portion of the marine exhibit. This tower, built by the Nuremberg Machine company, is provided with parabolic reflector of 1,560 millimeters diameter and a smaller one of 900 millimeters diameter. The apparatus could be moved either in a vertical or horizontal direction by means of electric motors. Of the immense power of the light from this tower Mr. Hornsby speaks in his report.

An interesting scientific display was that shown in Fig. 3. The exhibit was that of Dr. A. Von Waltenhofen, and the illustration represents an induction pendulum, an electro magnetic differential balance and a wall chart setting forth the theory of the differential balance.

The fine exhibit of the Helios company of Cologne-Ehrenfeld is shown in Fig. 4. The chief attraction of this exhibit is the large alternating current dynamo, this company being the proprietors of the German patents of Ganz & Co. This dynamo has an output of 200 amperes at 2,000 volts, and is directly coupled to a horizontal Paucksch engine of 600 horse power. In place of the fly wheel of the engine, the magnets of the dynamo are employed, and for this purpose they are arranged on a large wheel and present the appearance of an armature. These magnet coils are excited by a current of only 100 volts potential, which is brought from the exciting dynamo to two contact rings on the axle. The magnet wheel is surrounded by a circle of 48 stationary coils, each insulated from its neighbor with the greatest care. The cores of the coils are made up of thin T-shaped sheets of soft iron, insulated from each other by paper. The [illegible] claimed for this arrangement [illegible] various parts and the fact that [illegible] the stationary part of the machine, thus permitting the induction of an extremely high voltage without imposing this upon the movable parts. Unusually high voltages can be attained without the employment of costly converters. The engine used in driving this dynamo is compound condensing. The dynamo gives the proper voltage at 125 revolutions.

In the main machinery hall of the exhibition, the exhibit of Naglo Bros., Fig. 5, consisted principally of a ring armature machine coupled direct to a 250 horse power engine and a drum armature dynamo belted to the same engine. These two dynamos supplied the current for the lighting of the Naglo exhibit and for the railway building.

A magnetic ore separator exhibited by Siemens & Halske of Berlin is shown in Fig. 6. An interesting comparison can be instituted by comparing it with similar machines of American manufacture.

The interesting model of an electric railway switch controller, shown in Fig. 7, was put on exhibition by the Prussian government. All the movements of switches controlled by this device are automatically indicated on the large card shown above the actuating mechanism.

The beautiful electrolier shown in Fig. 8 is of bronze, and was manufactured by K. A. Seifert. As can readily

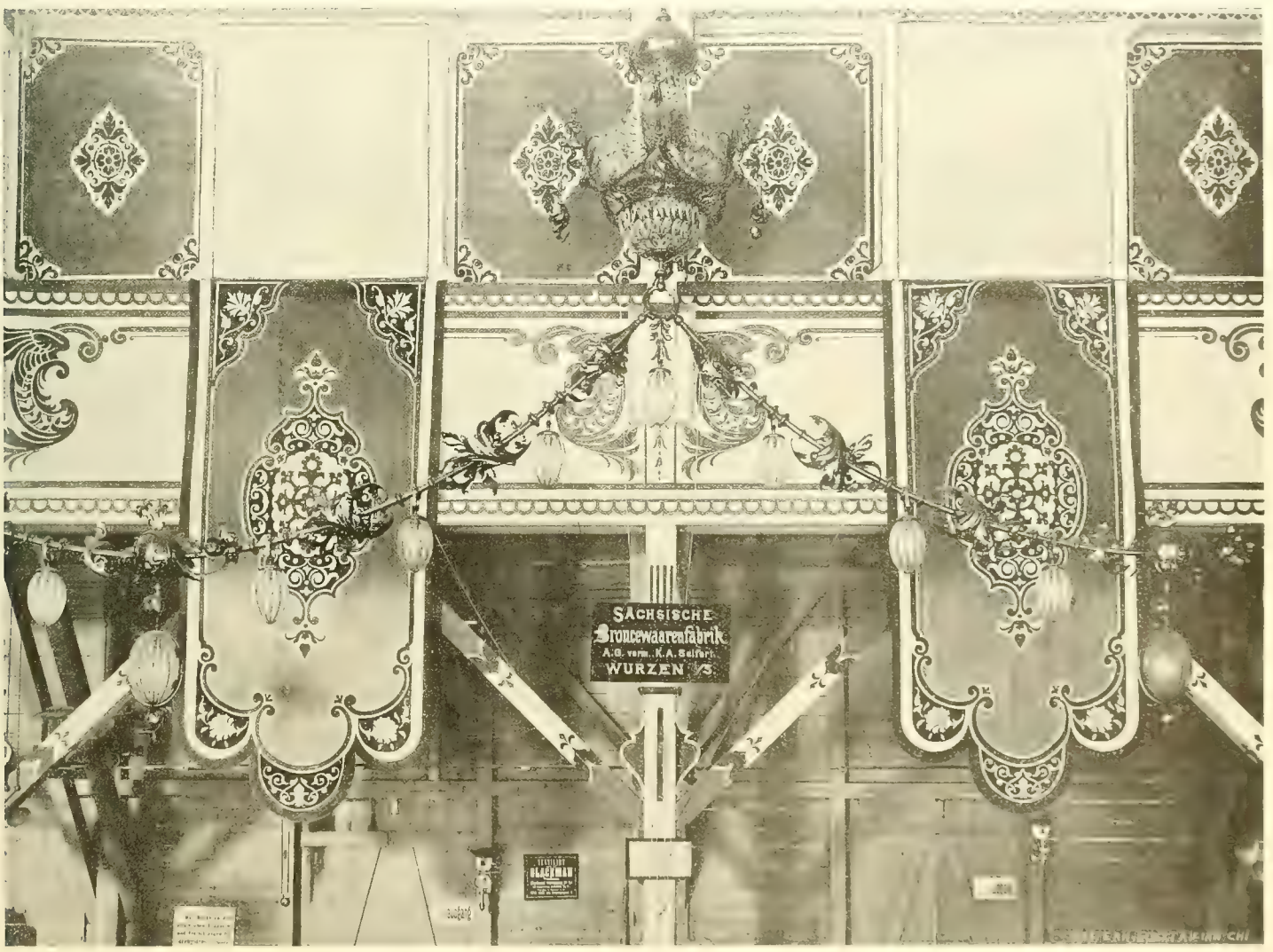


FIG. 1. ELECTRIC LIGHTING IN THE TEMPORARY VICTORIA THEATER AT THE FRANKFORT EXHIBITION.

be seen, the design is entirely Oriental. The figure is [illegible] and the whole shows what the Germans can [illegible] of artistic fixtures.

A 30 kw. alternating current plant, manufactured by the Thomson-Houston Electric company, is shown in Fig. 9 as it looked when in operation at Frankfort. The method of operation is self-evident.

In beginning his report Mr. Hornsby says that the first cost of the exhibition, up to the date of opening, was about

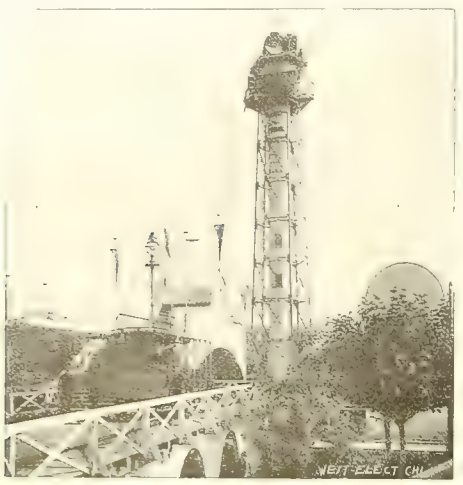
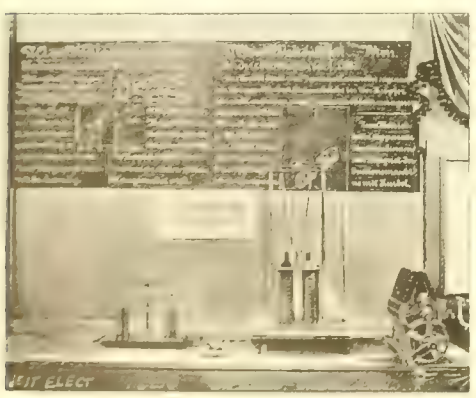


FIG. 2. TOWER AT FRANKFORT WITH ELECTRIC SEARCH LIGHT.

$155,000, while the running expenses aggregated $128,000, making a total cost of $283,000. The estimated resources were exactly equal to this sum, including $162,500 for tickets of admission and the receipts from privileges and attractions. Before the opening of the exposition, 200,000 tickets were placed with German bankers at 12½ cents each. The average daily week-day attendance was estimated to be 10,000, and that of Sunday was placed at 40,000. These figures were justified by the actual number of people present. Exhibitors were charged $3.75 per square meter of wall or floor space in the main exposition hall and $2 50 per square meter in the "unornamented" buildings. Space out of doors was charged for at the rate of 50 cents per square meter. Power was furnished at the following rates: One to fifty horse power, $7 50 per horse power for the three months of the exposition; 50 to 100 horse power, $6.25 per horse power; 100 to 300 horse power, $5 per horse power; over 300 horse power, $3.75 per horse power. Rebates of from 5 to 35 per cent. were made for the benefit of those who expended from $500 to $6,000. The actual figures of the final settlement were not to be obtained at the time Mr. Hornsby left. The secretary concludes the financial portion of his report as follows:

"It was admitted by the management that some mistakes had been made in overtaxing some of the privileges and underestimating the importance of others. For instance,



[illegible] well patronized, and, I understand, that the privilege for a

to be asked. All of these attractions were more or less popular, but to all of them there was objection on the part of visitors that an entrance fee into the grounds ought to have carried with it entrance to all places within the inclosure."

Referring to the architectural features of the exhibition, the secretary states that the exposition occupied a piece of ground 1,200 feet long, 300 feet wide at one end, and 1,000 feet at the other. The main machinery hall was about 500 feet long by 100 feet wide, and was built of wood at a cost of $27,000. The flooring was of concrete. This building contained the displays of 78 exhibitors, who each took up, on an average, 400 square feet. The aisles were 15 feet wide. The other buildings were a boiler house, telegraph and telephone building and annex, building for conduits, wires, cables, insulators, etc., hall for general installation work, hall for electro chemical apparatus and a hall for scientific instruments. In speaking of the decorative effects Mr. Hornsby says: "Looking toward machinery hall from the main entrance of the exposition were fountains, plats of flowers and grass, an ornamental music pavilion, from which music was dispensed afternoons and evenings by the famous Uhlan band of sixty pieces. At one end of the grounds was an artificial hill, with waterfall and caves lighted by electricity, the latter occupied by figures of gigantic monsters—dragons, etc.—which breathed out electrically colored steam and spouted forth electrically colored water. A small lake into which the waterfall poured its contents was laid out with pleasing landscape effects, little islands, floral ornamentation, statues of nymphs, etc. The marine exhibit, containing the best and most modern apparatus for navigation and war, was situated some 500 feet from the main exposition on the River Main. On the river, as a part of the exposition, plied aluminum and electric boats as well as those operated by gas and naphtha motors. On the top of a tower adjacent to the river were two ground glass parabolic reflectors, two meters in diameter, and of immense lighting capacity."

Probably that portion of Mr. Hornsby's report given under the heading "Physical" will be of greatest interest to American electrical engineers. Here the secretary describes the exhibits, including the operating plant. It seems that the latter was catalogued as a part of the exhibition, classified for competition, and subject to awards for excellence at the hands of the awarding jury. The central plant is thus described:

"Power and light were supplied after the following scheme: Manufacturers of boilers wishing to place their products in competition were charged for the space they occupied under the regular schedule rates, installed the machinery and laid the fountains, etc., at their own expense. The exposition company furnished the fuel employed, but exhibitors maintained and operated their own machinery. The wiring used in the service of the exposition was obtained by rental, the exposition paying for the three months' use thereof five per cent. of the selling price, the owner reclaiming it at the close of the exposition. The boiler house being adjacent to the main machinery hall, in which were the engines and electric generators, the expense for connecting was borne jointly by the boiler and engine exhibitors. Exhibitors of engines were charged for the space which their engines occupied in the main machinery hall; each exhibitor installed his engines at his own expense, and paid to the exposition company a specified amount for the steam necessary to operate the engines. Belting and the incidental apparatus for operating the generators from the engines were paid for by the exhibitors of dynamos, and these in their turn were charged for the space occupied by their apparatus; and the exposition company derived an additional revenue by charging the dynamo exhibitors for the power from the engines which was necessary for the operation of their machinery. The exposition company did the work of wiring necessary for the various department buildings, and charged against each exhibitor in these buildings an amount necessary to cover the cost of the light furnished to each.

"By this system of able financiering the exposition company, sharing only in the expense to the extent of the wiring and the fuel, obtained revenue first from the steam which came from the boilers; second, from the power produced by this steam, and, third, from light furnished to individual exhibitors. Lamps, incandescent and arc, were furnished free of cost to the exposition company in all the buildings and about the grounds by those exhibitors making [illegible] of the class of apparatus. Of course those [illegible] for operating dynamos to supply current had the privilege of lighting space in which other of their own apparatus was on exhibition.

"While the financial engineering incident to this part of the [illegible] great credit on the management of the [illegible] operation of the system would hardly be possible either in Frankfort or elsewhere. There seemed to have been a misunderstanding between exhibitors and the corporation as to the expenses incident to the exhibition, until the exhibitors had progressed so far in their arrangements that it became impossible for them to decline exhibiting; therefore, items of expense were borne which would not be tolerated on a second occasion.

"Exhibits were divided into sections and were placed in the ten or more buildings. The large firms making general exhibits, therefore, were compelled to prepare, install, maintain, and pay space and lighting charges at several points. In two instances, at least, corporations operated and maintained twelve exhibits each, in separate buildings or out of doors remote from the other locations of exhibits of the same firm. However much they might have desired to do so, the managers of the exposition, carrying out the policy of sectionalizing exhibits according to their relationship to each other, would have found it impossible to save exhibitors the expense incident to the maintenance of these separate exhibits. Some of those

FIG. 8. ARTISTIC ELECTROLIER DISPLAYED AT THE FRANKFORT EXHIBITION.

in attendance upon the exposition, and at least a few of the directors of the corporation, maintained the position that the existence of several exhibits of one firm at different points in the grounds or buildings was an advantageous condition to exhibitors, because the tendency on the part of visitors would be to magnify the exhibitor's importance on account of his presence at so many points. The exhibitors, on the other hand, asserted that the added expense incident to this separation of exhibits was not justified by the impression made on the minds of visitors, and contended further that the installation and maintenance of exhibits at so many points was too expensive to allow of that amount of decoration and the preparation of those features necessary to attract visitors. At least exhibitors were unanimous in the contention that the system was not one calculated to serve their best interests, and I would respectfully present this feature of my observation to the consideration of the management of the World's Columbian Exposition.

"No stringent rules were laid against exhibitors for the installation of exhibits, and almost absolute freedom was

allowed in their arrangement. The result was a most harmonious preparation of individual exhibits in the main buildings of the exposition, but a lack of symmetry and harmony in the effect of the whole. Elaborate ornamentation and spectacular arrangement of exhibits are features developed by the European exhibitor to a point unknown in this country. European electricians and European electrical manufacturing companies are far in advance of those in the United States in artistic lighting and in the

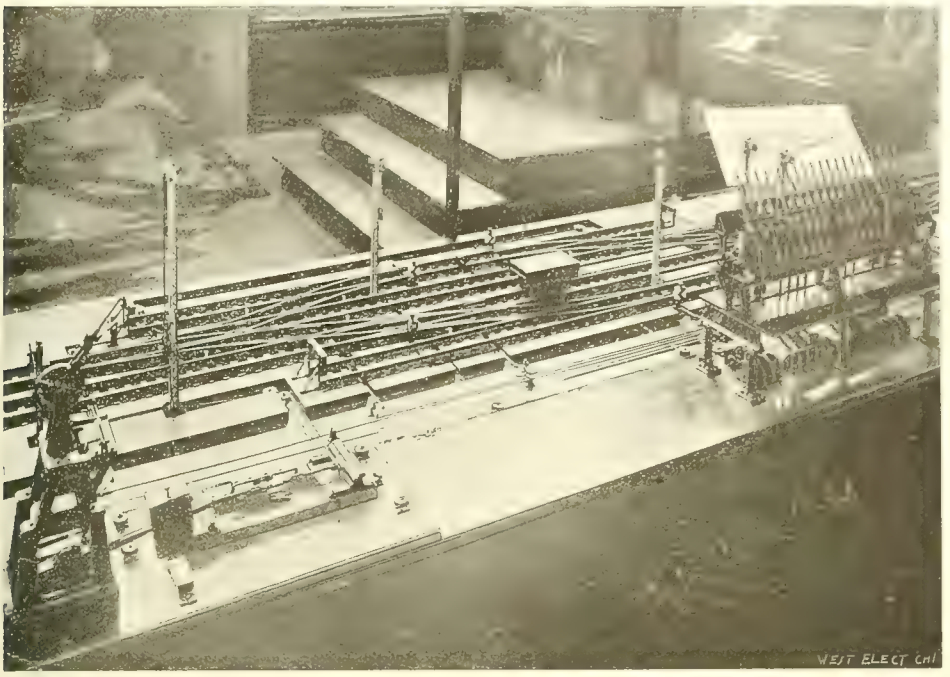


FIG. 7. MODEL ELECTRIC RAILWAY SWITCH EXHIBITED AT THE FRANKFORT EXHIBITION.

electric installation of dwellings, hotels and theaters. The designers of electroliers and metal ornamental work spend much energy and great genius in these directions, and the result in an installation of exhibits such as that at Frankfort can hardly be exaggerated in description. Where usually there are iron railings with inexpensive and inconsiderable ornamentation, the exhibition spaces at Frankfort were inclosed by beautiful metal wreaths varitinted and exquisitely wrought, with here and there flowers of almost perfect design, inclosing within their petals tiny incandescent lamps, the globes tinted to reflect the shades of the flower intended to be presented. Wreaths in bronze, nickel and aluminum were twined around metal trunks of trees as the corner posts of exhibits, and arches and canopies, in vines of the same description, separated parts of exhibits, as it were by drapery, and secured for the exhibitor most beautiful effects."

Treating the scientific features of the exhibition, the World's Fair representative first refers to the Lauffen-Frankfort long distance transmission experiment. He has this to say of the success of the venture: "The current was transmitted as intended, and the lighting of incandescent lamps was done, and to that extent the experiment was a success. Good authorities deny, however, that more than 13,000 volts pressure was attained, and I believe the projectors will not claim to have saved for final application more than 60 per cent. of the original power, the loss being approximately 20 per cent. in the dynamos and transformers, and the other 20 per cent. in transit. No really satisfactory tests of measurement were made. For all practical purposes, however, the experiments were essentially successful, in that the principles set forth were demonstrated."

Other features that attracted the visitor's attention are described as follows: "The lighting of art galleries by the use of arc lamps was a feature that attracted much attention, and was brought to a state of perfection not hitherto achieved. The exhibitors were S. Elster & Co. of Berlin, and their process of lighting consisted in the total shading of pictures from the rays of light by the use of yellowish-tinted ground glass laminated reflectors. Large cambric screens behind the lamps to throw the light upon the walls completed the system, which was uniquely simple, and more nearly resembled the light of day than any other system which the visitors had ever seen.

"Another achievement was the exhibition of electric search lights and reflectors, especially the immense ground glass parabolic mirrors, 80 inches in diameter, which, with an arc light requiring 70 horse power to maintain, cast shadows at a distance of 45 miles.

"Still another noteworthy feature, and one in which Europeans far surpass Americans, was in the direction of stage lighting for theaters, and electric ventilators for the same. Two theaters were on the exhibition grounds, one in miniature, in which were installed two distinct systems of theater lighting both deserving more than passing praise. By one of these systems the lights and shades incident to each of the twenty-four hours of the day, with all of the beautiful tints of dawn and twilight, the noonday sun and the midnight moon, were marvelously portrayed"

On the important subject of securing European exhibits similar to those shown at Frankfort for Chicago, Mr. Hornsby says: "Taking advantage of the presence in Frankfort of the heads or representatives of more than 500 European electrical firms, I discussed with these, except in a few instances, the work contemplated for this department of the World's Columbian exposition, and had expressions from them with regard to their anticipations. I would say at this point that there are only a few, possibly a dozen, electrical firms in Europe which do a general manufacturing business. The vast majority of electrical firms are engaged in manufacturing electrical specialties. In cases of the firms doing a general business, I found objections on the part of managers to exhibit at Chicago on the score of the reputed superiority of American electrical machinery, and the alleged inability of Europeans to compete along these lines. There are a few firms however, so powerful

FIG. 8. DISPLAY OF THE HELIOS COMPANY AT THE FRANKFORT EXHIBITION.

they have developed to such a perfect state that in spite of

only in this country, but throughout the world. Barring

participate in the exhibition of this department of the World's Columbian Exposition. For obvious reasons I shall not digress to the extent of discussing the intention of individual firms in respect to their participation at the World's Columbian exposition, and will only say that the smaller firms—manufacturers of electrical specialties—admit that should the larger firms exhibit at Chicago, they, with

same; and to the end of securing this general result I am able to state that the following general electrical manufacturing

esting exhibits at the World's Columbian Exposition:

of Berlin

Ghent

Carpentier & Co., Paris

"I was informed by

weighing at least 45,000 pounds to the single piece would be a part of their exhibits, and the question was asked whether this machinery could be moved. The answer which I gave, viz., that arrangements would be made for moving pieces of 30,000 pounds, was met by the supplementary question, 'How can heavier machinery be moved by exhibitors and what will the same cost?'"

Mr. Hornsby says that where commissioners have been appointed by foreign governments he discussed his work with these commissioners or their representatives before

approaching

London,

Preece of the Royal Commission, similar agreements [illegible] which would be the basis of intercourse hereafter. Under these agreements all pamphlets or circulars or items of information to be transmitted to exhibitors may be transmitted directly to the exhibitors, a copy of the same to be sent to the Royal Commission with the names of the persons to whom sent; in all cases a paster to be attached to documents pointing out to exhibitors that all business between them and the World's

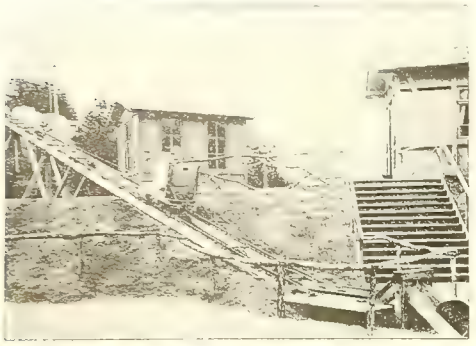


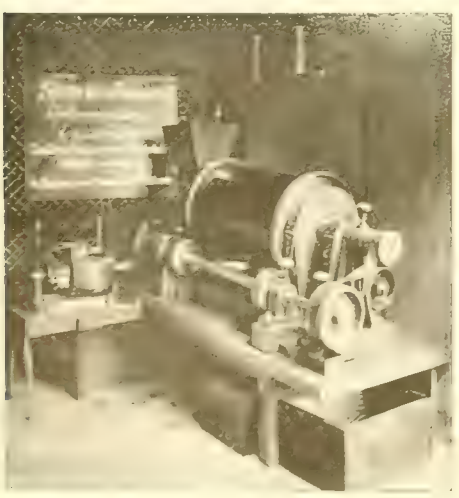
FIG. 6. AMERICAN MINE HAULAGE PLANT DISPLAYED BY THE THOMSON-HOUSTON COMPANY AT FRANKFORT.

Columbian Exposition must be done through their government commissions.

After brief references to his visits to Paris and London, Secretary Hornsby concludes his report by a review of the prospects for the International Congress of Electricians in Chicago in 1893. In reference to this subject he says:

"As a part of my work in Europe, under instructions from the chief of the department of electricity, I visited several of the scientists of England and the Continent in behalf of an international electrical congress, for the success of which the chief of the department of electricity has been working since his appointment, and I am prepared to state that the success of the congress is assured, providing, of course, it is prepared and carried out in a manner satisfactory to the scientific men who will create its dignity and make its chief value. Among those with whom I conferred regarding this congress were Prof. Galileo Ferraris of Italy, Prof. Siemens of Berlin, Prof. W. E. Ayrton of City Guilds College, London, W. H. Preece, Esq., F. R. S., electrician-in-chief, telegraph department of the British government, M. Hospitaliier of Paris, and M. Abdank-Abokanowitz of Paris. The consensus of opinion expressessed by these distinguished men and others of eminence was as follows:

"Hitherto electrical congresses have not been successes, and essentially for the reason that the methods of their organization were not calculated to give them that dignity necessary to the accomplishment of effective work. In



the United States government, through the governments to which the individuals belong. This course of action, the gentlemen say, will insure an official character to the proceedings of the scientific congress, and will virtually pledge the various governments to a recognition and adoption of the standards created. If such a congress is to be held at all, it can only be a success along these lines, for past experience has determined that men without whose aid such an affair would fall flat decline participation in any congress which has for its end less than the work outlined above, to the conclusion that the World's Columbian Exposition shall mark a distinct epoch, and the greatest one in the history of electricity.

"To carry out such a work as the scientific people picture to themselves, they would have established a purely scientific committee embodying a member from each of the important governments, at least those which have contributed materially to the progress of electrical science, the duty of which committee should be to prepare a programme, including a settlement of the issues to be discussed, and the individuals to take part in this discussion; to attend to the preparation of the scientific work, etc; in fact, to prepare for the congress in all directions appertaining to science. Another working committee should also be appointed, for the preparations other than scientific, to include gentlemen interested in the commercial success of electricity, and this committee could also convene, if it were deemed advisable, a congress of electrical engineers, which would indulge in discussions of the commercial value of the appliances of electricity.

"One other point was made by the European scientists, namely that such a scientific congress should be convened in August or September, as those months constitute the vacation time of European professors, and nearly all the desirable electrical scientists of Europe are teachers in the educational institutions. They would probably not be able to attend during any other season.

"In conclusion, I beg leave to report that Europeans fully appreciate the magnitude and completeness contemplated for the World's Columbian Exposition, and that they have arrived at that point in their enthusiasm where their chief topic of discussion in connection with it is that of the sufficiency of the means of transatlantic transportation for passengers and freight."

Mr. Hornsby's report was ordered printed by the executive committee.

A telegram from Paris describes a peculiar accident [illegible] theater in that city. It appears that [illegible] performance of "Lohengrin" at the Opera [illegible] lights in the theater were suddenly [illegible] became panic-stricken in the darkness, but no one was hurt and order was soon restored. [illegible] it was found that the stage [illegible] had become entangled in the belt of the dynamo and had been torn into shreds.

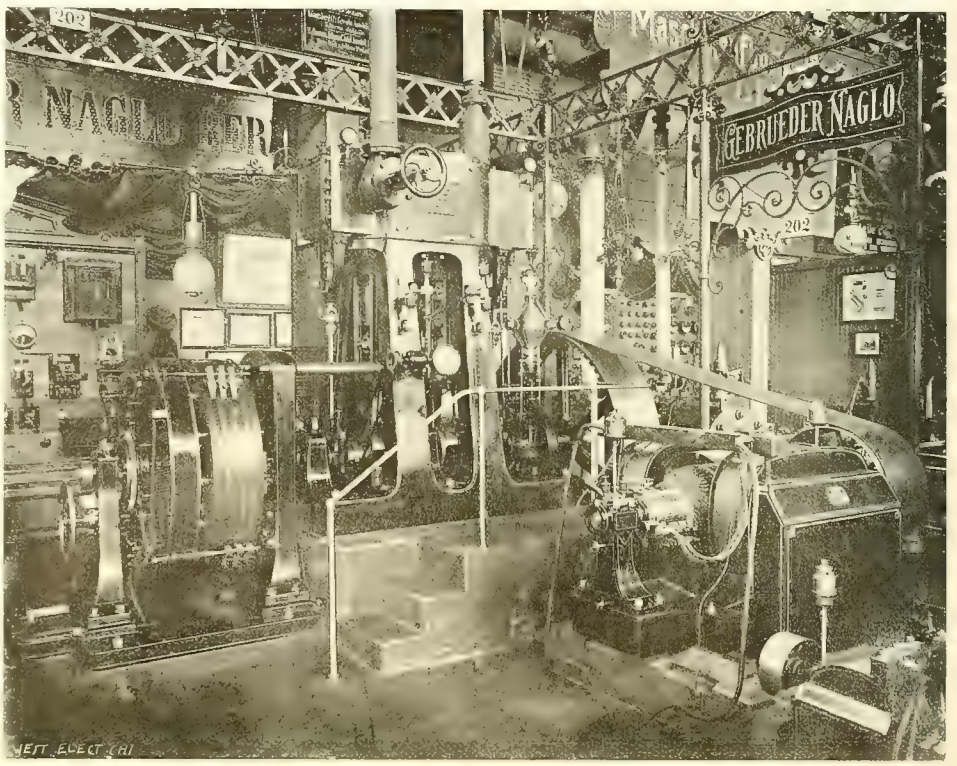


FIG. 5. NAGLO BROS. GENERATING APPARATUS DISPLAYED AT THE FRANKFORT EXHIBITION.

Surveying for a Submarine Cable in the Pacific.

The United States steamer Albatross has ended the first half of the survey of the bed of the ocean for a submarine cable between San Francisco and Honolulu, which was authorized by a special appropriation of $25,000 made by the last Congress. It is considered quite impossible to run a cable from San Francisco direct, for the reason that a plateau or shelf extends out for a distance of about 60 miles with an average depth of only 100 fathoms, but at that point the depth suddenly increases to 1,200 fathoms, proving the existence of a precipice that would soon ruin, if not sever any cable. In fact the whole coast of California does not offer more than a half dozen places suitable for a cable landing. But comparatively few stretches of sandy beach, free from outlying rocks, exist along the coast and by far the greater portion of the shore waters are shallow and the bottom is besprinkled with sharp rocky projections. In the bill making the appropriation Congress designated San Francisco as the point from which the cable should be laid, but a poorer location is not to be found on the Pacific coast. It happens, however, that the most eligible site existing is the one nearest San Francisco. This place, which is generally known as Moss landing, though the goverment charts designate it as Salinas Landing, is almost in the center of the long, clear, sandy beach circling Monterey bay and at a point about one mile south of the mouth of the Salinas river. The bay has practically no shipping traffic, hence no injury is to be feared from dragging anchors.

It was determined, therefore, that the survey should commence from Salinas landing and accordingly the Albatross, with Lieutenant Tanner commanding, left San Francisco on October 9th at daybreak, arriving there at 2 o'clock the afternoon of the same day. The remainder of this, as well as the following day, was spent in "swinging ship" to determine the magnetic error of the compass, an important matter where absolute accuracy is essential. On the following morning the Albatross started the survey and it was found that the bottom consisted of a dark mud slightly mixed with sand and that the depth gradually increased at the rate of about 50 fathoms to the mile for the first 14 miles. The soundings were made in a direction a trifle southward of west at intervals of a mile, describing a great circle course towards the Sandwich Islands. The depth gradually increased until 2,112 fathoms was reached at a point 725 miles west of Monterey. Thence the depths fluctuated over an undulating bottom between 2,600 and 2,900 fathoms for the next 250 miles, sounding stations being made at intervals of ten and fifteen miles and the changes noted being quite gradual, seldom exceeding 100 fathoms in fifteen miles. On the morning of the 17th, however, a change both in the character of the bottom and depth was encountered, the line passing over an area, the bottom of which was principally decom-

posed lava and the depths were slightly shallower, though no indications were met of the existence of a barrier to the successful laying of a cable over the region. The lava specimens secured were in small particles about the size of a pea and readily crumbled to the touch. This area extended on the line between seventy-five and 100 miles to the eastward of Belknap mountain, a submarine volcanic peak whose summit approaches to within 388 fathoms of the surface of the sea, rising from the ocean bed

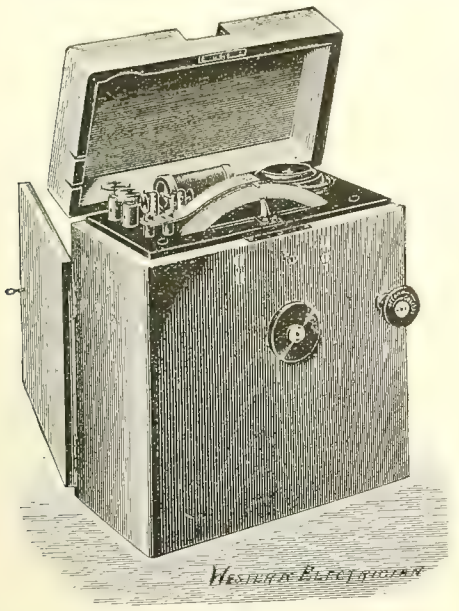


FIG. 1. TWO INGENIOUS ELECTRICAL TEMPERATURE INDICATORS.

2,600 fathoms below. This peak was discovered by Admiral Belknap, whose name it bears. The Albatross passed about forty miles to the northward of Belknap mountain on the 16th inst., and obtained soundings in depths averaging 2,600 fathoms.

With the exception of the lava bed mentioned the bottom from the start to the point where the last sounding was made (850 miles off Salinas landing) was uniformly muddy and will make an exceptionally good bed for the cable, as it will sustain the least strain when resting easily and deeply in a bed of yielding soil. The mud allows the cable to sink well into it, protects it from rapid and consequently dangerous changes in temperature, from the sweep

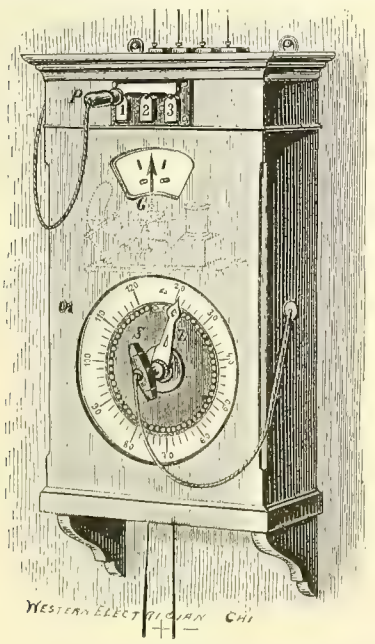


FIG. 4. TWO INGENIOUS ELECTRICAL TEMPERATURE INDICATORS.

of strong currents and from the attachment to it of submarine growths. It also precludes the necessity of anchoring the cable.

The number of soundings taken by the Albatross was 98 and everywhere below 2,000 fathoms a uniform temperature of 35 degrees Fahrenheit was found, proving the absence of submarine currents likely to move a cable.

The number of incandescent lamps in use in Berlin is reckoned to be 104,100, with 1,314 users.

Two Ingenious Electrical Temperature Indicators.

Among the electrical scientific instruments shown at the Frankfort exhibition the two illustrated in the accompanying cuts are worthy of especial mention for the ingenuity shown in their construction, and for their practical value. They are Braun's electric pyrometer, and the telethermometer.

The first, shown in Figs. 1 and 2, measures temperatures up to to 1,500° Centigrade by the rise of resistance of a coil of platinum wire. The wire is wound non-inductively on a fire-proof "former" inside a fire-proof case, and it forms one branch of a Wheatstone bridge. A telephone or sensitive galvanometer is used, and the apparatus gives accurate readings of temperature with the greatest ease. The apparatus itself, apart from the tube containing the platinum wire, is arranged in a solid oak case in such a manner that only the parts which have to be adjusted are accesible. The dry cells are arranged in a separate compartment at the back of the case. The apparatus is made in two styles, one for portability and the other for permanent use in one place.

The manipulation of the instrument is perfectly simple, and no electrical knowledge is necessary. The pyrometer is inserted where the temperature is to be measured, and the leads are connected to the terminals on the left, Fig. 1. The battery is then put in circuit by turning the knob in front, and the instrument adjusted till the telephone is silent, or until there is no deflection, if a galvanometer is used. The scale then reads the temperature direct, without any calculation or reference to tables, an advantage which is at once apparent. The whole of the measurements can be made without opening the box, as the scale is visible through the lid, and the battery switch and adjustment button are outside the case. The distance between the pyrometer and the bridge may be very great without reducing the sensitiveness of the instrument. All that is needed is a pair of leads of larger cross section. The instrument is then a telepyrometer, and the temperature of any oven or furnace can be read in the manager's office. The sensitiveness is great enough to show the least variation even at the highest temperatures.

The accuracy of the instrument is extraordinarily high, and it is carefully calibrated from the average of a large number of determinations from measurements with a porcelain air thermometer.

The pyrometer is made in two styles, one for use up to 1,000° Centigrade, and the other up to 1,500° Centigrade. The portable pyrometer bridge has telephone attachment with induction apparatus, while the pyrometer bridge for fixing permanently, has a highly sensitive moving galvanometer, Fig. 2, with shunt specially arranged for temperatures up to 1,000° centigrade, or 1,500° centigrade. This galvanometer differs from the original form of Deprez, in having a large number of permanent magnets with pole pieces common to them all. By this means a very strong field is produced. There is a metal tension suspension at the top, and a silk fiber at the bottom of the coil to keep it in position. The circuit is completed by a weak spiral, so that the instrument is twice as sensitive as those with double metal suspensions. The silk fiber is attached to a small spring to keep it taut. A traveling stop takes the pull off the silk, and holds the moving coil securely. The instrument is very constant and is unaffected by external fields, and is sensitive enough to be used without a mirror.

The telethermometer is a simple apparatus which can be used by those having no electrical knowledge. It is employed for measuring the temperature of distant rooms. By its use the various class rooms in a school, or the offices in a suite, which are heated by hot water or hot air, can be kept at any desired degree of heat by regulation from a central office. It is also useful for granaries, and for inaccessible rooms, such as are found in malt houses, drying ovens, etc. The device is also available for enameling ovens, bakeries, breweries, etc., as well as for all purposes where it is desirable for the manager to be able to tell the temperature of any part of his works without leaving his office. It consists, like the Braun pyrometer, of a resistance which changes with the temperature.

The metal thermometer is inclosed in a metal case so as to be fully exposed to the atmosphere. For dry and non-corrosive atmospheres the form, shown in Fig. 3, in which the resistance is fully exposed in an iron case with perforated sides is available. This form of thermometer is especially sensitive to the smallest variations in temperature. The indicator consists of a very sensitive galvanometer, which is not affected by the earth, or by neighboring metal, and of a resistance bridge. The galvanometer and bridge are arranged in an oak case, so that the index is visible, and the resistance can be adjusted from the outside, the temperature being read direct. The cells can be

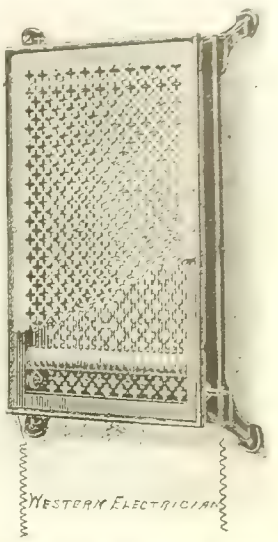


FIG. 3. TWO INGENIOUS ELECTRICAL TEMPERATURE INDICATORS.

ters, all that is necessary being separate leads to each thermometer, and a small switch-board to put any one in circuit. The thermometers have a common return. The apparatus is supplied for measuring temperatures from 20° below zero to 150° Centigrade,

Electric Letter Delivery System.

A contemporary announces the invention of an ingenious contrivance for distributing letters or parcels to the different flats of large buildings. A large collection box, provided with compartments to correspond to the various flats, is fixed in the basement. The placing of letters or parcels in this box establishes electric communication with the top story, the effect being to release a stream of water which fills a cylinder. As soon as the cylinder is full it descends, causing the box in the basement at the same time to ascend, and by a simple mechanical contrivance to dis-

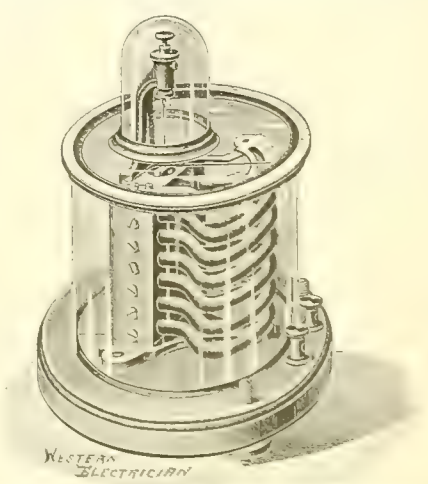


FIG. 2. TWO INGENIOUS ELECTRICAL TEMPERATURE INDICATORS.

charge the contents of the various compartments into the receiving boxes of the various floors. When the collecting box has reached the top story, the cylinder, by emptying itself, permits it to return to the basement.

The first application in Australia of electricity to the purpose of welding metals took place at the [illegible], Sydney, at the end of July last, when, by the invitation of H. H. Kingsbury & Co., electricians of Sydney, who had fitted up a small Thomson electric welding plant, the members of the Engineering Association of New South Wales had an opportunity of seeing the apparatus at work. The plant was afterward taken to Melbourne for exhibition in a similar manner.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - - - Editor and Publisher.
J. B. O'HARA, - - - - - - - - - - } Associate Editors.
F. L. PERRY, - - - - - - - - - - - } Associate Editors.
W. E. KEILY, - - - - - - - - - - } Associate Editors.
J. L. BAKER, - - - - - - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own.* THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

The Frankfort Exhibition and the World's Fair. Illustrated. 285, 286, 287, 288
Surveying for a Submarine Cable in the Pacific 288, 289
Two Ingenious Electrical Temperature Indicators. Illustrated. 289
Electric Letter-Delivery System 289
[illegible] 290
Improved Low Speed Multipolar Motor. Illustrated 291
Boston Electric Company's Apparatus. Illustrated 291
Proposed Canadian Electrical Association 291, 292
New Standard Measurement Apparatus. Illustrated 292
New Champion Battery 292
Straightway Back Pressure Valve. Illustrated 293
Combination Adjusting Screws. Illustrated 293
New Lamp Holder. Illustrated 293
[illegible] Arc Light Cord. Illustrated 293
Incandescent at World's Fair 293
Electric Lighting in the Eternal City 293, 294
Electrical Meeting 294

DEPARTMENTS.

[illegible] 295, 296
New Incorporations 297
Electric Lighting 297
Electric Railways 297
Trade Notes 297
Patents 297, 298
Business Points 298

An instance of the efficiency of government telegraphs was related in a recent issue of a London paper. A gentleman was riding on an English railway at a considerable distance from his home, when his train was, unfortunately, derailed, with the result that several persons were injured. The traveler in question, however, was but little hurt, although subjected to an annoying delay. He immediately telegraphed this fact to his wife to allay any alarm that she might feel at the news of the accident. Arriving at home several hours afterward, he was surprised to learn that the telegram had not arrived, and a couple of hours later he received the message himself. Facts like these are discouraging to the American advocates of [illegible]

SEVERAL of the trains that have been operating on the [illegible] have [illegible] patronage. The management admits that it cannot compete with the [illegible] ferred to ride on the electric roads, and the steam railway patronage dropping off day by day, until the trains were operated at a positive loss. Still the company hoped that with the return of cool weather the patronage of the old lines would improve, but they have been forced to admit their error, and the recent withdrawal of these trains is another substantial victory for the electric road.

The people of Minneapolis and St. Paul have reason to be proud of the excellent system of electric railways which they possess, and their support of the electric company will enable it to continue to improve the service, and keep abreast of the times.

MUNICIPAL management of electric light plants is occupying the attention of tax-payers on the Pacific coast. Our San Francisco correspondent calls attention this week to recent developments in this line. First came the city of Vancouver, Wash., which abandoned the experiment at the end of the first year. Then the city of Alameda, Cal., found that the electric lights furnished from the city plant cost considerably more than would be paid for contract lighting, and in the hope of bringing down the cost of operation to a figure at least equal to that of a stock electric lighting company, the city has put more money into the concern. The town of Berkley, however, furnishes a new idea in the way of municipal management. This town is a suburb of San Francisco and in its desire to control the lighting plant, purchased machinery, set it up and then hired a man at $150 per month to run it and furnish coal oil, attendance, etc. He retained the privilege of selling lights for his own benefit to commercial houses and has installed two additional dynamos. This is certainly "Municipal management" with a vengeance. The spectacle of a city furnishing a man a place for the operation of a commercial enterprise to the exclusion of other citizens is certainly a novelty, and, it is to be hoped, the example will not be generally followed.

EASTERN electrical papers continue to discuss the "claims" of the American Institute of Electrical Engineers to recognition by the authorities of the World's Fair. A contemporary says: 'Inasmuch as that body was the first formally to propose an international congress for the World's Columbian Exposition, and has more than once taken action to aid in bringing about this end, it seems most singular, to say the least, that its services should have been overlooked and its existence passed by in the first official move made. We trust that this unfortunate state of affairs is due to carelessness rather than intention, and believe that the committee appointed by the Institute to look into the matter will find that such has been the case. It would be a most serious mistake if the local authorities at Chicago should attempt to hold an international gathering without the co-operation of the one organization that may best be taken to represent American electrical science." Prof. Gray, chairman of the committee on the electrical congress, has already defined his policy, and there should be no room for doubt as to his intentions. He does not intend to hand the management or direction of the congress over to the American Institute or any other body, nor does he intend to disregard any of the different electrical organizations. He expects to receive the hearty support of every member of the Institute and of that body as an organization. There are no doubt many members of the Institute who would like to see the Congress directed by that organization, but there is little hope that such will be the case. The undertaking is too great to allow one association to assume control, and there is really no valid reason for giving the Institute the direction of the Congress. There will be plenty of work for all, and if the members of the American Institute are desirous of assuming a prominent position in the affair, they will have little trouble in finding an opportunity to display their good will toward the enterprise.

THE Germans have the reputation of being a thrifty race, but one hardly expected to see this admirable trait exercised to the degree exemplified in the financial methods of the management of the Frankfort exposition. In glancing over Secretary Hornsby's report one is struck with the manner in which the exposition managers drew revenue from almost every possible source. For instance, exhibitors of engines paid for space and steam, not to mention all expenses incidental to making the installation. Competing boiler manufacturers paid for space, laid foundations, etc. The exposition furnished the fuel, but the exhibitors operated their own machinery. Exhibitors of dynamos were charged for space, and the exposition people derived additional revenue from this last named class for the power from the engine which was necessary to drive the machinery. In a word, the exposition company, sharing only in the expense to the extent of the wiring and the fuel, obtained revenue first from the steam, which came from the boilers; second, from the power produced by this steam, and third, from the light furnished to individual exhibitors. This was "able financiering," to be sure, but when in addition to this we learn that even seats within the exposition inclosure were charged for, and also that "there seemed to have been a misunderstanding between exhibitors and the corporation as to the expenses incident to the exhibition," there arises a hesitancy to concur with Mr. Hornsby to the extent of agreeing that such a policy "reflects great credit on the management of the exposition." We feel sure that "a repetition of the system would hardly be possible, either in Frankfort or elsewhere."

CONSIDERABLE space in this issue is given to the report of J. Allan Hornsby, secretary of the department of electricity, World's Fair, who was sent to Europe as the authorized agent of the electrical department. Mr. Hornsby succeeded in accomplishing a great deal in a short space of time. He was successful in securing pledges of exhibits from many of the largest manufacturers of electrical machinery in Germany, England and France, while at the same time he gathered much information relating to the great exhibition at Frankfort that will be of value here. The Germans have certainly no superiors in producing decorative lighting effects, and many of the exhibits were most artistic, both in material and arrangement. Their beautifully designed fixtures and well constructed machinery will be decided acquisitions to the fair. In the meantime prospective American exhibitors at the World's Fair can get many a useful hint by a careful perusal of Mr. Hornsby's report.

In this connection it is proper to refer to a brief article in our usually accurate and sagacious contemporary, *Industries*, of London, entitled "Foreign Exhibitors at the Chicago Exhibition." The writer thinks there is but little prospect of European manufacturers of electrical machinery making exhibits at Chicago, and says: "The question put by European firms is: Will exhibiting pay? To make it pay it must be useful as an advertisement and extend sales in America or at home. It is questionable whether English manufacturers can sell goods in America to any extent. This arises, not so much from tariff difficulties, as from the difference in the methods of doing business. For example, most electric lighting in America is done by offshoots of a few large manufacturing companies with 'systems' In England one firm makes engines, another makes dynamos, and so on. There is certainly a tendency among American electric supply companies to throw off the yokes of their parents, and to buy machinery in the open market, and this feature may help European manufacturers. In the open market, and with prejudice discounted, English electrical machinery could, we think, easily compete with American, but probably both might be beaten by the manufactures of continental engineers. Under the present conditions of American electrical industry it is scarcely likely that any European firms will exhibit heavy electrical machinery at Chicago. Mere accessories, such as measuring instruments, may be shown, but we can think of nothing else that it would pay to send there."

Passing over the fact that Mr. Hornsby's report shows that several of the most important of English and continental electrical manufacturing concerns have already agreed to make displays at the World's Fair, in the face of our contemporary's objections, two curious misconceptions in the article quoted are at once apparent. For one thing, *Industries* totally fails to take into account any advertising results from the exposition save in the United States. Does it not realize that thousands of observing visitors from Canada, Mexico and the Central and South American republics will carefully note the machinery, electrical and otherwise, at the exposition? Are English manufacturers prepared to abandon this field entirely to the United States, so far as the undeniably great influence of the World's Fair is concerned?

Then again, our contemporary attaches an altogether fictitious importance to what it styles the "system" method of doing business in the United States. Great electrical corporations, it is true, do exert a marked influence on the central stations of the country, but even these companies do not, with perhaps a single exception, make engines, as implied by the English paper. The statement that "most electric lighting in America is done by offshoots of a few large manufacturing companies," is inaccurate and misleading. In the largest arc lighting station in Chicago dynamos of half a dozen different manufacturers are employed, and even if it were not so, there would be nothing to prevent the purchase of English machines. The "difference in the methods of doing 'business" is simply a bugaboo, and should deter no foreigner from exhibiting at the World's Fair.

Perret Low Speed Multipolar Motors.

The accompanying cuts illustrate the special features of the Perret low speed multipolar motor. Fig. 1 is a side view of a motor, complete with sliding base and belt tightening screw, while Fig. 2 is an end view of the machine.

The armature is a ring of comparatively large diameter, with longitudinal channels on its periphery, in which the conductors are wound and thus practically embedded in the iron, which is in such close proximity to the iron pole pieces that there is practically no gap in the magnetic circuit.

The field consists of three separate magnets arranged at equal distances around the armature, each magnet having two pole pieces. The winding is such as to produce alternate north and south poles. The magnets are built up of plates of soft charcoal iron. A non-magnetic bolt passes through a hole in each pole piece, and the plates are clamped together between washers and nuts. These bolts

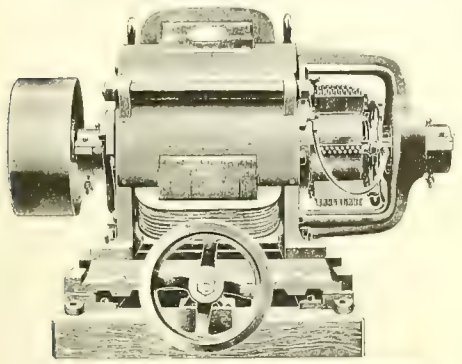


FIG. 1. PERRET LOW SPEED MULTIPOLAR MOTORS.

also serve to attach the magnets to the two iron end frames, which are of ring shape and are bolted to the bed plates of the machine.

The magnetic circuit is of unusually low resistance by reason of its shape and its shortness, which is shown by the diagram, and the superior quality of iron used.

The magnets are supported at some distance from the frame by means of the non-magnetic bolts and the armature is mounted on the shaft by spiders of non-magnetic metal. The whole is inclosed by a shield or case of sheet metal.

These motors have been applied by direct gearing to pumps, mining machinery, dock and builders' hoists, street cars and traveling cranes. It is noteworthy that while the speed of these motors is low they are very light in weight and require only small floor space. They are manufactured by the Elektron Manufacturing company, Springfield, Mass.

Easton Electric Company's Apparatus.

In the accompanying cuts is illustrated the special apparatus of the Easton Electric eompany of Brooklyn. Fig. 1 shows the constant current dynamo, the chief claim for

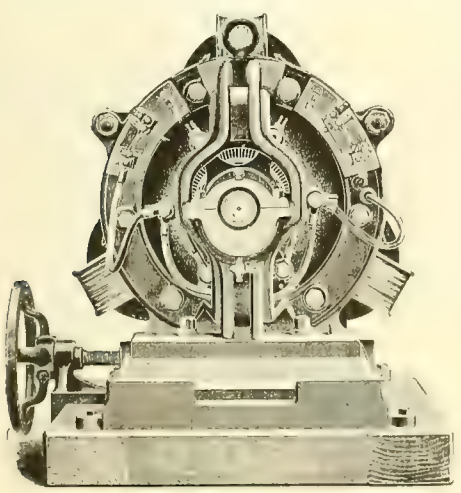


FIG. 2. PERRET LOW SPEED MULTIPOLAR MOTORS.

which is that it is so constructed as to provide against overheating, and that no automatic regulator is required.

The magnet coils of the dynamo are so proportioned it is stated as to be saturated by 75 per cent. of the normal current in their coils, while the armature does not become saturated with less than five times the normal current in its coils, and is also a relatively powerful magnet compared to the field coils.

While there is naturally a tendency to increase the current, when the resistance is reduced by cutting out any number of lamps, yet the field magnets do not feel the increase, because they are already saturated, whereas, the armature, not being saturated, opposes the field magnets more powerfully, and an actual reduction of voltage results. Meanwhile the current increases, but very slightly,

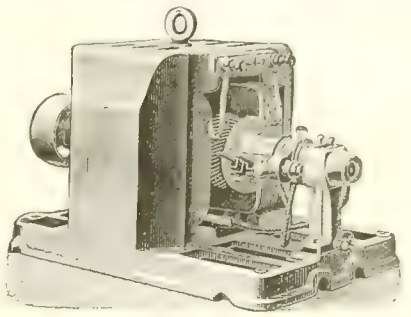


FIG. 3. EASTON ELECTRIC COMPANY'S APPARATUS.

and far out of proportion to the reduction of the resistance. By this means, it is claimed, lamps may be cut in or out of circuit without affecting the dynamo injuriously. Another important characteristic is the fusible connection between each section of the armature and the corresponding commutator plate to prevent damage to the armature from an injured or imperfect commutator.

The method of mounting the armature on the shaft is shown in Fig. 2. It is claimed that this method secures excellent ventilation.

Another peculiarity is the arrangement of the pole pieces in such a manner that the center of the armature is the most strongly magnetized portion, and the self-repellant property of magnetic lines of force is taken advantage of, to bring the entire core to saturation at once, thus securing the maximum of inductive action with minimum power and weight of dynamo.

The lubricating devices are automatic and reliable, and

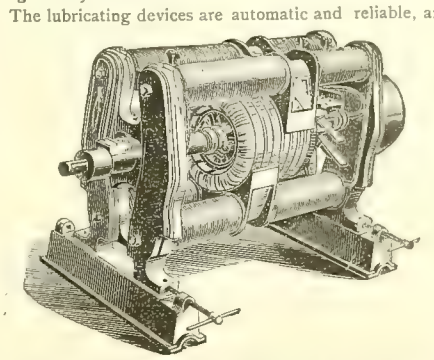


FIG. 1. EASTON ELECTRIC COMPANY'S APPARATUS.

require very little attention. The brushes are small and light, are not expensive, and require but little care.

The constant potential dynamo shown in Fig. 3, is of the ironclad type, and is notable for its solidity and efficiency. The armatures are wound with but one layer of wire, and all sizes that have a capacity of more than 120 amperes, have but one turn per section. These machines

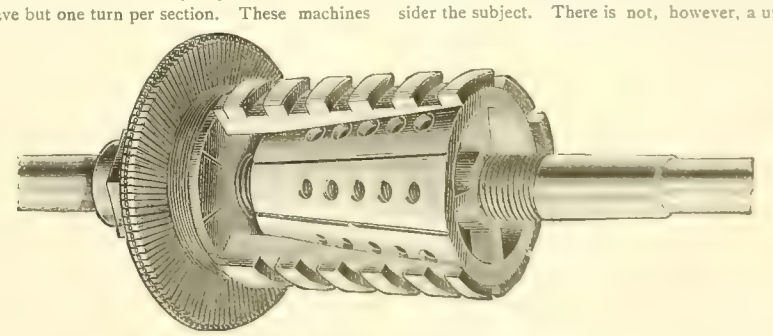


FIG. 2. EASTON ELECTRIC COMPANY'S APPARATUS.

are compounded, or over-compounded, to any desired extent, to compensate for the drop in line, and, it is claimed, are absolutely automatic in regulation. The bearings are self-lining and automatically lubricating, as in the constant current Easton dynamos.

The Easton Electric company manufactures two distinct types of arc lamps, which are designed respectively for use on currents of definite or indefinite amperage. The one for definite amperage, Fig. 4, is a balanced lamp, or one in which the feeding is governed by the different pulls of solenoid coils in the main circuit. The lamp for indefinite amperage has a universal movement. The main coil has nothing to do with the feeding, but is only used to form the initial arc. The universal lamp when once adjustment.

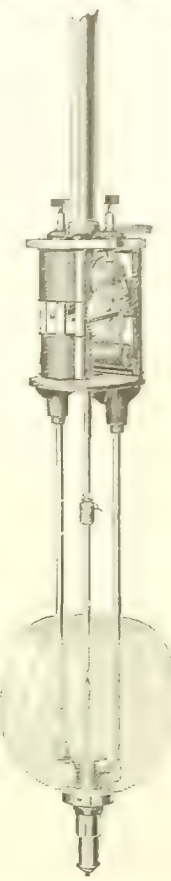


FIG. 4. EASTON ELECTRIC COMPANY'S APPARATUS.

lamps may be operated two in series on 110 volt circuits, or eight in series on railway circuits of 500 volts.

All these are single carbon lamps, but by varying the size of the carbons they can be made to burn from six to fourteen hours.

Proposed Canadian Electrical Association.

Attention has heretofore been called to the movement on foot for the formation of an electrical association in Canada on the same general plan as that of the National Electric Light association in this country. The Montreal convention did much to awaken interest in the movement, which had been advocated principally in Toronto. A meeting has been held and a committee appointed to consider the subject. There is not, however, a unanimity of opinion on this subject. At the Montreal convention many of those interested in the matter expressed the belief that much greater benefits could be obtained by joining the National Electric Light association [illegible] a purely Canadian organization. A. L. Corliss, president of the Canadian Electrical Construction, Manufacturing & Supply company of Montreal, who took such a prominent part in the arrangements for the last meeting, expresses the following opinion:

This Canadian association might be very good to stimulate electrical interests to a certain extent. I suggested last February that a Canadian association might be formed similar to the American organization, but after attending the Providence and Montreal meetings I [illegible] believe that it would be better for those interested in

electrical enterprises in Canada to join the American association instead of forming one in Canada, as surely we could not derive as much benefit from the meetings of a Canadian association as we could from the National Electric Light association conventions.

I do not altogether approve of a purely Canadian association, although there is no question that the electrical interests in Canada are large enough to support one. We certainly could not derive as much benefit from the papers discussed at the meetings, as our friends of the electrical fraternity from the other side of the border are certainly ahead of us in electrical science, and we could learn a great deal more from them by the valuable and practical discussions by prominent electricians and experts, such as there

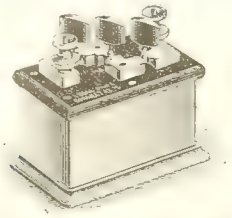


FIG. 1. NEW STANDARD MEASUREMENT APPARATUS.

are in the American association, which certainly we could not expect, for some time to come at least, to have in the Canadian association; and certainly more benefit could be derived by central station men. I also think that after

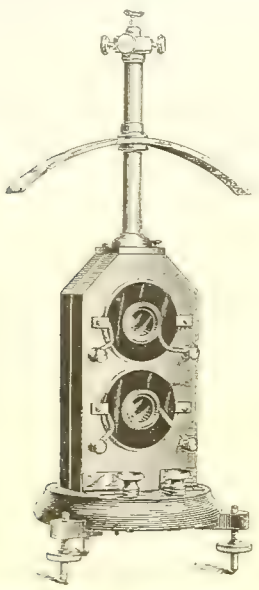
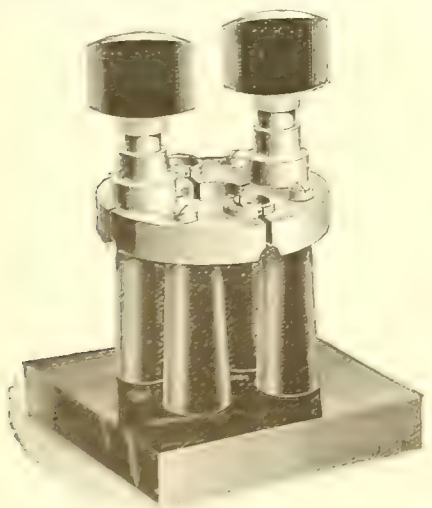


FIG. 4. NEW STANDARD MEASUREMENT APPARATUS.

what was seen at the last meeting in Montreal, that every Canadian interested in electricity should be proud to belong to such an important institution. I hope that the gentlemen who are interested in forming this association will consider well the undertaking before definitely organizing, and will take note that at the last session of the



New Standard Measurement Apparatus.

The E. S. Greeley & Co. of New York has recently placed on the market a number of standard testing instruments designed by Charles P. Frey, electrician for the company. The chief aim has been to render them as light and portable as possible without endangering the essential

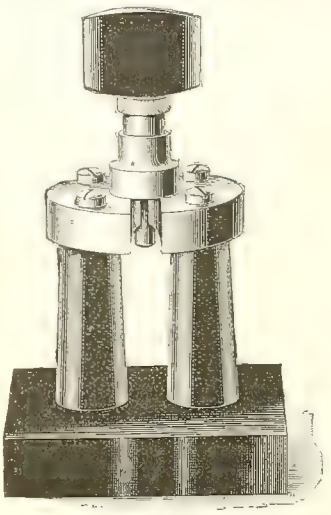


FIG. 6. NEW STANDARD MEASUREMENT APPARATUS.

features. These instruments are shown in the accompanying cuts. In Fig. 1 a one-tenth megohm box, consisting of two separately adjusted coils of 50,000 ohms each, is

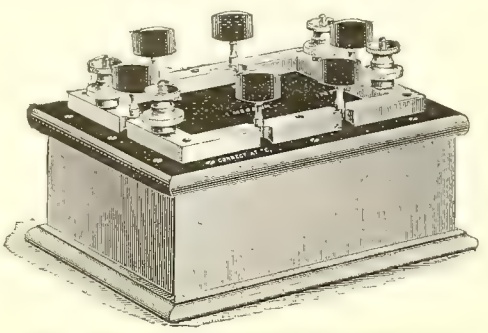


FIG. 2. NEW STANDARD MEASUREMENT APPARATUS.

shown. The arrangement of the brass top connections permits the introduction of an infinity plug without crowding. This box weighs only 2¼ pounds complete. Fig. 2 shows a megohm box which has four readings of respectively, 100,000, 200,000, 300,000 and 400,000 ohms.

Fig. 3 illustrates a one and one-tenth megohm box, having eight readings as follows: Ten thousand, 20,000, 30,000, 40,000, 100,000, 200,000, 300,000 and 400,000 ohms. Taking into consideration the large quantity of wire carried in these boxes they are remarkably light and compact, especially since the wire is (with the exception of the four

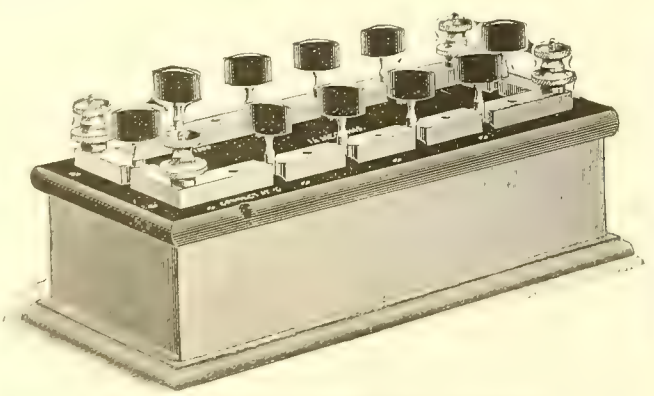


FIG. 3. NEW STANDARD MEASUREMENT APPARATUS.

coils of 10,000, 20,000 30,000 and 40,000 ohms) all wound on spools of 50,000 ohms each, and separately adjusted in order to secure the greatest possible accuracy. These [illegible] are all standard and adjusted at given a temperature.

Fig. 4 shows a four coil Thomson reflecting galvanometer of the Rowland type.

The Greeley company recently conducted a series of experiments in order to determine what materials could be used to the best advantage in constructing commercial condensers for telegraphic and other purposes, with the object in view of eventually adding instruments of this type to the regular line of standard condensers.

Fig. 5 shows a ballistic galvanometer which, although built to a certain extent on conventional lines, embodies several novel features. The casing for the mirror is provided with a hood, which can be turned so that the reflection from the mirror may be observed from either side. The coils, two in number, are usually connected in multiple, but may be used independently by removing both of the coupling strips between the binding post blocks, or they may also be connected in series by removing but

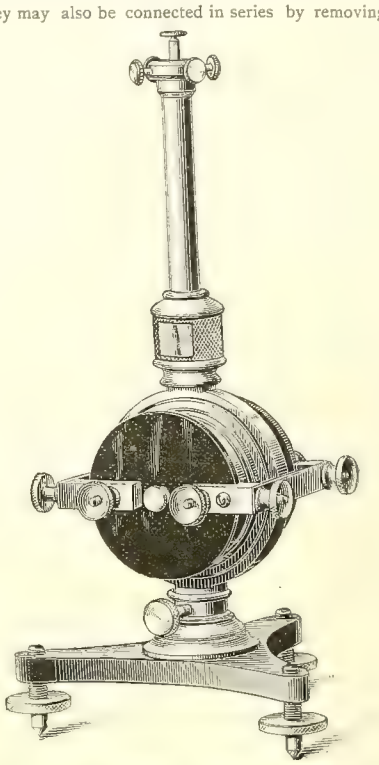


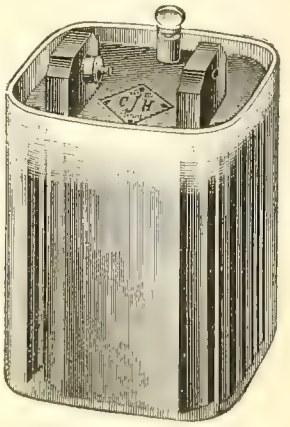
FIG. 5. NEW STANDARD MEASUREMENT APPARATUS.

one coupling strip and giving the front coil a half turn. This galvanometer is equipped with a bell shaped magnet as designed by Siemens & Halske, is highly insulated and is of superior construction and finish.

Figs. 6 and 7 show plug switches mounted on insulated pillars. The plugs are provided with caps which prevent the pillars from spreading when the plugs are inserted, and secure firm contact. These instruments are placed on the market by the E. S. Greeley & Co., New York city.

The Champion Battery.

The Champion battery, which is shown in the accompanying cut, was invented by C. J. Hirlimann, and placed on the market by the E. S. Greeley & Co. of New York. Prof. Morton of the Stevens Institute has subjected this battery to a series of tests, and his report is certainly very favorable to the new battery. He says he finds it equal to

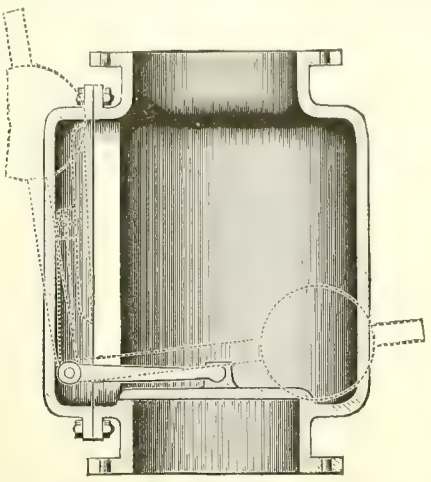


THE CHAMPION BATTERY.

the best, and possessing some distinctions, which in certain cases will give it an advantage. Thus, on open circuit or with a high resistance, it shows a higher electromotive force than others in about the proportion of 15 to 14. On closed circuit, through a low resistance, however, this advantage does not appear on account of the internal resistance, which is relatively high. "It also shows a remarkable promptness in recovering its electromotive force on the opening of the circuit," says the professor. Prof. Morton's report contains a record of the operation and results in a comparative test, which is highly creditable to the Champion battery.

Straightway Back Pressure Valve.

In the accompanying cut is shown a straightway back-pressure valve, designed by J. G. Beckerleg, Chicago, and at present in use in many electric plants in and about Chicago. The Excelsior valve, as it is called, is noiseless,and is free from complicated attachments. It closes after each pulsation of the engine, thus allowing no steam to



STRAIGHTWAY BACK PRESSURE VALVE.

escape above what is actually required to relieve the engine. The valve can be entirely removed from the passage of the exhaust without taking it apart. It has a flat face, which insures the lasting qualities of the device. It can be thrown in and out of use instantly.

Combination Adjusting Screws.

Richard Varley, Jr., of Passaic, N. J., has devised a "new method of assembling bells." The devices used are shown in the accompanying cuts. Fig. 1 shows the device complete attached to an iron box bell. In skeleton bells a lug is cast on the frame in place of the regular binding post now in use. Through this lug is drilled a hole, which admits a rubber stopple, shown in Fig. 2. This affords an insulator for the adjusting screw, and serves as a lock nut by compression of the rubber. The

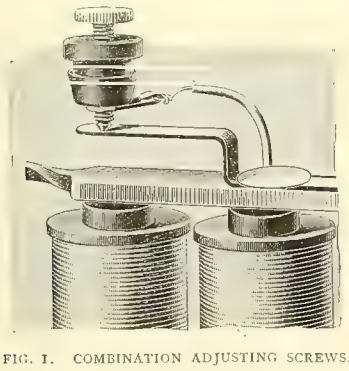
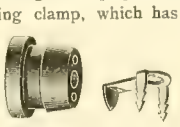


FIG. 1. COMBINATION ADJUSTING SCREWS.

adjusting screw itself and a connecting clamp are shown in Fig. 3. The office of this clamp is to connect the wire from the coils to the adjusting screw, it being held in position by the two prongs that fit into the small holes shown in the rubber stopple. The adjustment of the device is thus briefly explained: The stopple is first placed in position by forcing it through the hole in the side of box and through the upright in the skeleton bell. Next the connecting clamp, which has previously been



FIGS. 2 AND 3. COMBINATION ADJUSTING SCREWS.

connected to the wires leading from the magnets, is placed in position by forcing the prongs into the stopple. This brings the hole through which the adjusting screw passes, diametrically opposite the hole running through the stopple. Lastly the adjusting screw is pushed through the rubber stopple, which forms at once a perfect insulator and a lock nut for keeping it in position. The device is placed on the market by J. Jones & Son, New York city.

It is stated that, owing to the extensive development of the electrical transmission of power, and the consequent rise in the value of water power, that all motive power from water in Switzerland will be made a government monopoly.

New Lamp Holder.

In shops and offices it is often convenient and sometimes necessary to hold the incandescent lamp in some particular position so as to throw the greatest amount of light in a certain direction. This is particularly true in work at the lathe in boring out a cylinder, or at the planer. A small and simple arrangement, which permits of instant adjustment, is shown in the illustrations. It is clipped on the socket with the lamp cord passed under the hooked arm. As the hook is jointed stiffly to the clip it will remain in any position desired. The holder is made by the Electrical Supply company, Chicago.

Samson Braided Arc Light Cord.

The cord used for the suspension of arc lamps seems a small item in the supply account of an electric light company, but it is nevertheless of considerable importance on account of the liability to serious damage if the cord breaks, and of the annoyance caused by replacing worn-out cords. Solid braided cord, though not by any means a new thing for this purpose, has but recently come to be a staple for the electrical trade. It is usually made of cotton or linen, in sizes up to 3-8 inch diameter, braided on machines which, though complicated, have been so perfected that they begin to rival the rapidity of the machines for making ordinary twisted cord. The Samson Cordage Works of Boston recommend for hanging arc lamps the No. 12 3-8 inch diameter cotton cord, waterproof. Wherever the cord is to run over pulleys, whether for indoor or outdoor service, the waterproof finish is said to

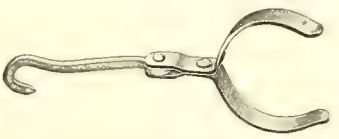


FIG. 1. NEW LAMP HOLDER.

increase considerably the life of the cord. Samson cord is suitable for trolley cord on electric railways. The size most commonly used for this purpose is No 8 1-4 inch. diameter, in cotton or linen. The waterproof finished cord is also used with trolleys. The small lines are used for covering the field magnets of dynamos as an armor.

Electricity at the World's Fair.

The general plans for lighting the big exposition buildings have been made public by Electrical Engineer Sargent of the department of construction. The present estimates provide for 19,700 lamps, aggregating something like 10,000,000 candle power. This is exclusive of the lights for the grounds, and does not include all the in-

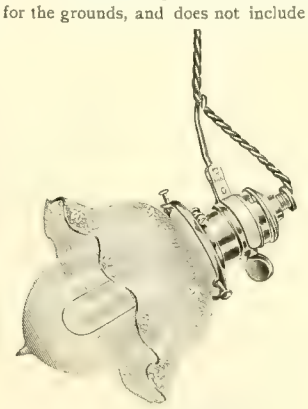


FIG. 2. NEW LAMP HOLDER.

terior lighting. The plan of distribution as now arranged is as follows:

ARC LIGHTS.	
Manufactures building	2,000
Machinery hall	600
Agricultural hall	600
Electricity building	300
Mines	450
Transportation	150
Horticulture	300
Forestry	150
Total	5,450
INCANDESCENT LAMPS.	
Fine arts galleries	12,000
Woman's building	2,250
Total	14,250

When it is remembered that the manufactures and liberal arts building will cover more than thirty acres of ground, the enormous number of arc lamps apportioned to it—more than those used in a great city—will be better understood. The arc lights will be of 2,000 candle power each and the incandescents of 16 candle power. Besides these necessary provisions all exhibitors will be given reasonable additional lighting facilities to display their wares. In

general, [illegible]

The London [illegible] by various [illegible] exercise to the World's [illegible] able picture. Mr. [illegible] at a meeting of the council of the Bristol chamber of commerce that he had replied to Sir H. Trueman Wood, respecting participating in the [illegible] fect that, as the birthplace of Sebastian Cabot, and as the point of departure of some of the earliest New England settlers, Bristol was very largely associated with the new world, and in view of the old association the chamber had already appointed a sub-committee to consider what steps should be taken to bring the aim and scope of the exhibition under the notice of local manufacturers.

The discussion over the adoption of electricity for operating trains between Milwaukee and Chicago during the

SAMSON BRAIDED ARC LIGHT CORD.

World's Columbian Exposition has been received with much interest generally. It is conceded that the operation of high speed electric railway trains at frequent intervals between these cities during the fair would prove advantageous to both, and would be welcomed by many who would prefer to live in Milwaukee during the excitement attending the great exhibition and make daily or weekly trips to Chicago. The Chicago *Graphic* says:

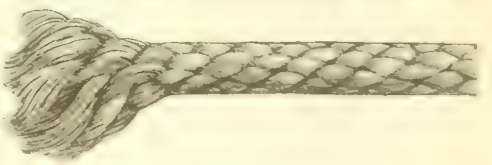
If Mr. Edison's promise be realized that his newly perfected motor for railway cars will make easily a speed of one hundred miles an hour, no one will doubt his prediction that electricity will soon displace steam as a factor of locomotion. The Edison system has received the approval of Henry Villard, and is to be put in operation between Chicago and Milwaukee during the World's Fair. It is thought that starting a train of two cars every twenty minutes from Milwaukee will about meet the local pressure at Milwaukee for rapid transit during the exposition season. In a choice between steam and electric power, with the odds of forty miles an hour in favor of the motor, the queston of personal safety will cut no figure. Next to being shot out of a cannon nothing will so fully comport the Milwaukee idea of rapid transit as to be fired into Chicago at a rate of one hundred miles an hour.

All industrial expositions have been noted for the display of steam machinery. In its ingenious applications as a motive power steam has met almost every practical requirement. At the Centennial in 1876 the great Corliss engine was the wonder of all nations. The genius born of a teakettle was developed in his kingliest stature. Yet there are men living who were born before steam was harnessed to machinery. Now the electrical era marches upon the stage to write its insignia over the gate of the World's Fair at Chicago. So insensibly has the application of electricity to power pushed its way that achievements that were undreamed of during the Paris exposition of 1889 have pushed steam to a secondary place as the exposition motor. In a spot that was unknown when Fulton built his steamboat, on territory that are then under another flag, all the industries which was plied by power will witness the triumph of the mysterious, invisible force which is to displace the conqueror.

C. B. Hopkins of Spokane Falls is in Chicago attending the meeting of the committee on awards of the World's Fair. Mr. Hopkins will look after the electrical interests in the organization of the board of judges to pass on the displays.

Electric Lights for the Eternal City.

A contemporary thus describes an electric plant recently installed near Rome, Italy, which is an indorsement of the Pelton water wheel and the high voltage method of electric transmission so successfully demonstrated at the Frankfort exposition: "One of the finest examples in Europe of water power utilization in connection with alternating currents is the new electric station now being established at Tivoli near Rome. As is well known, there is at this place a large and valuable water power, a



SAMSON BRAIDED ARC [illegible]

portion of which has recently been utilized in the establishment of a large alternating current station of a capacity of 2,000 horse power intended to supply a portion of the city of Rome with electric light.

"Water is taken from the falls of Tivoli by an [illegible] from which a pipe line [illegible] inches in diameter is run to the wheel station. The entire fall is [illegible] feet and the water supply 160 cubic feet per second. The power station consists of three 1,250 horse power Pelton wheels which operate direct current dynamos used as exciters for seven Pelton wheels coupled directly to the same number of 350 horse power alternators, which run at [illegible] revolutions per

minute. Each alternator is designed to furnish 45 amperes at 5,000 volts pressure. The wheels are governed by hydraulic inlet valves, which are worked by a sensitive hydraulic relay set in operation by a centrifugal governor. By this means the speed is automatically kept constant, independent of the working of the machine.

"The alternating current so generated is to be transmitted to Rome, a distance of 15½ miles, by means of four stranded copper cables, each being 100 square millimeters, or .15 square inches, in cross-section, and capable of carrying 120 amperes carried overhead on iron poles placed 114 feet apart, and about 30 feet high, insulated by means of double shed oil insulators, specially designed for this work by Prof. Mengarini. A drop of 1,000 volts, or 20 per cent. is to be allowed in these lines. At the far end of the trunk mains the pressure will be reduced by step-down transformers to 2,000 volts, and distributed underground by Siemens cables to secondary centers, at which it will be again reduced to 100 volts. The six machines are all capable of being worked together in parallel, the maximum number of five being used together, one machine being always in reserve. Two of the exciters are sufficient to supply exciting current to the whole of the dynamos, the third being a reserve "

Electrical Heating.

A new item of interest is being received from the electric railways this season. It pertains to the success met with in the use ef electric heaters. Many of the electric roads in this country and Canada have them upon their cars and express satisfaction with them in enthusiastic terms. The points which call forth the greatest comment are the neatness and economy of space labor and the money which attend their use. Scorching of car ceilings is prevented. No room desired for other purposes is required by the heaters. Fewer men are required to produce the same results as are obtained from stoves; that is, less attention is required to secure the same efficiency. Formerly it required the attention of some one to obtain the proper coal for the stove and of some one to place the proper amount on each car. It required, further, the attention of the conductors to feed the fires and then, questionable results have been obtained. Now the fuel for heating is simply more of the same as that used for the power station engines used at the same place and this fact does away with all the care of separate stoves The only necessary work is the tending to a single switch which at most would require not over three minutes a day, while the results are apparently all that could be desired—comfortably heated cars

CORRESPONDENCE.

New York Notes.

NEW YORK, Nov. 7.—Of course the election was the only thing that New Yorkers could think of during the week. But even the politicians could not get along without electricity. The New York *World* taking its cue, it is to be presumed, from the electrical manœuvres of the White Squadron, gave out that it would employ a system of flashes of the dot and dash order thrown upon the gilded dome to telegraph the news to distant observers. Down town at the Pulitzer building a big canvas was swung over the entrance at the southwest corner of the building. Upon this screen were thrown by means of an electric stereopticon, the figures that found favor alternately with either the followers of Flower or Fassett

The Western Union company, of course, had its hands full handling election news. But matters were so systematized that everything worked, apparently, to perfection.

Another reporter has been after Mr. Edison trying to "pump" him. This time it was about his experiments in the North Carolina gold fields. Mr. Edison said there was no difficulty with the experiments, but the trouble was [illegible]. What [illegible] there was he found had been [illegible] to discover anywhere gold enough to pay. So he returned to New Jersey and is now [illegible]. He considers that there is [illegible] and that the New Jersey mines will in the future produce some of the best iron [illegible]

[illegible] C. H. Lawrence, [illegible] who has been [illegible]

[illegible]

The subject for its after-dinner discussion. It is expected that Abram Hewitt will be among the speakers.

It will be remembered that when Judge Coxe granted a permanent injunction against the Julien company from infringing the patents of the Electric Accumulator company, the defendants asked for a reopening of the case on the ground that a Spanish patent of the Accumulator company had invalidated the patents in this country. The Accumulator people claimed that it was a different patent. On November 4 Judge Coxe decided that the injunction must stand.

The New York papers are comp'aining that there is no way of getting news from Brazil. It is thought that the telegraph offices have been seized by the authorities. Advices by cable to a New York firm of importers indicate that the troubles in the Brazilian republic are of a serious character. It has been stated that the Brazilian parliament had been dissolved, martial law proclaimed and a dictatorship re-established. And also that a censorship of the cable service has been ordered.

There is now being exhibited at the Hotel Warren in Amsterdam, N. Y., an instrument which goes by the scientifically sounding name of the Shaver molecular telephone. Whether this instrument is the invention of a barber is not stated. However this may be, the exploiter evidently knew his business to the extent of "filling" the gentlemen who furnish your correspondent with information relative to the principle on whieh the device operates. One is naturally overcome with admiration of someone's descriptive powers when we read that "it consists of a combination of two principles, one the transmission of sound by electricity, the other by molecular vibrations, both being operated over the same wire and at the same time, the instruments being arranged to operate separately near the terminus of any line." This is, of course, very clear to the reader familiar with "molecular" telephones

The Edison company, New York, has presented to the Johns Hopkins University, Baltimore, two electric motors of 15 horse power each.

In the court of Special Sessions, on November 5th, the Acoustic Telephone company was convicted by the New York Board of Electrical Control for stringing wires along housetops. The Telephone company claimed that its wires were not for the purpose of carrying an electric current, and therefore were not under the board's jurisdiction. The court thought differently, however, and the lineman was fined $5.

John H. Appleby of 55 Bond street, Brooklyn, was found dead on November 7th in the Excelsior Electric Manufacturing company's office, 204 Willoughby street, Brooklyn. He was found on a heap of coal in the boiler room. As there were some arc lights in the boiler room a post mortem examination will be made to determine whether or not electricity was the cause of the death.

To say that the illumination of the Madison Square Garden tower was a beautiful sight would be putting it very mildly. Your correspondent has seen a number of electrical displays, but the one in which the statue of Diana was the central figure surpassed all former attempts. The first glimpse of the display was obtained late one evening as the writer suddenly turned into Madison street a few blocks north of the building. The tower stood out strongly marked against the sky in lines of light, with Diana in bold relief. The yellow tinting of the tower was strengthened by the glow of the myriads of incandescent lamps which covered the structure, and the whole effect was heightened by the periodical burning of different colored fires. It is a difficult matter to describe the peculiar effect obtained. Diana, which presents a striking appearance even in the day time, appeared as though illuminated from within. The surface of the statue appeared as though it was gilded. The distinctness with which the lines of the statue stood out against the sky was the most remarkable feature of the display. F. L. P.

Minneapolis, Minn.

MINNEAPOLIS, Nov. 7.—The Minneapolis Street Railway company has determined upon an important addition to its electrical facilities. About three years ago, when the company undertook the construction of a couple of cable lines, a large power house was erected at Thirty-first street and Nicollet avenue. The subsequent abandonment of the cable project and the substitution of electricity left the power plant on the company's hands. It has now determined to remodel the structure into an electrical [illegible] a reserve. The building will be fitted [illegible] power dynamos, giving a considerable [illegible] power. The changes will cost prob[illegible]. It is reported in this connection that this action means the early operation of a direct line from St. [illegible] street bridge to [illegible] may come of it eventually its present use will be for local lines and suburban extensions that are contemplated by the company. Five Westinghouse upright engines of 250 horse power each have been received for the new plant. Four new electric lines will be opened for travel within a few days in Minneapolis. They are the Plymouth avenue north, the Monroe street northeast, the Cedar avenue and the Bryant avenue lines. Of these the Plymouth and Monroe are practically complete and ready for the cars. The Cedar avenue line will be finished in a few days, only some street grading and "switch work" remaining to be done. A spur track is being built from Cedar avenue to the Bloomington car house where the Cedar avenue cars will "tie up." As soon as this is finished the line will be opened, probably at the same time as the other two. Large Jones and Northern motor cars are to be put on the new lines, and the very best service is guaranteed. The last line to be built this year is the Bryant avenue, line from Thirty-first to Fortieth, on Bryant, as an extension of the present Lyndale line Work was commenced yesterday, and the new division will be rushed through in a few days. It is still undecided where the down town terminus of the new Plymouth, Cedar and Monroe lines will be, but they will either round the loop, turn at Washington or be run in conjunction with some of the other lines. When these lines are started all the plans of the company made a year ago will be realities.

It is surprising what a vast amount of work the Minneapolis Street Railway company has done this year. Besides building the Hennepin, Bloomington, University, Sixth avenue north, Central avenue and Western lines, the big East side car house has been erected, about 200 new motors have been introduced, and 80 dingy old horse cars have been rebuilt and converted into handsome trailers.

The last work is just finished, and has been taking up all the time of the shop force since the latter part of April. A third big engine has been put in the power house, affording the heaviest power of any electric street railway in the West. The big pavilion at Harriet was also built, and many improvements made along all the old lines. It has been determined to connect the new Monroe street line with the present Lyndale line as soon as the former is ready for operation. The cars will run from the northeast terminus on Monroe street, out Lyndale avenue to Thirty-first, to Bryant, and out the new Bryant line to Fortieth street. As the district beyond Thirty-first street is but sparsely populated some of the cars may turn at Thirty-first street at present. Twelve large motors will be needed for this line. As soon as the Bryant avenue line is completed, the Nicollet line is to be extended from its present terminus at Thirty-second street to Thirty-eighth street, where all cars will turn. In a short time stoves are to be placed in all the motor and trailers. When all these little things are done, Manager Goodrich believes the public will cease to kick for awhile. The company has been seriously hampered in its work recently by the scarcity of laborers, who have been attracted by the better wages of the harvest fields to North and South Dakota. Almost every available man in the Twin Cities has been employed by the street railway companies.

The street railway company undoubtedly considers itself lucky when a single day passes in which some damage suit is not filed against it. Helen L. Briggs is the latest complainant, and her complaint is a trifle out of the ordinary run She brings suit as the widow of Arthur S. Briggs, as and administratrix of his estate, and the claim is for $5,000. On September 5th, she says, he presented a proper transfer check to the condutor of a Washington avenue north car. The conductor refused to accept it, and proceeded to summarily bounce Briggs from the car. He did this most effectually, according to the complaint, dragged him the full length of the car, down the steps and across the street to the curbstone, where he finally landed him in a heap. In the fracas, Mrs. Briggs says, her husband received injuries which caused his death.

In another suit, just tried, the jury awarded William Solomon $600 for damages against the street railway company The amount asked was $5,000. This case hinged upon the question of the company's responsibility for the acts of others on its cars, and has especial interest to street railway corporations in consequence. The plaintiff alleged that while riding on a car on May 10th last two men came on board who were decidedly the worse for liquor. A rumpus arose between the three, in which Solomon got a severs blow in the eye, bunging it up so that he could not appear in public for some time.

W. E. J. Deming, inspector of electric lights for Minneapolis, has made a report of his work, which demonstrates pretty clearly the rapidity with which local electric interests have been growing. The city is now adding to its incandescent electric light equipment at the astonishing rate of 1,200 lamps a month, and during the past five months

the average monthly gain in arc lights has been 25. In the residence sections of the city incandescent lamps are being placed at the rate of about 100 per month, and few dwellings of importance are being erected without electric wiring. The motor service for light manufactures is also growing very rapidly, the average rate of increase per month being 100 horse power. These figures, of course, include nothing which is being done by the street railway, company. Inspector Deming says that there is a steady demand for more light in the stores, and in the show windows electricity has superseded gas almost universally.

Inspector Deming went to Chippewa Falls Monday to testify as an expert witness in a damage suit now on trial at that place. The suit is against an Eau Claire electric company, and is based on the claim that an electric wire was the cause of an extensive conflagration in that city several months ago. Experts have been summoned from several cities, and the case will be of great interest in electrical circles.

Trouble has arisen about the conduit limits in this city and the electrical companies which have been this summer engaged in laying their wires underdround are urging greater limitation of the district. The principal trouble is on the East side, where compliance with the law will almost bankrupt the companies whose wires must be lowered. Several companies have notified the building inspector that rather than go underground in all the conduit territory on that side of the river they will go out of business. The Minnesota Brush Electric company and the Western Union are making rapid progress. The Western Union is now just finishing its circuit work. The Brush company will not succeed in getting its poles and wires down before winter sets in on account of the enormous amount of conduit work it is doing.

Charles Peterson was fatally hurt by an electric car on Washington avenue Saturday. He was driving under the Milwaukee viaduct when struck.

F. W. Carr, of the firm of Carr & Smith, electrical engineers, will spend the winter in the South, with headquarters at Chattanooga. Mr. Carr has had charge of the construction for the Minneapolis Street Railway company. He expects to return in the spring, and resume his former position.

Mr. Donaldson, of the the D. & D. Electric Manufacturing company, has completed his arrangements and has moved his factory from St. Paul to 745 and 747 Washington avenue, north, Minneapolis, and is now ready to begin the manufacture of electrical apparatus on a large scale. Mr. Donaldson has perfected a motor that has very few parts, and, it is claimed has a high efficiency. This company will also make generators of a new design for power and lighting purposes.

Late in the season the S. R. Clark company put on the market a new octagonal pole for street railway use, the Coolidge Fuel company undertaking its sale. Before the machinery for the making of the pole had been perfected, nearly all the season's contracts had been closed, but several good orders were received and the demand for next season is most promising. Street railway lines in St. Cloud and Winona have adopted this pole.

Work on the great Minneapolis and St. Paul electric street railway system has been nearly suspended for the season, only a little clearing up being necessary to put the line in shape for winter. The consolidation of the two companies has been fully perfected, and the offices have been moved from St Paul to the central station in this city. F.

San Francisco, Cal.

SAN FRANCISCO, Nov 2 —The Pacific coast is certainly furnishing some valuable experience for those who believe in the fitness of municipal electric lighting plants. First came the city of Vancouver, Wash., which abandoned the experiment at the end of the first year. Then the city of Alameda, Cal, found that the electric lights furnished from the city plant cost considerably more than would be paid for contract lighting, and in the hope of bringing down the cost of operation to a figure at least equal to that of a stock electric lighting company, the city has put more money into the concern. Now Berkeley, another San Francisco suburb, bobs up serenely and announces that it has employed A. A. Osborne to run the city electric lighting plant at a salary of $150 per month, Osborne to furnish all coal, water, oil, waste, attendance, etc., free from expense to the city other than the salary named, but he also has the privilege of selling lights from the station and pocketing the proceeds. The city now gets the same number of arc lights as formerly. Osborne has installed two more dynamos, and is waxing financially corpulent.

Judge Hebbard of the Superior court, has rendered a decision in the action brought by George L. Henzel against the chief engineer of the San Francisco Fire Department to enjoin the department from removing housetop wires erected by Henzel in violation of a local ordinance prohibiting the suspension of electric wires over or upon roofs or tops of buildings, or attached to or on buildings, and empowering the fire department to remove all wires maintained contrary to the provisions of the ordinance. Henzel contended that the ordinance was illegal and invalid in that it constituted an unreasonable exercise of the police power vested in the board of supervisors, but the court held that this point was not well taken; the injunction was denied and judgment was given for the defendant with costs.

Certain San Francisco capitalists are to invest $460,000 in improvements in Stockton, Cal. They have purchased the Stockton street railway, consisting of ten miles of double track horse car lines, and will equip it for an electric road. About $25,000 will be spent in improving Goodwater Grove, which will be illuminated and arranged specially for evening recreation. The generating station will therefore include electric railway and electric lighting machinery. The fuel is to be natural gas, which abounds at Stockton. A new gas well, costing $15,000, is to be sunk for the plant.

The Edison Illuminating company of Spokane Falls, proposes to furnish 2,000 candle power arc lights to the city of Spokane Falls for $10 for a yearly contract; $9.50 on an eighteen months' contract, or $9 on a three years' contract, the figures given being the cost per lamp per month for all night lights. Inasmuch as there are no competitive bidders, one of the proposals named will certainly be accepted.

Some interested persons in Seattle recently drew up an ordinance defining proper methods of electrical construction, and introduced it before the Seattle council. It passed the board of delegates without serious trouble, but it found its Waterloo in the board of aldermen, when a member arose and read a clause in the city charter to the effect that all electric lighting or power work should be done under the immediate supervision of the city plumbing inspector.

The San Antonio Electric Light & Power company of Los Angeles, is hard at work installing what is to be an interesting plant. The generating station is being constructed in San Antonio canon, near Pomona, where about 800 horse power will be realized from a mountain streams. In order to get the greatest possible fall it has been necessary to run a 1,200 foot tunnel, whence the water will be carried through pipes down the canon for 360 feet to the station. Pelton water wheels are to be used, and the cities of Pomona, San Bernardino, Ontario and Chino are to be supplied with incandescent lights and electric power by means of continuous current circuits, using storage batteries as adjuncts. From the generating station to Pomona the distance is twelve miles, while the distance to San Bernardino is twenty-six miles. The several novel features of the plant will awaken more than passing interest, and its early completion will be eagerly looked for.

The Consolidated Piedmont Cable Railway company wants to improve its horse car service from Oakland, out a practically level road to Mountain View cemetery, but does not seem to know whether to run electric cars out there or to build a cable line. In either event the motive power would be taken from the present cable power house. It is said, however, that a change will be made within six months, provided the county supervisors act favorably on the company's petition for an amended franchise permitting the use of either electric or cable power over the route of the present horse car line.

E. C. Sessions, of the Sessions electric road in Oakland, has stated that the road will be equipped with electric cars operating upon the Patton system, in which each car contains a gasoline engine, a dynamo, a storage battery and two motors, the gasoline engine running continuously and the battery taking whatever surplus energy there may be, returning it when the load is in excess of the capacity of the engine. A local newspaper in announcing this stated that storage batteries were to be used, and then concluded with the mystifying statement: "No central station, power-house or steam engine will be needed, nor even a place to take the batteries to be charged. Only a shelter for the cars is required." Theodore Meetz, owner of the Meetz horse car line between Oakland and Alameda, and who has announced his intention of connecting his line with an electric road, has concluded to defer the selection of a system until he has profited by the experience to be gained by the Sessions road with the Patton system.

Last week an electric car on the Fulton Park branch of the Metropolitan Railway company, of Portland, was rounding a trestle located at a curve in the track, when it jumped the track and fell to the ground, thirty feet below.

[illegible] road along [illegible] mated the [illegible] menced.

The Oakland and Berkeley Rapid Transit Railway company has [illegible] the Oakland Consolidated Street Railway company. On the first of [illegible] existence. No material change in the management will be made.

A franchise has been granted for the operation of an electric road through the town of Los Gatos, Cal., by which the fare from Los Gatos to Oakland will be 55 cents instead of $1.60 as it is at present. This is part of the Hayward [illegible] pleted, will be sixty miles long.

The Edson Light and Power company has filed a certificate of the creation of a bonded indebtedness of $800,000. The Edison electric light plant at Fresno, Cal., is to have a 200 horse power compound engine, which is being built by the Golden State and Miners' Iron Works. The new city hall, San Francisco, is to have a large electric light plant. Redwood City, Cal., is placing a new boiler and engine in its electric light plant. V. Wattier proposes to erect a complete system of electric lights in Gervais, Oregon, in conjunction with a flour mill. The citizens of Gervais have raised a bonus of over $2,500 toward the project.

Superintendent West of the Pacific Avenue Street Railroad company, of Santa Cruz has been instructed to lay steel flat rails or combination rails from the Lower Plaza to Elm street, and to take up the present track on Pacific avenue. The new track will be arranged so as to be used for an electric road.

Modesto, Cal., will have its streets lighted by the Modesto Electric Light company, at the rate of $5.50 per light per month, moonlight schedule. The bid of the Modesto Gas company was for $4 per light.

The Edison Electric Illuminating company, of Spokane, Wash., by its annual report, shows a high state of prosperity. It is the only light and power company in that city, being without a rival by reason of the immense water power at its command, which enables it to give low rates to consumers. The company took possession of its new water power station last December, and a portion of the plant has been run continuously ever since then, both night and day. This station is equipped for 3,000 horse power and now uses 1,900. Within the past two months two Edison 80 kilowatt generators have been installed to run the electric roads of the city, and the addition of a third is contemplated. These generators are run by two 17½-inch horizontal Victor turbine wheels, developing 400 horse power. The number of lamps in operation at present date is 8,300, all on the Edison three-wire system. The company is using 1,560 poles, and the total length of the Edison mains and feeders is 90,280 feet, an increase of 48,080 feet over last year. There are eighteen arc circuits extending 61.31 miles, an increase of 17.64 over last year. One arc circuit is 14.9 miles in length, and a total of 400 arc lights are in use. The increase in the incandescent load for June, 1891, over that for June, 1890, is 70 per cent., while the motor load, in the same period, has risen from 86 horse power to 236 horse power, or an increase of nearly 400 per cent.

Last week F. J. Crouch, superintendent of the Eugene, Ore., Electric Light company, and who is really a bright fellow, talked to a reporter of the Portland *Oregonian*, and this appeared:

Mr. Crouch smiled, and released a 16 candle power incandescent from its attachment. Then he put the wires into his mouth again, crossed them, and connected them with the incandescent lamp, and a bright light shone from the globe. Then the inventor placed his hand on one of the brushes, and a spectator took hold of the other, and the two joined hands. Mr. Crouch broke the current repeatedly, but neither he nor his friend was in the least affected. Mr. Crouch explained that his machine required an absolutely metallic circuit or it would not work. Other machines ground and became useless with this kind of a circuit. The inventor then wrapped each of the wires around a piece of carbon, and pressing his hands around the naked wires, brought the points of the carbon into contact. The result was a 2000-candle power arc light, which shone with dazzling brilliancy. Previously Mr. Crouch rubbed one of the wires on a carbon which was connected with the other wire, and the first wire melted.

A feature of Mr. Crouch's exhibit is a [illegible] candle power light, burning in a jar of water, the naked wire being exposed to the water. Right above the jar is a [illegible] electric bell on the same circuit. A telegraph instrument has been worked a distance of three or four miles on the same line as an electric light without damage to either branch of the service. Again, the incoming and outgoing

wires of the dynamo have been run without insulation through mud, and have then started lights without any [illegible]. Mr. Crouch says his dynamo has the [illegible] that invented by Edison has 110 [illegible] 16 candle power incandescents, with 4½ horse power, including friction. In inventing it, Mr. Crouch says he cast aside all the theories of construction of electrical machines, and started on a new track.

For some time Mr. Crouch has been experimenting on an idea for a unipolar dynamo, and from the exuberance manifested, it must be that success has rewarded his efforts, even to the extent of causiug him to forget that the commercial uses of ten volt dynamos are not altogether unrestricted. At all events the Crouch-Houston Electric and Manufacturing company has been incorporated under the laws of the State of Oregon. The capital stock of the new company is $1,000,000, and the object of the corporation is "to manufacture and sell the Crouch safety dynamo, which promises to revolutionize electric lighting. By its use live wires are rendered harmless."

The Edison General Electric company, Pacific Coast District, reports sales as follows: Chino Valley Beet Sugar company, Chino, Cal., 10 arcs and 250 incandescents; Whittier Reform School, Whittier, Cal., two 25 kilowatt incandescent and one 5 kilowatt arc machines and plants complete; Croker building, San Francisco, 1,700 incandescents; Leland Stanford, Jr., University, Palo Alto, Cal., two 25 kilowatt dynamos and 840 incandescents; Fisher Opera House, San Diego, Cal., 125 kilowatt dynamos and 688 incandescents; Edison Electric Light & Power company, Fresno, Cal., three-wire central station with two 60 Kilowatt incandescent dynamos and one 25 kilowatt, 50 light arc dynamo; Messrs. Chase & Kittle, Sanger, Cal, three-wire station with two 15 kilowatt incandescent dynamos and one 15 kilowatt arc dynamo, thirty lights; Steamer Mary Garratt, Stockton, Cal., one 8.5 kilowatt incandescent dynamo, 128 lights; Woodland Gas, Electric Light & Power company, Woodland, Cal., three-wire station with two 20 kilowatt incandescent dynamos; Hotel del Monte, Monterey, Cal., two 20 kilowatt dynamos and 628 incandescents.

S.

Milwaukee, Wis.

MILWAUKEE, Nov. 7.—Henry Villard now controls every foot of street car track in Milwaukee. The West Side railway, one of the best paying systems in the city, has just been added to the Villard possessions. The sale was made through the agency of the Central Trust company of New York. The consideration was $875,000. Washington Becker, the former owner of the road, received one-third of the price in cash, another third is to be paid in six months, and the balance in a year. The titles will be held in trust by the Central Trust company until the last payment is made. The negotiations which resulted in the sale had been pending for six months or more. Two or three times they had been broken off. The Becker line, by the way, was covered with bonds to the amount of $500,000, and it is understood that Villard has assumed the incumbrances. The Becker system comprised twenty-one miles of track. It is an electric road, equipped with the Sprague system. The deal includes the power house on Wells street and about fifty motor cars. The principal difference between the Becker road and the other Villard electric lines is that the former has the side poles and the latter the center poles. On the Becker line as many as [illegible] passengers are often carried in a day. So far as the Villard system is concerned, the Becker line was an important missing link, and its acquisition makes a complete and exclusive street railway system under one management, and covering all parts of the city. The Hinsey line is already controlled by the Villard interests, [illegible] as soon as the litigation between Hinsey and Pfister, and Hinckley of Chicago, [illegible] comprises 120 [illegible] aggregate 150 miles when the contemplated extensions are completed. More than 900 men are permanently employed by the company. It [illegible] at the head of the [illegible] for the different lines from one power house—the Edison [illegible] at a [illegible] too. Sixty-pound girder rails are fastened directly to [illegible] East Water and North Water streets to Pleasant street bridge, thence across to Third street, thence to West Water street and across Michigan street bridge to East Water street again. It will cross every one of the trunk lines, and will give perfect facilities for transferring passengers. Mr. Payne states that his company intends ultimately to charge just one fare for a ride from any part of the city to any other part of the city. Should such a policy be carried out, it would probably put an end to the talk of the city exacting pay for new franchises or a percentage of the gross earnings.

On Wednesday of last week Chief Engineer Meyer, of the Villard lines, found himself with a huge strike on his hands. Between 600 and 700 laborers, all employed on the Villard lines, quit work because of an order reducing the hours of work from ten to nine and the wages from $1.50 to $1.25. The men themselves acknowledged that it was necessary to reduce the hours of work, as they could not see to labor ten hours, but they declared that a cut of 25 cents was altogether too much under the circumstances. They stated that they would have worked nine hours for $1.35. The trouble was unfortunate, inasmuch as the company was trying very hard to get a large amount of work completed before the cold weather sets in and expected to get through with the work in two weeks.

Objections are being made to the Villard people erecting center poles on the leading business thoroughfares, such as East Water street, West Water street, etc. Side poles, it is claimed, would be better in such places. In the common council a resolution has been introduced requesting the chief of the fire department to report the parts of East Water street where side poles would be preferable. The ordinance originally provided for side poles throughout, but was amended so as to provide for center poles.

The rails which the Villard people are laying on the down-town streets are very heavy. They are 85-pound rails, heavier than the rails usually laid on steam railroads, and are seven inches high. The rails used on the other lines are only five inches high. It was thought that the latter rail would not last long enough on the down-town business streets. The work of laying cables under the river is progressing rapidly. The ends of the cables are received and joined to the underground feed wire in little rooms built on both sides of the river. The rooms are built of brick and can accommodate several men.

Henry C. Payne of the Villard concern attended the American Street Railway Association at Pittsburg. Mr. Payne announces that next May he will retire from the chairmanship of the Republican state committee in order to devote himself exclusively to the Villard street railway interests.

The common council has practically decided to grant the Milwaukee Street Railway company a franchise over Michigan street bridge, and Mr. Payne announces that within a month the Farwell avenue electric cars will be running along that route to the Union Depot. The Huron-Clybourn street line will be abandoned.

The National avenue electric line began running a few days ago, and is giving excellent satisfaction. Manager Hommell claims that it is even superior to the Farwell avenue line.

Prof. Warren S. Johnson has just made public the modus operandi of his new rapid transit system. He was unwilling to divulge the secret until patents were issued in both the United States and European countries. He received word last Thursday that the patents had been granted. The impulsive railway, as Prof. Johnson calls his invention, is operated by passing a car or carriage through a series of explosion chambers, in each of which an explosion of gas adds to the momentum of the vehicle as it passes along. It is intended to elevate the track a few feet from the ground. The track will rest on iron supports shaped like the letter A, only that the top is flat, in order to afford a box for the castings to which the rails are fastened. A gas pipe is designed to run along the track and to be connected with the various explosion chambers. Each line will possess double tracks, so that cars may be run in opposite directions. Each track will consist of two rails, one above and the other below the car, which is to run on grooved wheels, so that it cannot be derailed. The cars will be small, as the system is intended only for mail and light express matter. Normally the explosion chambers are open to the air, but when a car enters one a door closes behind it automatically, and the chamber becomes a cannon. In its passage the car automatically admits a quantity of gas from the pipe connected with the chamber and makes and breaks an electric circuit, causing a spark which explodes the gas. The car then bowls along to the next chamber and there the operation is repeated. It is not yet known how far apart the explosion chambers will be placed. That is a matter that will have to be determined by experiment, as it is impossible to obtain a maximum speed on any model track set up in a building. The model lines that have been built, however, work very well indeed. Prof. Johnson has constructed the model of another form of his invention, in which a hollow steel ball, four inches in diameter, is substituted for the car. This ball is intended for the transmission of dispatches, and each ball will hold 100 ordinary messages. The ball automatically operates the explosive apparatus, just as the car does, and either can be sent at a speed of 150 miles an hour. It is intended to run the cars separately, not in trains. The Rapid Post & Transit company, which has been organized to build and operate each line, has a capital stock of $1,000,000, all subscribed, and prominent men of Milwaukee, Chicago and elsewhere are among the stockholders. The company intends to manufacture the material for equipping such lines in Milwaukee, and considerable work has already been turned out at the Johnson Electric Service company's shops.

The project of building an elevated electric railway between Chicago and Milwaukee is in *statu quo*. The projectors are waiting for subscriptions to the capital stock, which is $10,000,000. One subscription of $500,000 has been offered, it is said, but the company announces its intention of doing no work until all or nearly all of the $10,000,000 is received.

A compromise ordinance to permit the Western Union Telegraph company to string aerial cables in alleys has been drawn up and submitted to the common council. The company's wires are all strung on poles in the usual way, and strong attempts have been made to have the wires put underground. The aerial cable scheme, it is thought, will prove satisfactory, both to the company and the public. From the main office on Michigan street it is proposed to run a cable south to Detroit street, through the alley, thence to and under the river, and thence to the railroad. Another cable is to be run north from the office to Martin street, where the wires will be separated and strung on poles. It is proposed to place the cables on poles 50 feet high. Isolated wires will run from the cable to the branch stations, newspaper offices, etc. The system, it is claimed, will free the business portion of the city from the network of wires. The fire and police alarm telegraph wires are already underground, and the work of laying the conduits for the telephone wires, many of which are buried now, is nearly completed. Soon only the electric railway wires will remain overhead in the business section.

C.

Indianapolis, Ind.

INDIANAPOLIS, Nov. 7.—The Supreme Court has decided a case of interest and importance to cities. Following is an extract of the decision in the case of the city of Crawfordsville and others against Hector S. Braden: "A municipal corporation in this state has the power to erect, maintain and operate the necessary buildings, machinery and appliances to light the streets, alleys and other public places with electric light, and it may at the same time in connection therewith supply residences and places of business of inhabitants with such lights. And this may be done under the police power without express statutory authority. Where a city council has power to act in a given case and the charter does not prescribe the manner of acting it may accomplish its purpose by resolution as well as by ordinance."

Brightwood, a suburb of Indianapolis, is making an effort to secure electric lights. At present it has no street lights. A proposition has been made the city by the Indianapolis Terra Cotta company, whose establishment is located near Brightwood. A committee has been appointed to investigate. Irvington also has a committee looking into the question of street lighting.

Since the Citizens Street Railway company began operations on East Washington street and College avenue there has been constant complaint from telephone subscribers of interference, at times rendering their instruments almost useless. The telephone company is now stringing heavy copper return wires.

M.

PERSONAL.

Thos. Lowry of Minneapolis was in Chicago for several days during the last week.

H. S. Walker has just returned to Chicago from a short business trip to Boston and New York.

Wm. W. Burnham, treasurer of the Electric Gas Lighting company of Boston, was in Chicago last week.

Edward A. Chapin has retired from the *Street Railway Journal* to engage in business in Rochester, N. Y.

Charles Fay will represent the Thomson-Van Depoele Mining company at the exposition soon to be held at Augusta, Ga.

C. A. Daigh, general manager of the Electrical Engineering & Supply company, has been at his Chicago office

for some days, leaving on Thursday evening for Stansbeery, Mo.

J. H. Pumpelly has been confined to his house during the last thirty days by an attack of typhoid fever. He has so far recovered that he is able to devote a portion of his time to business.

Geo. H. Bliss left Chicago a few days since to be absent two weeks His first stopping place will be at some point in North Carolina, going thence to New York and other leading Eastern cities.

E. W. Hammer has been appointed manager of the Chicago Electric Manufacturing company, vice J. S. Harding resigned. Mr. Hammer will continue his expert work in the testing and calibrating department.

A. M. Wilcox of Chicago has accepted the position of associate editor of the *Railway and Tramway World*, London, Eng., and will assume his new position about January 18th, when the new periodical will appear.

Alexander M. Robertson, general manager of the Minnesota Brush Electric company of Minneapolis, was married on the evening of November 4th, at the home of A. F. McDonald, 901 Thirteenth avenue, south, to Amy E. McDonald. The ceremony was performed by the Rev. J. J. Faude. The bride wore a peach cloth suit, with trimmings of passementerie, and carried white roses. Miss Nellie Birns was bridesmaid, and Will Robertson, brother of the groom, was best man. The young couple will be at home after December 1st at 1816 Ninth avenue, south, Minneapolis.

NEW INCORPORATIONS.

Walton Electric Light company, Walton, N. Y.; capital stock, $20,000; manufacturing and using electricity for light, heat and power.

Gardner Electric Light company, Gardner, Mass.; capital stock, $30,000; to generate and distribute electricity for supplying light, heat and power.

Taylor Electric Light, Gas & Power company, Taylor, Tex.; capital stock, $40,000; to manufacture and supply gas, light and heat to the city of Taylor.

Marion Manufacturing company, Chicago, Ill.; capital stock, $20,000; manufacturing electrical and mechanical devices; F. H. Fenno, 704 Chamber of Commerce, Chicago, Ill.

Western Telegraph and Electric company, Ouray, Colo.; capital stock, $100,000; to build a telegraph line from Ouray to Red Mountain in Ouray county, Colo.

John A Crisp Electric Belt company, Jefferson, O.; capital stock, $25,000; to manufacture and sell the John A. Crisp body battery and appliances; Wade & Betts, Jefferson, O.

United States Burglar Alarm company, Galesburg, Ill.; capital stock, $50,000; to manufacture, sell and erect burglar alarms and electrical specialties; O. J. Colton, Galesburg, Ill.

Woolverton Glove arc Electric Light company of New York, N. Y., Newark, N. J.; capital stock, $250,000; to manufacture and operate electric lights; J. E. Woolverton, New York, N. Y.

Marshall Electric Light company, Marshalltown, Ia.; capital stock, $60,000; to build, equip and maintain an electric light plant in Marshalltown, Ia; J. M. Parker, Marshalltown, Ia.

Suburban Light, Heat & Power company, Chicago, Ill.; capital stock, $50,000; to furnish light, heat and power for all purposes; E. T. Greenacre, room 11, No. 64 Washington street, Chicago, Ill.

Decker Electrical & Novelty Manufacturing company, Detroit, Mich.; capital stock. $20,000; the manufacture and sale of electrical and all other kinds of machinery; Chas. A. Decker, Detroit, Mich.

Crown Electric Manufacturing company, Bridgeport, Conn.; capital stock, $10,000; to manufacture and sell all kinds of electric goods, apparatus and supplies, etc.; Geo. Watson, Bridgeport, Conn.

Clayton & Forest Park Railway company, St. Louis, Mo.; capital stock, $50,300; to build and operate by electricity or cable a passenger railway for public use; Thos. K. Skinker, 417 Olive street, St. Louis, Mo.

Adjustable Telephone Manufacturing company, Cincinnati, O.; capital stock, $20,000; manufacturing, selling and setting up telephonic instruments, electrical instruments, etc.; John. A. Caldwell, Cincinnati, O.

Proctor Electric Fleet company, Chicago, Ill,; capital stock, $30,000; manufacturing, fitting out and running a fleet of electric barges for the purpose of carrying passengers; D. R. Proctor, 144 La Salle street, Chicago, Ill.

Edison Electric Light & Power company Newark, N. J.; capital stock, $1,000,000; to construct, own, maintain and operate power stations and works for the manufacture, production, distribution, etc., of electric currents; Henry Young, Newark, N. J.

Northern Car company, Minneapolis Minn.; capital stock, $250,000; to manufacture street and railway cars, omnibuses, carriages and vehicles of all kinds; locomotives, kinds used for street and railway purposes; Hahn & Hawley, Minneapolis, Minn., Minnesota Loan & Trust company's building.

Ohio Fuel Gas company, Chicago, Ill.; capital stock, $5,000,000; to manufacture and sell gas for illuminating, fuel and other purposes; steam for heat and power; compressed air for cold storage and ventilation; electricity for light, power, and other purposes; T. G Hall, 102 Auditorium building, Chicago, Ill.

ELECTRIC LIGHT.

The Bartow Tube Well Works will erect an electric light plant at Bartow, Fla.

The Ashland, Ky., Electric Light & Power company will add a 750-light Westinghouse machine to its plant.

R. V. Booth, mayor of Vicksburg, Miss, will receive sealed proposals until December 7th for lighting the city by electricity or gas.

An electric light company has just been organized in San Salvador upon a novel plan. The capital is 200,000 pesos, and can be increased. The charter is for 24 years. One per cent. of the earnings must be kept as a reserve. At the end of the 24 years the property is to be sold and all assets divided among the stockholders.

The town of Oaksdale, Wash., has purchased of the Edison General Electric company an electric light plant consisting of two No. 12 Edison dynamos, which will supply current to 1,200 incandescent lamps, and six street arc lights. Russell & Co.'s engine is to be used, and McCoy Bros. are installing the plant.

An example of the unsatisfactory state of the Scottish law in relation to electric lighting is afforded by the case of the town of Ayr. The magistrates applied for a provisional order and obtained it, but the cost of doing so has been about $1 600, a sum quite out of proportion to the total amount which the town is likely to expend upon the actual carrying out of the work for many years to come.

The Boston & Montana company of Butte, Mont., is putting in an electric light plant. The dynamo will be placed in one of the side buildings of the Leonard shaft house, and will have a capacity of 500 lights, which will be distributed through all the mines except the Mountain View. The various shaft houses, smelters and ore bins will also receive their share. The Mountain View is omitted because both the mine and hoisting works of this property are already lighted by electricity.

ELECTRIC RAILWAYS.

W. A. Bright proposes building an electric railroad at Monroe, La.

An electric road will be built from Ocala to Silver Springs, Fla.

Animal power will be used at first on the new railway at North Danville, Va., but electricity will be adopted later on.

The Elyton Land company of Birmingham, Ala., will probably adopt the storage battery system for its South Highlands street railway.

The Bridgeport, Ohio, Electric company is making arrangements to extend its line through Etnaville to Martin's Ferry, where tracks have already been laid.

Three distinct routes for the proposed electric railway from Rochester to Fairport, N. Y., have been surveyed. They are respectively seven, eight and nine miles long.

The Alamo Electric company of San Antonio, Tex., has been placed in the hands of a receiver. The company operates about twenty miles of street railroads in that city.

The Brush Electric Light & Power company of Savannah, Ga., is said to be negotiating for the purchase of the City and Suburban railway, Coast Line railroad and the Thunderbolt & Sandfly railway. The result of the sale would probably be the operation of these lines by electricity.

The Northwest Thomson-Houston Electric company has just closed a contract with the Whatcom Lake, Wis., Electric Railway company to build and equip a line of road ten miles in length. The line will run through the principal streets of New Whatcom and out as far as Lake Whatcom, where the companies will build a popular resort after the style of those in Seattle on Lake Washington.

TRADE NEWS.

The Safety Insulated Wire & Cable company of New York, has been running its factory up to 10 o'clock at night to keep up with the orders on hand.

Pierce Bros. & Co., manufacturers and dealers in electric railway supplies, Leominster, Mass., have just issued a neat circular descriptive of their specialties.

The firm of R. Hollings & Co., manufacturers of gas and electric fixtures, 547 Washington street, Boston, Mass, has just issued a circular descriptive of the Hollings electric bracket back and Dawes' electric light support.

The State Bank of Minneapolis has commenced action to recover $2,900.52 from the Northwestern Water and Gas Supply company on a judgment secured some time ago. The bank claims that the Supply company is insolvent and petitions for a receiver.

A glance at the partial list of plants in the new catalogue of the Heisler Electric company would lead one to believe that this concern is not only abreast of the times, as far as long distance and lighting is concerned, but that its work is being rewarded with most substantial returns.

Elias E. Ries last week visited the New York office of the WESTERN ELECTRICIAN. Mr. Ries is making a business trip through the Eastern states. He reports that the new socket is meeting with great success. The company is now putting in machinery to double the capacity of the works.

The Mosher Arc Lamp company has recently rented additional space in the building occupied by them on Ontario street, Chicago, and is putting in new machinery in order to make lamps in sufficient quantities to meet the demand. Several important improvements have recently been made so that a lamp embodying all the desirable points is now made for continuous or alternating systems. Several fine orders for lamps have been received recently, one coming from Canton, China, and a very active business for the coming season is anticipated.

For the last few years there has been a growing demand for some means of utilizing the natural flowing current of streams, where no fall is accessible. The John E. Beggs Manufacturing Supply company of Cleveland, O., has perfected a system which, it is claimed, will meet these demands. A current power wheel has been invented, which with a stream flowing as slowly as at [illegible] and a depth of from 3 to 5 feet, the power is steady enough to transmit power to electric generators. The method has proved practical, it is claimed in many mines situated two to three miles distant from power stations.

The Electric Appliance company is the name of the latest electrical supply house in the western field. This company will be at home at 242 Madison street about November 15th. The officers of the company are Willard M. Low, president; Harry B. Gilbert, vice-president, and Thos. I. Stacey, secretary and treasurer, all of whom have been in the electrical supply business in Chicago, and need no introduction to electrical people. It will be the aim of the new company to meet the wants of the trade. It will control some very desirable specialties, and it promises to be in a position before December 1st to meet any demand that can be made on an electrical supply house.

The Royal Electric company, Peoria, has recently shipped a 500 light alternating plant to Shelbina, Mo.; a 500 light plant to a company at Hoopeston, Ill., the latter being an addition to an old plant of 500 lights that had been in successful operation for some time, and a 500 light alternating plant to Blandinsville, Ill. In addition this company will ship, during the present week, a 650 light alternating plant to El Paso, Ill. Orders have also been filed for three additional plants, upon which the work is now being done. This indicates a very successful season's business, and fully establishes the popularity of the Royal system.

The Northern Car company of Minneapolis has found the pressure of business large enough to demand the acquisition of new blood and capital. Articles of incorporation have been filed with the secretary of state, the capital stock being announced as $250,000, and its object the construction of electric cars, omnibuses, locomotives and engines of all kinds for railway use. The Northern Car company is a comparatively new enterprise, but it has been exceedingly successful. Under the new organization, which was perfected October 31, C. P. Jones is retained as president; W. E. Steel as vice president; D. M Gilmore is treasurer and general manager, and Geo. P. Stearns is secretary. D. M. Gilmore was formerly an extensive furniture manufacturer of this city, and his experience will be of value to the Northern Car company. Their cars are pronounced the finest in use by the Minneapolis street Railway company. W. E. Steel, the vice-president, is a leading banker and financier of Minneapolis. With Mr. Jones continuing as president and Mr. Stearns as secretary, the directory is exceptionally strong and assures the rapid future development and substantial success of the company.

BUSINESS.

W. C. Lyman reports an active demand from the owners of electric plants for his exhaust pipe heads, and exhaust pipe. Mr. Lyman has spent a large amount of time and money in perfecting his apparatus.

J. F. McLaughlin is having an unusually heavy run of repair work rewinding armatures and other heavy electrical apparatus. Mr. McLaughlin has had a varied experience in the repairing of all makes of dynamos and power generators, and has arranged his factory to handle this class of work to which he gives his personal attention.

The Knapp Electrical Works report the sale of a large number of the Bain ammeters and voltmeters. A new circular describing these instruments has just been issued. The fall sales of Perkins lamps are larger than ever. One order for 10,000 has just been received from a company which, it is stated, has used and tested nearly every make of lamp on the market.

The Central Electric company, Chicago, reports that the new Gladiator dry battery is meeting with the most unexpected success. The factory supplying the batteries is already doubling its capacity, so as to meet the increased demand for these cells. The company also reports a very satisfactory trade in the Bryant goods, including sockets, switches, cut-outs, etc.

The Goodrich-Coleman Electric Works, 31 South Canal street, Chicago, report an active demand for a new single magnet bell that they are arranging to make on a large scale. The outlook is also very promising for several other specialties that this enterprising firm is about to put on the market, and it is advertising for other specialties to be manufactured under contract or on royalty.

The Union Electric Works, Springer building, Chicago, are bringing out an unique wood box bell that will undoubtedly have a very large sale. The bell is made with a single magnet, but it is so arranged that a pole extends from either end getting practically the strength of a double magnet. This concern is also making a specialty of a new gravity annunciator that is specially adapted to apartment houses and family hotels. Several large wiring contracts have been taken recently by this company.

The Bell company's rival for short line telephone service, the National Telephone Manufacturing Company of Boston, is bringing its instrument to the front. This concern has installed several telephone lines for the Old Colony Rail-

road company, which are giving good service. An important line connects the train dispatcher with a signal station at the drawbridge, where a Bell telephone would be utterly useless, on account of the noise. Another line is ordered for depot service, also one for use at freight station at Middleboro.

The Chicago Electric Motor company, 205 and 207 S. Canal street, Chicago, has employed J. G. Hart, an experienced workman, giving him charge of the repair department. A prominent street railway company writes under date of October 21st as follows: "We are well pleased with the work done in the past two months by J. G. Hart. He has rebuilt three No. 32 Edison generators, and overhauled the general equipment of our road to our satisfaction." This company makes a specialty of the repairing and rewinding of armatures of all makes, guaranteeing satisfaction in all cases. It is securing a good run of work.

The Fitchburg Steam Engine company, Fitchburg, Mass., reports business as being exceedingly good just now. This concern has a large amount of work on hand, and expects very soon to remove its tools to the new works. A 600 horse power cross compound condensing engine has just been shipped to the Powelton Electric Light company of Philadelphia. This is the third engine of the kind furnished this company. Two large engines are also booked for the W. C. T. U. Temple in Chicago, Ill. The above are only a few of a large number of orders obtained by this concern for engines to be used in other lines outside of the electrical.

J. K. Pumpelly has just been granted patents on a new form of storage battery that promises very efficient results. The design is made up of a series of narrow perforated lead strips of any required length After the perforations are filled with active material the plates are put in either a perpendicular or horizontal position, according to the work to be done. The narrow strips are separated by means of a new insulating material known as "cellulose" fiber, each element consisting of three rows of the narrow plates, one positive and two negative, the whole weighing in the ordinary cell, about thirty pounds. From such a cell, Mr. Pumpelly expects to get 250 ampere hours. The "cellulose" fiber is proving very satisfactory for the purpose for which it is used. Mr. Pumpelly is pushing his invention with considerable energy, and hopes soon to be able to place his cells on the market.

The Electric Merchandise company, Chicago, must be pursuing a paying policy, for it is still engaged with the same rush of business that has occupied its attention during the summer months. General Manager Mason reports that present indications are against the usual winter dullness being experienced this year. For standard line material, station and car equipment there seems to be an increasing demand, while repeated large orders for Pratt's portable conductor's register and the Burton electric heaters are being filled. The electric heater is making itself felt in more ways than one. The Escanaba Electric Street Railway company writes that the Burton heaters already have been put to a "good thorough test and have been found equal to the emergency." The company writes: "We have had some cold weather and quite a fall of snow, but the cars have been as warm as toast."

Rapid progress is being made toward the enlargement of the plant of the Cicero & Proviso Street Railway company. Orders have been placed with the Chicago office of the Pond Engineering company for an 800 horse power Hoppes exhaust feed water heater, and one 8-inch and one 6-inch Pond separator. The City Electric Street Railway company of Little Rock, Ark., has contracted with the Pond Engineering company for three Hoppes live steam feed water purifiers for immediate shipment. Each of these purifiers is to have a capacity sufficient to take care of the feed water for 250 horse power boilers. The Hammond, Ind., Electric Light company has purchased of the Chicago office of the Pond Engineering company a 50 horse power high speed automatic engine. This engine was shipped immediately from the St. Louis warehouse of the company, and is now being installed. The Provident Life Assurance company's building at Waco, Tex., which is nearing completion, will be lighted by an isolated Edison plant. Two 50 horse power steam boilers and one 45 horse power Armington & Sims engine are being furnished by the Pond Engineering company through the St. Louis and Dallas houses. On the evening of the 30th ult. the engine driving the isolated lighting plant in the works of the Howard Harrison Iron company, Bessemer, Ala., met with an accident. A telegram to St. Louis resulted in the immediate shipment [illegible] of a [illegible] horse power high speed automatic engine, complete, with foundation box, pulleys, etc., by the Pond Engineering company.

[illegible] Crocker-Wheeler Motor company [illegible] flourishing business. [illegible] aggregate about as follows [illegible] horse power, ½ horse power, [illegible] horse power, [illegible] horse power and [illegible] power machines [illegible] Canada. [illegible] horse power motors were [illegible] in connection [illegible] horse power [illegible] Electric company [illegible]

Thomson-Houston International Electric company of Boston.

The growing demand for wire to be used in damp places has led to the manufacture of specially well insulated wires for service in mines and tunnels. At the same time the quality of some of the rubber wires on the market has been steadily improved so that the product now largely used for indoor circuits will stand the severest tests. An instance of this recently occurred in Utah, where the United Electric company of Salt Lake City was called upon to explode about 100 pounds of dynamite in the Anchor mine at Park City. The object of this blast was to break through the bottom of a 900 foot shaft into the Anchor drain tunnel so that the mine could be drained. The water in this shaft was up to the 300 foot level or 600 feet deep. The dynamite was encased in a sheet iron tube together with the electric exploder and lowered by means of No. 14 Simplex braided rubber wire through the 600 feet of water to the bottom of the shaft. The first trial was not successful, and the torpedo was pulled up and it was found that the water had worked its way into the torpedo through a poorly soldered joint in the sheet iron and dampened the exploder wires. To test the leading wires 2000 feet of wire was placed in a barrel of water and allowed to remain over night. The next morning six caps were successfully exploded through the 2000 feet of wire in the barrel of water. The repaired torpedo was then lowered to the bottom of the shaft and exploded. Simplex wire that had been under water from 20 to 24 hours continuously was used. While this work was a success electrically, yet it failed to break the shaft through into the tunnel, as some error had been made in surveying the tunnel. It is to be noted that the wire used did not have the extra heavy insulation which is intended for mine work but was the same high grade of braided rubber wire which is being put into some of the largest buildings in the West. The sample used was taken at random from a batch of wire furnished by George Cutter, Chicago.

ELECTRICAL PATENTS.

Issued Nov. 3, 1891.

462,231. Electric Railway. Edward M. Bentley, New York, N. Y.

462,237. Electric Lighting System. Joseph I. Conklin, Brooklyn, N. Y.

462,261. Automatic Electric Welding Machine. Hermann Lemp and Carl G. Anderson, Lynn, Mass.

462,262. Laminated Die, Hammer, etc., for Electric Metal Working Apparatus. Hermann Lemp, Lynn, Mass.

462,263. Method of and Apparatus for Constructing Electric Light or Other Lines. Hermann Lemp, Lynn, Mass.

462,311. System of Electric Lighting. Frank M Garland, New Haven, Conn.

462,315. Electric Wire Support Bracket. Osborn B. Hall, Malden, Mass.

462,321. Electric Magnetic Separator. Richard R. Moffatt, New York, and Sylvester Chichester, Brooklyn, N. Y.

462,322. Electro Magnetic Separator. Richard R. Moffatt, New York, and Sylvester Chichester, Brooklyn, N. Y.

462,338. Incandescent Lamp. Elihu Thomson, Lynn, Mass.

462,339 Incandescent Lamp. Elihu Thomson, Lynn, Mass.

462,345. Electric Signaling System. Frank B. Wood, New York, N. Y.

462,348. Gearing for Electro Magnetic Motors. Chas. E. Chinnock, Brooklyn, N. Y.

462,349. Ceiling Block. Axel Ekstrom, Lynn, Mass.

462,353. Electric Switch. Maurice Hoopes, West Chester, Pa.

462,359. Clamp for Trolley Wires. Charles A. Lieb, New York, N. Y.

462,369 Controling Device for Electric Motors. Francis O. Blackwell, New York, N. Y.

462,381. Electric Alarm Bell. Charles A. Hale, Cleveland, O.

Of the two claims the first follows:

A base frame formed with means for attaching the circuit wires and contact post, magnet core and pole pieces, all formed integral from one piece of metal.

462,403. Electric Gate. Harleigh Gillette, Highland Park, Ill.

462,407. Electric Switch. Rudolph M. Hunter, Philadelphia, Pa.

462,418. Method of and Apparatus for Electrical Conversion and Distribution. Nikola Tesla, New York, N. Y.

[illegible] charging a condenser or conductor [illegible] capacity and maintaining a succession of intermittent [illegible] charges of said conductor into a [illegible] translating devices.

462,4[illegible]. Electric Lighting Apparatus. Harrison B. Meech, Chicago, Ill.

462,4[illegible]. Secondary Battery John H. Palmer, Boston, Mass.

462,452. Electric Fuse Cut-out. Edwin W. Rice, Jr., Lynn, Mass.

462,463. Switch and Cut-out Device. Henry Price Ball, Brooklyn, N. Y.

462,4[illegible]. Commutator Brush. Francis O. Blackwell, New York, N. Y.

[illegible] at one end and [illegible] the rear ends [illegible] bottom of the box. The brush, [illegible]

462,477. Covering for the Bulbs or Globes of Electric or Other Lamps. Alexander Duval and Henri Nelson, Paris, France.

462,489. Conductor for Three Wire Systems. Edward H. Johnson, New York, N. Y.

This invention consists of three conductors insulated from one another one surrounding the other two and forming a protecting covering therefor.

462,504. Electric Current Meter. John W. Th. Olan, New York, N. Y.

Of the twelve claims the eighth is given:

"The combination of a needle or pointer, a coil or magnet for moving it, a record sheet over which the needle moves, a motor for regularly advancing the sheet, and a printing roll having means for marking the sheet."

462,513. Automatic Signal Apparatus. Joseph B. Stewart Haverstraw, Tappan, N. Y.

The last claim is given:

"9. In a block signal system, the combination, with the normally closed local circuit and the normally open line circuit and relay controlling the signal included in both of said circuits, of the branch circuit, including a track switch, and operating to neutralize the relay magnet"

462,527. Electric Elevator. Harry H. Blades and William J. McKee, Detroit, Mich.

The object of this invention is to combine with an elevator, and more particularly a freight elevator, an electric motor, the said motor connected with the elevator cab and adapted to travel with it, and switch mechanism on the car for governing the admission of current to the motor; also, in connection therewith a continuous cable traveling with the car, whereby any person at any floor may operate the said electric switch, and cause the elevator to ascend or descend to his level, as the case may be.

462,532. Electric Cooking Stove. John V. Capek, New York, N. Y.

The last claim is given:

"20. In an electrical stove the combination of a fixed and movable heater, means for adjusting the position of the movable heater, and a switch for throwing either or both heaters into or out of circuit."

462,540. Incandescent Electric Lamp. Thomas A. Edison, Llewellyn Park, N. J.

Of the two claims the latter is given:

"2. The improvement in the method of making incandescent electric lamps, which consists in heating the filament to a red heat after the lamp is exhausted and sealed."

462,564 Cross Tree for Suspended Electric Wires. Jacob Levy, Shreveport, La.

462,571. Electric Lamp Cover and Switch. Emil T. Mueller, LaCrosse, Wis.

462,574 Key Socket for Double Filament Incandescent Lamps. William J. McCutcheon, Jr., Pittsburg, Pa.

462,578. Trolley for Electric Cars. Robert D. Nuttall, Allegheny, Pa.

462,595. Electric Railway. James B. Sheldon and Daniel J. Murnane, St. Louis, Mo

Of the twelve claims the first is given:

"In an electric railway a series of yieldingly secured rotating stationary switches located in the conduit, and having connection with a source of electricity and devices on the motor car adapted to conduct the current from said switches to the motor."

462,599. Electric Hair Brush. Alexander Stanton, Lynn, Mass.

462,624. Electric Arc Lamp. Thomas Conroy, Kansas City, Mo.

462,648. Threading Rod for Underground Conduits. Frank G. Bolles, Washington, D. C.

The last claim follows:

"4. A rod for inserting wires in conduits composed of sections, each section having a portion at one end provided with one or more openings and at the other end a portion provided with one or more hooks having two bends, and the angles of the hook or hooks being alternate."

462,660. Electric Arc Lamp. Fred. H. Carpenter, Boston, Mass.

The claim for this invention is as follows:

"In an electric arc lamp a disk carbon and its holder journaled in a supporting frame, which is attached to a carbon rod and a spring, provided with a lip, secured at one end to the said frame, its free end pressing upon one end of the said carbon holder."

462,661. Electric Arc Lamp. Fred. H. Carpenter, Boston, Mass.

The last claim reads.

"6. A detachable extension device cruciform in cross section, provided with means for interlocking with an electric lamp, means for supporting the globe, and a dust receptacle."

462,662. Carbon Holder for Electric Arc Lamps. Henry E. Chapman, Melrose Highlands, Mass.

462,663. Pencil Carbon Holder for Electric Lamps. Henry E. Chapman, Melrose Highlands, Mass.

The claim is as follows:

"A pencil carbon holder for electric arc lamps, consisting of a standard secured to the lamp frame and provided with a pair of lugs, screws mounted in the said lugs, clamps carried by the inner ends of the said screws, and each having its inner face provided with beveled recesses at right angles to each other, one of the screws having an annular groove near its inner end, and a pin in the clamp carried by the said screw engaging said groove."

462,669. Stay for Suspended Electric Lights. Fred A. Johnson, Bath, Me.

This invention consists in the structure of the flexible or elastic non-conducting stay or cushion, and in attaching the same to the frame rods and hood rods that support the parts which aid in producing the light, whereby the lamp is held in position of contact.

462,672. Conduit Electric Railway. Archibald J. Robertson, New York, N. Y.

462,673. Electric Art Lamp Edwin C. Russell, Boston, Mass.

Of the eighteen claims the fifteenth is given;

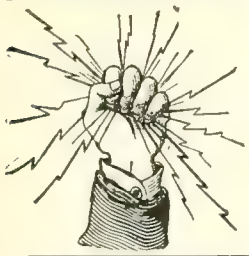
"A disk carbon holder consisting of a spindle provided with a pinion, suitable journals, a disk carbon support consisting of a slotted collar in which are pivoted levers of the first order, and a screw thread upon said spindle, upon which a nut [illegible]."

462,677. Incandescent Lamp Socket. Thomas J. Fay, New York, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.



Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

CHICAGO

The Electrical Construction Co.

43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES

A SPECIALTY

L. BLATZ, 103-107 West Monroe St., CHICAGO.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and specially finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible cables with Clark insulation

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

CHICAGO AGENTS: The Electrical Engineering Co., 320 Dearborn St. TORONTO, ONT. AGENTS: The Toronto Electrical Works.

Queen's "1891" Portable Testing Set.

For Illustration see THE WESTERN ELECTRICIAN, Sept. 19, page 183.

The galvanometer in this set is made of the D'Arsonval type, and is extremely sensitive, without being affected by *mechanical vibrations*, as on shipboard, or by intense *magnetic disturbances*, as in proximity to a dynamo. It is especially recommended for making tests where a galvanometer with fibre suspension cannot be used.

Send for Illustrated Descriptive Catalogue, 1-66.

QUEEN & CO., PHILADELPHIA.

WANTED.

One 15 and one 25 H. P. Westinghouse or Atlas Steam Engine.

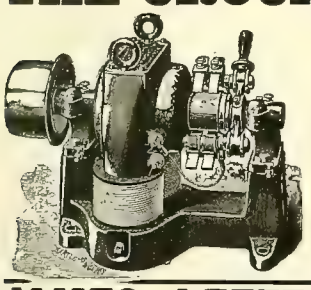
Address J. C., Care WESTERN ELECTRICIAN.

WANTED.

A salesman for a neutral Electrical Engineering and Construction Company, operating in all kinds of electric lighting and electric power work, in connection with all first-class apparatus. Headquarters, New York. Address "NEUTRAL," Care of WESTERN ELECTRICIAN.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK

ELECTRIC FAN OUTFIT.

MASON'S FAMOUS BATTERIES.

MEDAL AWARDED, American Institute Exhibition, 1891.

SEND FOR ILLUSTRATED CATALOGUE B.

JAMES H. MASON, 118 & 120 Park Ave., Brooklyn, N.Y.

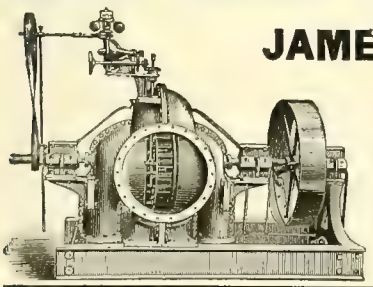
JAMES LEFFEL WATER WHEELS

BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL, FOR

ELECTRIC, MINING AND MANUFACTURING PLANTS.



Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY.

The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

MICA

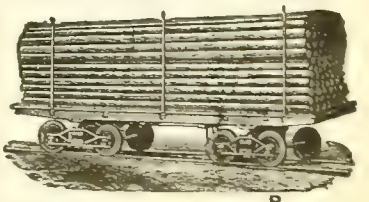
ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } POLES CROSS ARMS

OCTAGONAL PINE AND STEEL POLES.

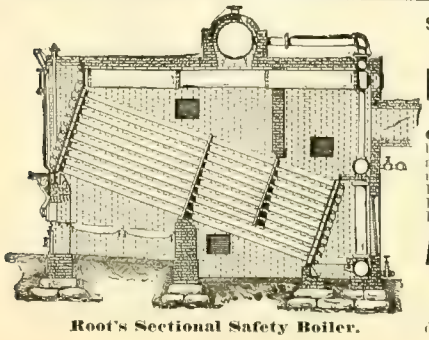
C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

Binders

FOR THE Western Electrician

$1.00.

ROOT'S WATER-TUBE BOILER.



Root's Sectional Safety Boiler.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Electric Light Companies** of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass., and the Thomson-Houston Electric Co., Lynn, Mass.

Abendroth & Root Mfg. Co.,

28 Cliff St., New York.

BRANCHES: Chicago, Boston, Philadelphia, Dallas, Rochester.

AN EXPENSIVE DELAY

Will Not Occur If You Order Supplies from Us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers; Packard High Grade Lamps; Eddy Motors; "Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

931 Rookery, CHICAGO. 134 E. 6th St., opp. Hotel Ryan, ST. PAUL. 409 W. Michigan St., DULUTH.

SEND FOR CATALOGUE AND DISCOUNT SHEETS.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES, SHADES, Etc., Etc.,

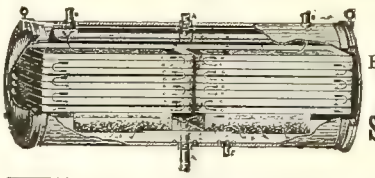
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingo s, Slabs, Sheet Wire and Castings at lowest market rates.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.

SEALED PROPOSALS.

Notice is hereby given that sealed proposals will be received at the office of the Clerk of the City of Peru, Indiana, up to 7 o'clock P. M. of the 8th day of December, 1891.

For furnishing and maintaining of fifty or more arc lights as the Council may deem necessary; said lights to be of 2,000 candle power each and to burn all night, and be placed in such parts of the city as the Common Council shall designate, the Council having the right to add one or more lights to any contract they may make, at any time during the life of such contract at contract price of same, said contract to take effect on the 1st day of June, 1892.

The Council reserves the right to reject any or all bids.

By order of the Council October 13, 1891.

Address, JOHN TOLL,
City Clerk.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

---

TO AMERICAN INVENTORS.

Woodhouse & Rawson,

UNITED, LD.,

88 Queen Victoria Street,

LONDON, ENC.,

NEW YORK OFFICE, 36 WALL STREET.

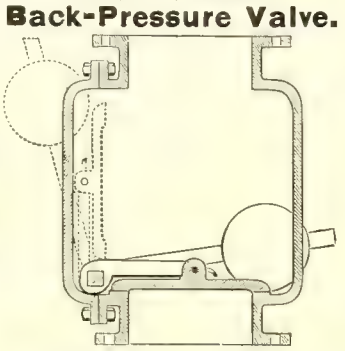
Are Prepared to Negotiate and Introduce Inventions of Merit into Great Britain and all Parts of the World.

CORRESPONDENCE INVITED.

THE EXCELSIOR

Straight-Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,

229 S. Franklin St., Chicago.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. **136 Liberty St.,** NEW YORK.

FOR SALE.

One 3 Horse Power Electric Motor.
One 5 Horse Power Electric Motor.

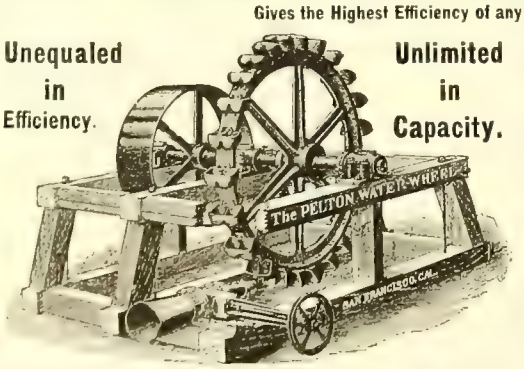
Both in excellent condition, having been used but little.

ERIE ELECTRICAL SUPPLY CO.,
ERIE PA.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 20 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,
121-123 Main St., San Francisco, Cal., U. S. A.
143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

Gleason & Bailey Mfg. Co.,

(LIMITED.)

GENERAL WESTERN AGENTS FOR THE

STEUBEN INCANDESCENT LAMPS,

The best in the Market,

Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.

Rubber Covered, Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and catalogues.

BERNSTEIN ELECTRIC CO.

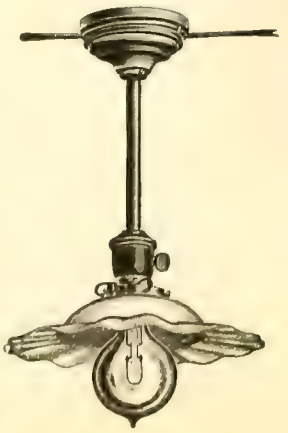
INCANDESCENT LAMPS

—FOR—

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

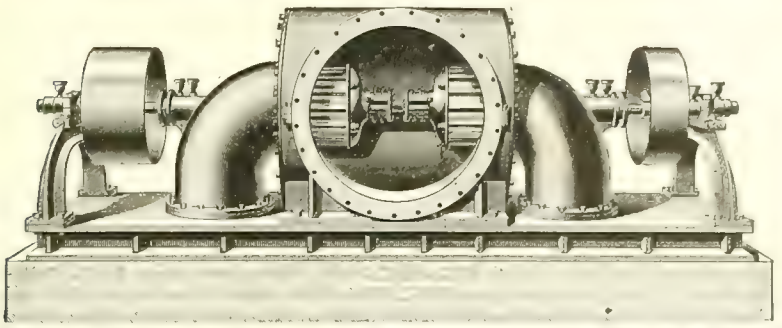
The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC CONTRACTORS [illegible] CELEBRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** [illegible] diameter, being **double** the **Power** of [illegible] by a number of the leading [illegible] economical use of water it is [illegible] of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly [illegible] and it can be belted directly to dynamo.

The accompanying engraving [illegible] **VICTOR TURBINES** arranged on a [illegible] Tubes, End Bearings for Shaft [illegible] a substantial cast-iron bed plate. [illegible] strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO., RAVENNA, OHIO. MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

GOING TO CALIFORNIA?

If so, and you want to make the journey quickly and have the most comfort en route, purchase your tickets via the Chicago & Northwestern, Union Pacific and Southern Pacific Railways. Pullman drawing room sleeping cars are run on fast trains Chicago to San Francisco, without change, and all meals are served in dining cars. Completely furnished tourist sleeping cars are also run, in which accommodations can be procured by passengers holding either first or second class tickets at a cost of only $4.00 per berth Chicago to San Francisco, and other California points. All classes of tickets at the most favorable rates, including first class excursion tickets good returning six months from date of sale, reservations in sleeping cars, and full information can be obtained at ticket offices of the Chicago & North-Western Railway, No. 208 Clark St., Oakley Avenue Station, and Passenger Station, Corner Wells and Kinzie Sts.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

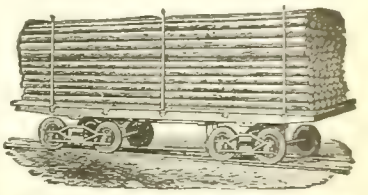
HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY. 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

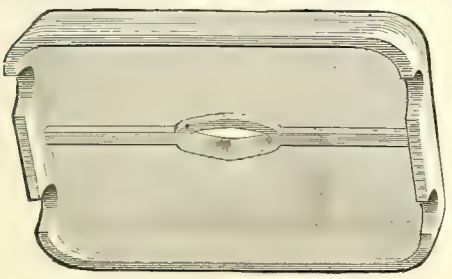
47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

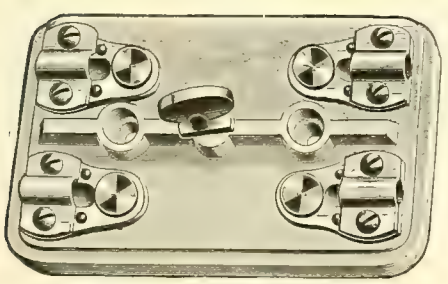
VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.





CUT-OUTS,

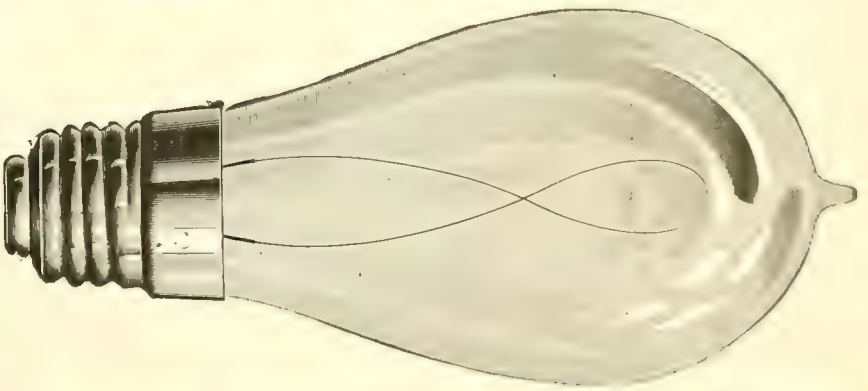
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.
510-534 W. 23d Street, NEW YORK.
217 LaSalle Street, CHICAGO, ILL.

C. & C. ELECTRIC MOTORS and DYNAMOS.

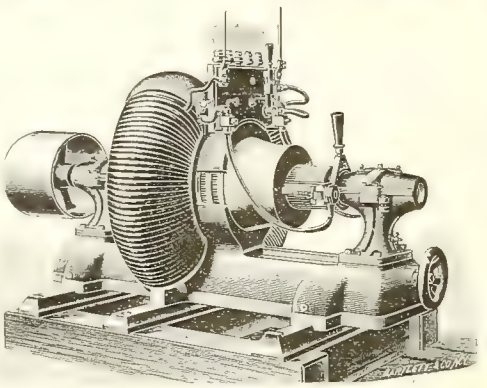
ELECTRIC MOTORS in all standard sizes, up to and including 100 H. P., for operating elevators, pumps, printing presses, and machinery for general manufacturing purposes.

POWER GENERATORS.

ELECTRIC MINING MACHINERY of all kinds, Hoists, Tram Cars, etc.

FAN OUTFITS. Electric Plants for pumping Church Organs.

We call the special attention of Station Superintendents to the fact that our machines are absolutely unsurpassed for economy of electric current.

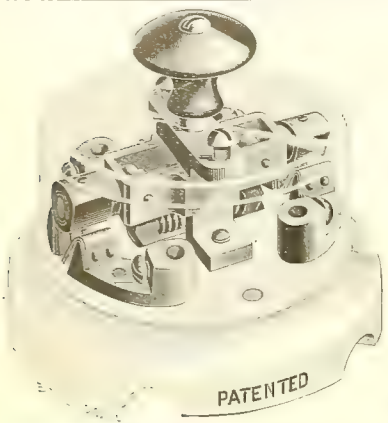


DYNAMOS for isolated plants and the equipment of Mills, Banks and Office Buildings with Electric Lights.

ELECTRIC BLOWERS for ship ventilation. Have equipped 18 U. S. and foreign War Ships with ventilating apparatus.

NEW ENGLAND Office,
63 Oliver St, BOSTON.
PHILADELPHIA Office, 38 S. Fourth St.
CHICAGO Office, - Phenix Building.
SAN FRANCISCO Office, - 35 Market St.
ST. LOUIS Office, - - 421 Olive St.
NEW ORLEANS Office, 78 Customhouse St.

THE C. & C. ELECTRIC MOTOR CO., 402-404 Greenwich Street, NEW YORK.



OF SOME THINGS ONLY THE BEST!

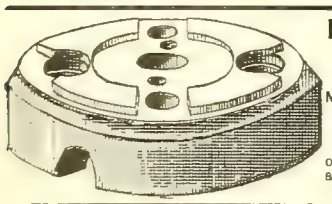
Three years ago we brought out what was THEN the best switch on the market—now we are doing the same thing again,

BRINGING OUT THE BEST.

THE UNION ELECTRIC MFG. CO.,

BRIDGEPORT, CT.

NEW YORK: Alexander, Barney & Chapin. BOSTON: Eastern Electrical Supply Co.



EMPIRE CHINA WORKS,

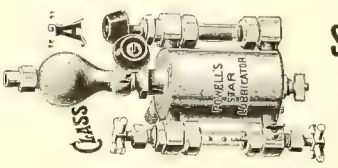
144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.



This cut represents our Class A

STAR SIGHT "UP-FEED" LUBRICATOR.

There are no joints about it. Arms and body cast in **One Piece**, so you won't be annoyed by leaking and it will work to your entire satisfaction. Will let you try it before you buy it.

For sale by Jobbers, or apply to

THE WM. POWELL CO., - CINCINNATI, O.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.

COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,

ST. PAUL, MINN.

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC,

All Supply Stores Keep Them.

THE NATION'S CHOICE.

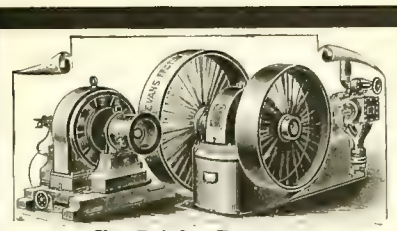
NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street,

CHICAGO.

MAIN OFFICE.
649 and 651 Broadway.
New York

Geo. H. Meeker,
Western Manager.

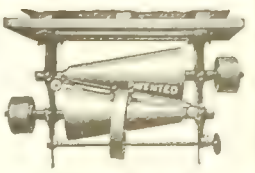


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

EVERYTHING IN

WIRE—FUSE— STRIPS.

WRITE U.S.

MANUFACTURED BY

The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

73-75 W. Jackson St. **RELIABLE**

WE ARE FITTED WITH
RELIABLE Machinery and Tools,
And Employ **RELIABLE** Workmen.
All Kinds of Electrical Apparatus to Order.
CHICAGO ELECTRIC MFG. CO.

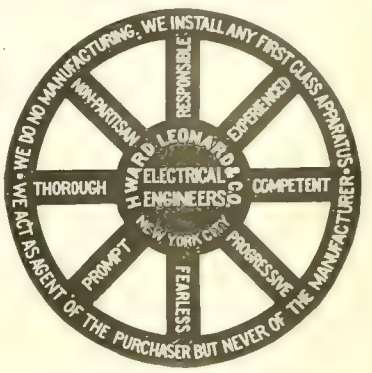
HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, Rods, Tubing, Washers, Discs and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

H. WARD LEONARD & COMPANY.



For full information regarding the application of electricity for any purpose, write to us. Ask for our pamphlet. Address,
Electrical Exchange Building.
NEW YORK CITY.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

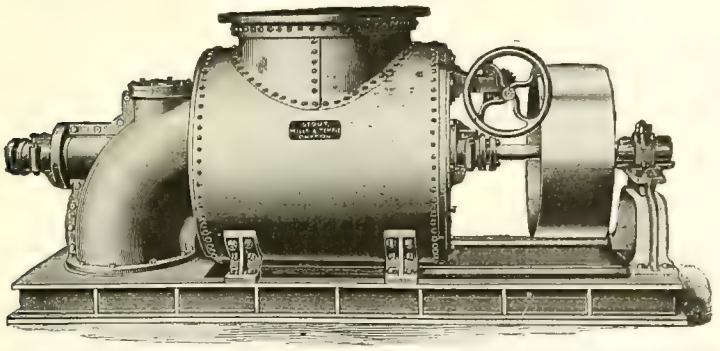
Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

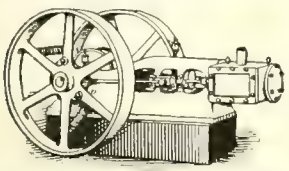
ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**



WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 447 North Street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

STEAM PLANTS

INSTALLED BY

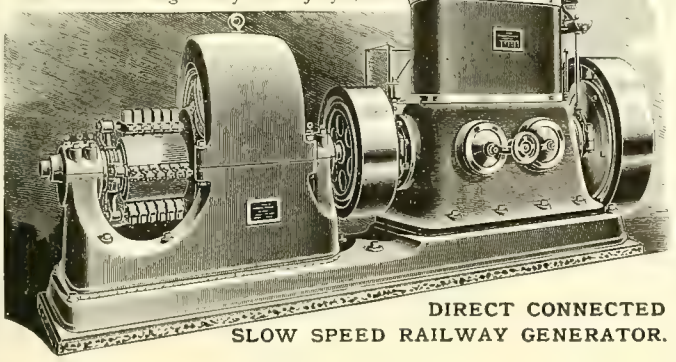
W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

WESTINGHOUSE ENGINES

In addition to about 4,000 Standard and Junior ENGINES,
551 Compound Engines
have been built during three years to July 1, 1891



DIRECT CONNECTED
SLOW SPEED RAILWAY GENERATOR.

125, 250, 500 HORSE-POWER.

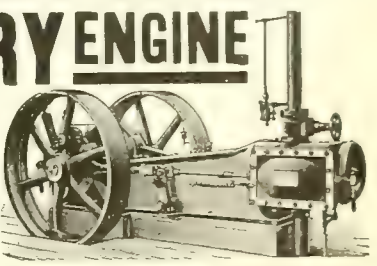
Also Direct Connected Slow Speed Alternating Dynamos of equivalent capacity.

For Circulars and Estimates on Complete Plants, address our Engineers.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application. —
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg.
San Francisco, 29 & 31 Spear St.



DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DID YOU SEE IT AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.,

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.

EVERY ELECTRICIAN INTERESTED.

BAIN'S

COMPENSATING

Volt Meters and Ammeters.

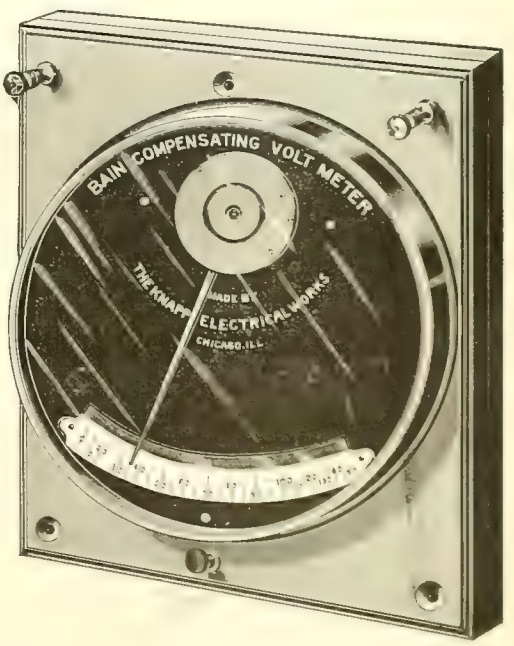
Never get out of calibration. They are moderate in price, and we guarantee them as good as any instrument made.

WRITE FOR SPECIAL CIRCULAR AND PRICE LIST.

PERKINS

INCANDESCENT LAMPS

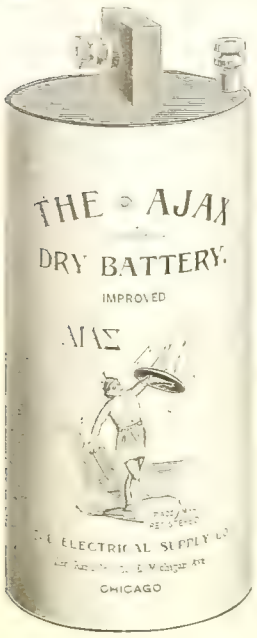
Declare dividends for you.



THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS AND DEALERS,

CHICAGO, ILLINOIS.

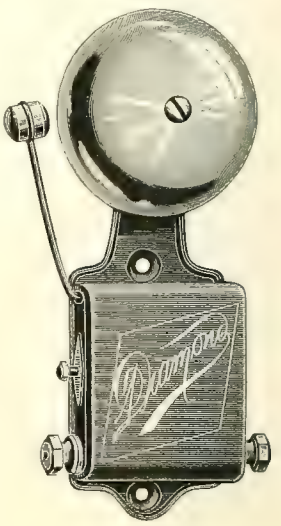


NO man who ever personally "set up" a battery of the ordinary fluid cells and had to carry water and mix solution, and perhaps break a jar in the operation, but wished away down in his heart for some neater, better way.

NO MAN who ever packed glass jars for "his man" to take out on a job, and thought sure he had *everything*—the zincs, the carbons, the sal ammoniac, all—but wished for something better, something compact, unbreakable, with *NOTHING* to *forget.*

NO MAN WHO ever bought a bell and fluid battery, and pushed the button and *expected* the bell and the battery to do the rest, but sooner or later was disappointed, because the fluid had evaporated or frozen, or the zincs eaten up, or the connections corroded, and wished for something *better.*

THE AJAX DRY BATTERY
IS BETTER



And combines all the desirable qualities of fluid cells with *none* of their disadvantages. It possesses many good features distinctively its own. It is Strong, Durable, Compact, Reliable.

The DIAMOND BELL is a Model of Ingenuity, surpassing in its mechanical and electrical construction any bell ever offered to the trade. All Metal. Dust and Bug proof. Neat and Ornamental.

For Prices of Batteries and Bells address the Manufacturers,

Eastern Offices & Factories, ANSONIA, CONN.

THE ELECTRICAL SUPPLY CO.,
Randolph St. and Michigan Ave., CHICAGO.

Send for Illustrated Catalogue of House Goods.

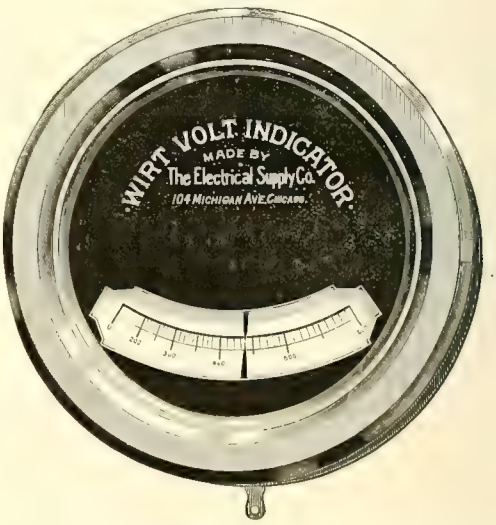
THE WIRT RHEOSTAT.

For many purposes the use of a rheostat or adjustable resistance is indispensable, and consequently the variety of forms in which these are made is very great. The chief difficulty has been to produce a sufficiently gradual increase of resistance and to insure good contact at the successive points, and at the same time have sufficient resistance and ample current capacity within reasonable space.

We are confident that these various points have been well combined in the Wirt Rheostat, one form of which we illustrate here. We can make these in various sizes adapted to any special purpose for which they may be intended, such as photometric testing, stage regulators, etc. They are finished either in hardwood polished, or mounted with marbleized slate. We will be pleased to answer any inquiries relating to these or special instruments.

THE WIRT VOLT INDICATOR.

(PATENTED.)



Is intended to be left in circuit continuously, and can be relied upon for constancy and accuracy under the most trying conditions. The resistance of the instrument is high—making the consumption of energy small. An adjustable index permits *reading at a distance,* indicating variations from normal pressure.

The Electrical Supply Co.,

WESTERN OFFICE AND WAREHOUSES

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

Eastern Office and Factories
Ansonia, Conn.

THE NATIONAL TRANSFORMER SYSTEM

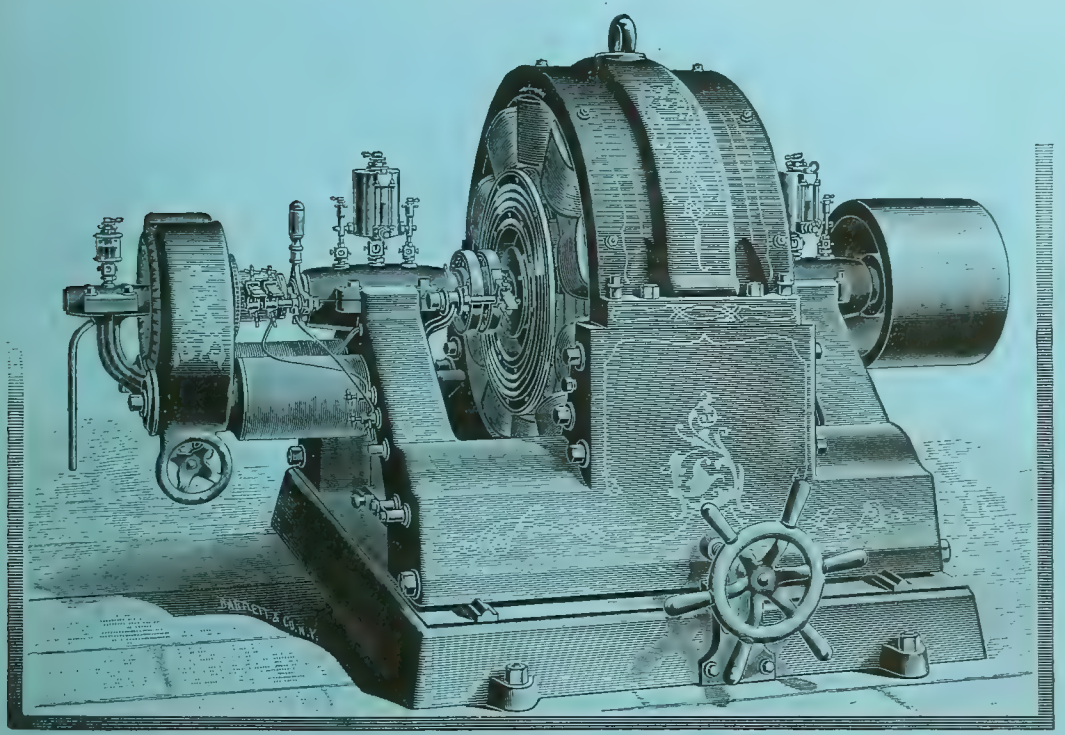
OF INCANDESCENT LIGHTING.

Florence, S. C., August 19, 1891.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.:

GENTLEMEN:—I write this to tell you of the wonderful performance of our Alternating Dynamo, which is a 750 lighter of your manufacture. Last night, while at supper, a cross got on our mains by their sagging on to a telegraph wire, and my engineer, who is a new man, ran the dynamo with the ampere meter needle clear on the end of the scale, which is about 80 amperes, or equivalent to approximately 1,600 lamps. It ran that way until it chocked down a 100 H. P. engine with 110 pounds steam, and then he sent for me. Strange to relate, the machine was not damaged a particle. The excessive current had melted all of the 4 fuses on the board, but the engineer had put in new ones and heavier ones, and had started up again. I consider that we have the only dynamo on earth that would stand such a strain and not be injured. I shall of course see to it, that a thing of this kind does not happen again.

[Signed] A. A. FORMAN, Supt. Florence Impvt. & Mfg. Co.



THIS IS THE MACHINE THAT WE BUILD.

Self-Contained Alternator. Capacity 1,000 16 C. P. Lamps.

SEND FOR CIRCULARS AND PRICES.

COMPLETE
CENTRAL STATION EQUIPMENTS
—FOR—
LIGHT OR POWER
DISTRIBUTION.

OUR APPARATUS IS OF THE
HIGHEST EFFICIENCY,
MECHANICALLY AND ELECTRICALLY.
WE GUARANTEE ITS OPERATION AND PROTECT OUR CUSTOMERS.

COMPLETE
DIRECT CURRENT SYSTEM
—FOR—
ISOLATED LIGHTING.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis.

GEO. B. SHAW, Gen'l Manager.

AGENTS:

NEW YORK, N. Y.,	National Electric Mfg. & Const. Co., Elect. Exchg. Bldg.	BRUNSWICK, ME.,	Maine Electrical Improvement Co.
BUFFALO, N. Y.,	Little, McDonald & Co., 141 East Seneca St.	SALT LAKE CITY, UTAH,	M. C. Godbe.
CINCINNATI, O.,	W. N. Gray, 12 Chamber of Commerce.	ST. PAUL, MINN.,	The Electrical Engineering & Supply Co.
WASHINGTON, D. C.,	L. N. Cox, 16 Fifth St., S. E.	DETROIT, MICH.,	Commercial Electric Co
PHILADELPHIA, PA.,	C. M. Blanchard, Girard Building.	DENVER, COLO.,	The Mountain Electric Co
LINCOLN, NEB.,	Lincoln Electrical Mfg. & Supply Co.	WINNIPEG, MAN.,	Simpson-Davis Electrical Construction Co.
SEATTLE, WASH.,	Chas. H. Baker & Co.	SAN FRANCISCO, CAL.,	National Electrical Development Co.
DULUTH, MINN.,	The Electrical Eng. & Supply Co.		

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

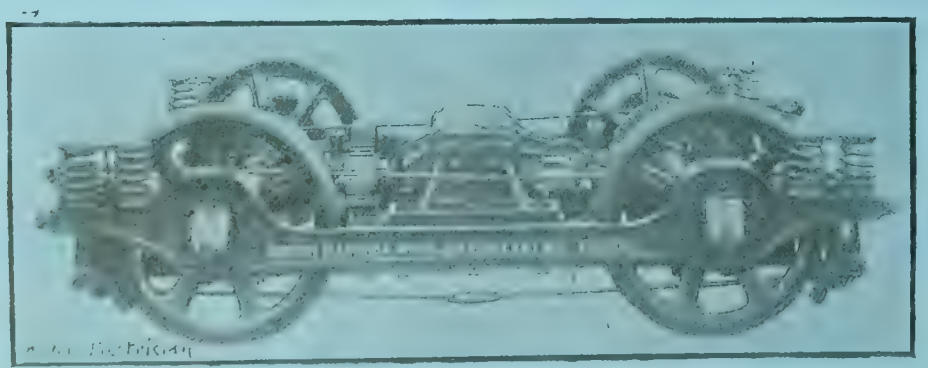
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

ONE MOTOR DRIVING BOTH AXLES

Of a street car, is the same principle as having all driving wheels of a locomotive connected, which is the AMERICAN SYSTEM.

Sizes: 15, 30 and 40 Mechanical Horse Power.



One Heat Proof Motor, Driving Both Axles.

This cut represents the latest construction of our Standard Apparatus equipped with our HEAT PROOF MOTOR. Attention is invited to the work being done by these equipments on the Merrimac Valley Street Railway, Lawrence, Mass.; Consolidated Street Railway Company, Grand Rapids, Mich.; and the People's Electric Street Railway, Springfield, Ill.; where, in each place, the two largest electric companies have put their latest equipments against them, with the result of proving our claims and strengthening the advantages derived from utilizing the full traction of the car, and driving all wheels simultaneously.

PATENTEES AND SOLE MANUFACTURERS:

DETROIT ELECTRICAL WORKS,

DETROIT, MICH., U. S. A.

Also Manufacturers of Electrical Power Machinery, Standard Line Appliances and General Electrical Supplies.

CORRESPONDENCE INVITED.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, NOVEMBER 21, 1891. No. 21

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE
Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

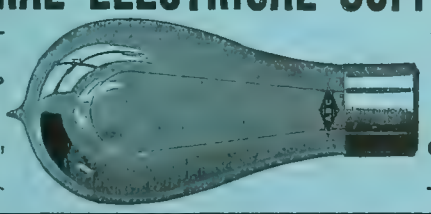
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."



WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

PACKARD HIGH GRADE INCANDESCENT LAMPS
Manufactured by the
NEW YORK & OHIO COMPANY, Warren, Ohio.
AGENTS: J. W. PEALE, 1 Broadway, NEW YORK.
ELECTRIC ENG. & SUPPLY CO., SYRACUSE, N. Y.
ELECTRICAL ENG. SUPPLY CO., 931 Rookery, CHICAGO, and ST. PAUL.
ST. LOUIS ELECTRICAL SUPPLY CO., ST. LOUIS.

CLOWER, HARRIS & CO.,
CONTRACTING AND CONSULTING ELECTRICAL ENGINEERS.
The largest Electrical Supply House west of the Mississippi River. EVERYTHING ELECTRICAL.
289 ELM STREET, DALLAS, TEXAS.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.

The International OKONITE COMPANY, LIMITED.
13 Park Row, New York.

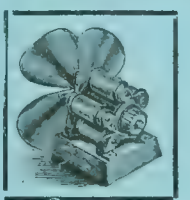
OKONITE TRADE MARK

INSULATED WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

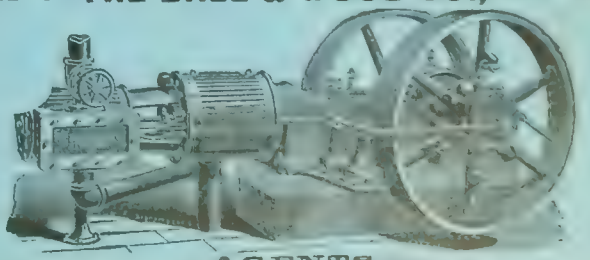
THE 1891 ELECTRIC MOTOR AND BATTERY.



SIMPLE. DURABLE.
ECONOMICAL. EFFICIENT.
For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at
ONE-HALF PRICE.
Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IMPROVED BALL ENGINES,
BUILT BY THE BALL & WOOD CO., NEW YORK.



AGENTS
W. B. Pearson & Co., Home Insurance Building, Chicago, Ill.
Thos. G. Smith, Jr., 11 Hammond Building, Cincinnati, Ohio.
W. A. Day, 128 Oliver Street, Boston, Mass.
A. M. Morse & Co., St. Louis, Mo.
Cooley & Vater, Minneapolis, Minn.
Mead & Stringham, 321 Hammond Building, Detroit, Mich.

The Thomson-Houston ELECTRIC CO.,

MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL.

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co.... —
Alexander, Barney & Chapin.....i
American Electrical Works.....xiii
Andrews & Co., A. H..... ... xix
Baggot, E xiv
Bain Electric Mfg. Co..... ix
Ball Engine Co.....xix
Ball & Wood Co , The i
Beckerleg, Jas. G..... xiv
Beggs, J. E., Mfg. & Supply Co.xii
Bernstein Electric Co..... —
Blatz, L..... —
Borden & Selleck Co..... xv
Braun Illustrating Co xix
Brownlee & Co..... xii
Brookfield, Wm..... ... xii
Brush Electric Co..... ...xvii
Burton Electric Co..... iv
Butler Hard Rubber Co..... —
Buxton, Geo. B ix
C. B. & Q. R. R..... —
C. & E. R. R..... xiv
C. & N. W. R. R..... xv
C. & C. Electric Motor Co.... xvi
Card E. Motor & Dynamo Co.. —
Central Electric Co..... ... v
Chicago Electric Mfg. Co.....xvii
Chicago Electric Motor Co.....xiii
Chicago Insulated Wire Co.... xvii
Clower, Harris & Co..... i
Colburn Electric Mfg. Co..... x
Consol. Elec. Mfg. Co., The... —
Cowles Elec. Smelt & Alum. Co.xiv
Crocker-Wheeler Elec. Mo. Co. xiii
Day's Kerite Insulation i
Dayton Globe Iron Works Co..xix
Delaware Hard Fibre Co..... x
Detroit Electrical Works.....xxiv
Densmore Typewriter Co..... xii
Eastern Electric Cable Co.....xiii
Easton Electric Co..... xvi
Edison General Electric Co.... vi
Edison General Electric Co., Cable and Wire Department..... vi
Electric Construction & Sup. Co..viii
Electric Merchandise Co..... iv, x
Electric Secret Service Co..... x
Electrician Pub Co..... xv, xviii
Elec. Construction Co., The.....xii
Electrical Engineering Co..... —
Elec. Eng. & Supply Co., The.—
Elec. Supply & Contracting Co..ix
Electrical Supply Co., The... xxii
Elektron Mfg. Co..... iv
Empire China Works.....xiii
Evans Friction Cone Co..... xvii
For Sale xii
Foster, O. A..... i
Fort Wayne Electric Co..... xxiv
Gleason & Bailey Mfg. Co. Ltd. xiv
Globe Carbon Co..... xv
Great Western Elec. Supply Co.. ix
Greeley & Co., The E. S.....i
Goodrich-Coleman Elec. Wks.. xvi
Heisler Electric Co..... iv
Hill Clutch Works..... xvi
Hirlimann, C. J ix
Hine Eliminator Co..... —
Holmes, C. H..... xl i
Holmes, Booth & Haydens... . vii
Hood, Wm..... .. x
India Rubber & Gutta Percha Insulating Co..... xxiii
Interior Conduit & Insulation Co... x
International Okonite Co..... i
Kartavert Mfg. Co..... xiv
Keller & Degenhardt..... xii
Knapp Electrical Works..... xxi
La Roche Electric Works..... iv
Law Telephone Co..... ..xiii
Leonard & Co., H. Ward.....xvii
Leffel & Co., Jas..... xiii
Loud, H.M. & Sons Lumber Co..xiv
McLaughlin, James xix
Milliken Bros..... xvii
Monitor Electric Co..... x
Mosher Arc Lamp Co..... —
Munsell & Co., Eugene..... xiii
Murphy, T. J..... xiii
National Carbon Co..... xiv
National Electric Mfg. Co ..... —
N. Y. Belting & Packing Co.... —
New York Insulated Wire Co.. xvi
New York & Ohio Co..... i
N. W. Elec. Specialty Co.... —
Nuttall Company, R. D..... i
Ostrander & Co., W. R..... xvi
Paiste, H. T..... xii
Page Belting Co..... xiv
Partrick & Carter Co..... v, i
Payne & Co., Geo. W..... —
Pearson & Co., W. B.....xix
Pelton Water Wheel Co xiv
Phœnix Glass Co..... xvi
Pond Engineering Co xix
Powell Co., The Wm..... —
Queen & Co..... xiii
Ries Elec. Specialty Co., The... x
Rockford Electric Mfg. Co..... xii
Royal Electric Co..... —
Samson Cordage Works. xii
Sargent & Lundy..... xiii
Sawyer-Man Electric Co..... xi
Schawel & Co., Jas..... xii
Schieren & Co. Chas. A..... xli
Schoonmaker, A. O xii
Schuyler Electric Co xv
Sealed Proposals xiv
Short Electric Railway Co xii
Schultz Belting Co.....xiv
Sperry Elec. Mining Mach. Co. xvii
Standard Underground Cable Co....i
Stanley Electric Mfg. Co.....xxiii
Star Electrix Co..... viii
Stearns Mfg. Co..... xix
Sterling, W. C..... xv
Steuben Elec. Mfg. Co., The.... ix
Stilwell & Bierce Mfg. Co....xiv, xv
Sunbeam Incand. Lamp Co..... vii
Taussig, S..... —
Temple, J. C..... xv
Thomson-Houston Elec. Co...ii, xx
Union Electric Mfg. Co., The.. —
Union Electric Works..... xii
Union Hardware Co..... xii
U. S. Electric Lighting Co..... xi
Van Nuis C. S..... i
Vulcanized Fibre Co xv
Wanted..... xiii
Western Electric Co viii
Westinghouse Elec. and Mfg Co—
Westinghouse Machine Co..... xix
Weston Electrical Instrum't Co...xii
Williams Engine Works.... ...xix
Woodbridge & Turner Eng. Co. xv
Woodhouse & Rawson, Ltd.... —
Worthington, Henry R..... xii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelt. & Alum. Co.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Samson Cordage Works.

Batteries.
Central Electric Co.
Electrical Supply Co.,The.
Foster, O. A.
Hirlimann, C. J.
Law Telephone Co.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.' The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Castings, Brass.
Blatz, L.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Steuben Electric Mfg. Co.
Temple, J. C.
Thomson-Houston Electric Co
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Easton Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co , The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Burton Electric Co.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The,
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co, The.
Star Electrix Co.

Electrollers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E., Mfg. & Supply Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co,
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Clower, Harris & Co.
Consolidated Elec. Mfg. Co., The.
Detroit Electrical Works.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Edison General Electric Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Clower, Harris & Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co
Steuben Electric Mfg. Co
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica
Munsell & Co., Eugene
Schoonmaker, A. O.

Mining Apparatus, Electric
Bain Electric Mfg. Co.
Brush Electric Co.
Electrical Engineering Co., The.
Elektron Manufacturing Co.
Foster, O. A.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co
Leffel & Co., James
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co

Type Writers.
Densmore Type Writer Co.

Valves

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Sperry Elec. Mining Machine Co

ELECTRIC HEATING.

BURTON ELECTRIC CO.,

RICHMOND, VA.

WONDERFUL IN ITS EFFICIENCY.

THE BURTON ELECTRIC HEATER costs less to operate than a stove, and requires **NO REPAIRS.**
THREE YEARS' SERVICE has demonstrated its practicability.
Circulars upon application. Information furnished.

WRITE TO THE SELLING AGENTS:

ELECTRIC MERCHANDISE COMPANY,

11 ADAMS ST., CHICAGO, ILL., U. S. A.

IMPORTANT.

THE HEISLER SYSTEM IS THE

ONLY APPARATUS

MADE FOR LONG DISTANCE LIGHTING THAT IS

SELF-CONTAINED

AND PROVIDED WITH ABSOLUTELY

AUTOMATIC REGULATION.

Our Series Socket is **SAFE, RELIABLE,** and **DURABLE,** and is protected with **INSULATED** covering, notwithstanding the claims of monopoly of these features by other manufacturers.

Series Sockets and Lamps for Arc Light Circuits.

WE INVITE INVESTIGATION.

HEISLER ELECTRIC CO.,

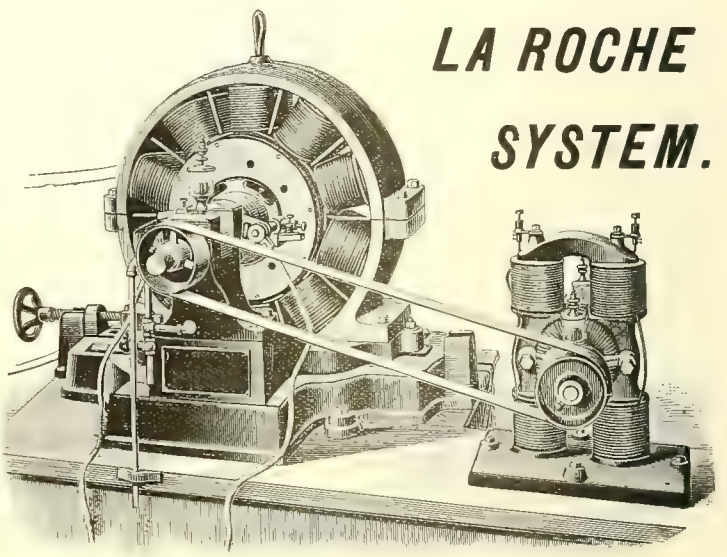
DREXEL BUILDING,

PHILADELPHIA, PA.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,

FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

YOU GET THE BEST

WHEN YOU BUY

PERRET ELECTRIC MOTORS AND DYNAMOS,

— Manufactured Only By —

The Elektron Manufacturing Co.,

NEW YORK OFFICE, 89 Liberty St. **SPRINGFIELD, MASS.**

SELLING AGENTS:

Washington, D. C., J. U. Barnard & Co., 1309 New York Ave. **New Orleans, La.,** George Baquie, 140 Gravier St. **Chicago, Ill.,** The Electrical Engineer-
St. Paul, Minn., F. J. Renz 95 East Fourth St. **Philadelphia, Pa.,** Pennsylvania Machine C[illegible] 29 North Seventh St.

CHICAGO, November 16, 1891.

TO OUR CUSTOMERS:

We have just completed arrangements with the Swan Lamp Manufacturing Company to handle their lamps and will, in future, sell this Company's lamps in preference to any others. We have heretofore been selling the Packard lamp, and in making the change, we do not wish to be understood as retracting any of our claims for that lamp. We are simply keeping pace with the wishes of our patrons, who demand a lamp of high efficiency and good average life, rather than one of low efficiency and extra long life.

As the electric lighting industry becomes one of the stable dividend paying interests of the world, station managers are obliged to pay more attention to every source of waste, and there has heretofore been none more prolific than that of low efficiency lamps, especially when the capacity of the station is nearly full.

The Swan lamp is one of high efficiency and good average life, say from 600 to 1,000 burning hours, while it does not blacken to any appreciable degree even when it is nearly burned out. These lamps are made to fit any socket, and, as we will carry a stock of all ordinary candle powers and voltages, orders can be promptly filled.

ST. LOUIS BRANCH.

OKONITE

TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY
823 Locust St., St. Louis, Mo.

KANSAS CITY BRANCH

OKONITE

TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OMAHA BRANCH.

OKONITE

TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

DENVER BRANCH.

OKONITE

TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
722 Lawrence St., Denver, Colo.

There is only one really high grade insulated wire in the market. Ask any one who has ever used Okonite, which it is.

OMAHA AND COUNCIL BLUFFS RAILWAY AND BRIDGE COMPANY.

GENERAL SUPERINTENDENT'S OFFICE.

COUNCIL BLUFFS, IOWA, April 27, 1891.

WM. H. MCKINLOCK, Prest., Chicago, Ill.

Dear Sir:—Yours of April 24th received, and contents noted. I certainly can have no objections when the article referred to is Okonite. You will undoubtedly think that the wire received rather hard usage to be burned out in the manner shown, but the cause was a motor man put in about a 25 ampere fuse on a piece of No. 18 Okonite wire, when the lamp circuit was grounded, and something had to give, and it seemed wonderful that the wire could be completely fused without destroying the insulation. I will also add that in the Blue Vitriol Shop of the Omaha & Grant Smelting & Refining Co., where five different brands of wire were tried, the acid fumes attacked and destroyed all of them except Okonite, that has stood the test for about two years, and we burn the lights there every night in the week for twelve hours.

Yours very respectfully, ISRAEL LOWTH, [illegible]

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

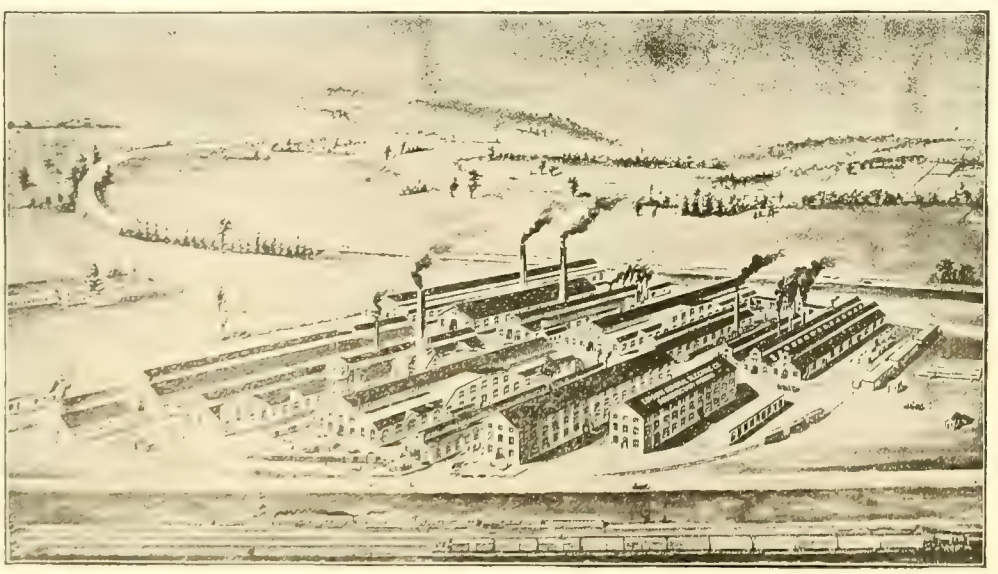
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Pamphlet mailed on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

ESTABLISHED 1867.

FRANKLIN S. CARTER. CHARLES M. WILKINS E. WARD WILKINS

—TRADING AS—

PARTRICK & CARTER CO.,

125 South Second Street, PHILADELPHIA, PA.

SOLE PROPRIETORS OF THE PATENT NEEDLE ANNUNCIATORS.

Manufacturers of and Dealers in all Kinds of

ELECTRICAL SUPPLIES.

—WE MAKE A SPECIALTY OF—

Bells, Disque Leclanche Batteries, Gas Lighting Apparatus, Bronze goods and a full line of supplies for hotel and house work.

Agents for Canada:—The Toronto Construction and Electrical Supply Co., Toronto

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of Application and Business Card.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire. Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

SUNBEAM INC. LAMP CO. SUNBEAM INCANDESCENT LAMP CHICAGO ILLINOIS U.S.A.

THE SUNBEAM INCANDESCENT LAMPS

Can be furnished of any desired efficiency or life to suit our customers. We make two standard styles of lamps, as follows:

High efficiency lamps, from 3 to 3 1-3 watts, which maintain their rated candle power from 750 to 1,000 hours.

Long-lived lamps, from 3 6-10 to 4 watts, which maintain their rated candle power from 1,500 to 3,000 hours.

Each style will be found to give more light per dollar expended in current than similar lamps made by other manufacturers.

SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

ELECTRIX

3 POINT SWITCH

NOW READY.

ALSO ALL SIZES AND KINDS OF SINGLE AND DOUBLE POLE SWITCHES.

STAR ELECTRIX CO., PHILADELPHIA.

Redding Electric Co., BOSTON. | Illinois Electric Material Co., CHICAGO. | St. Louis Elec. Supply Co., ST. LOUIS. | Mountain Electric Co., DENVER.

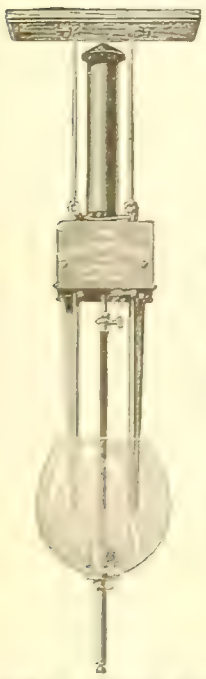
The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most xcellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

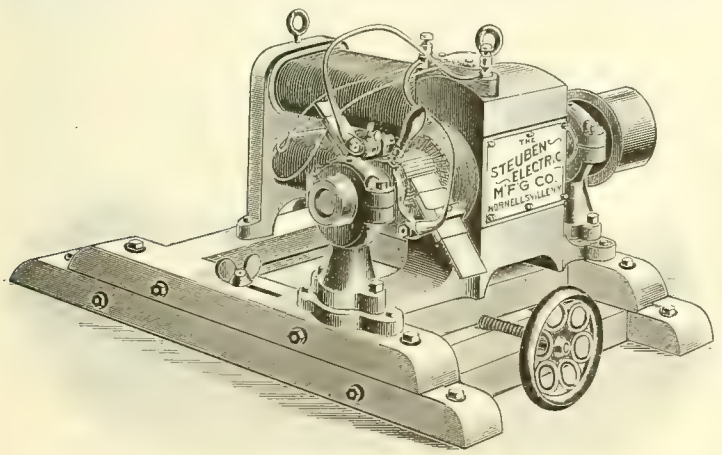
CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

DO YOU want a first-class DYNAMO with which to DRIVE your competition? If so, DIRECT your inquiries to us.



ELECTRICAL AND MECHANICAL ENGINEERING AND SUPPLIES.

REPAIRING

ELECTRICAL MACHINERY

The Electric Supply & Contracting Co.,
Nevada Building,
S. E. Cor. 5th & Sycamore Sts., CINCINNATI, O.

GIVEN AWAY!!

SAMPLE ORDERS OF

Buxton's Packing

At Only 50c. Per Pound.

"The Engineer's Favorite."
All Orders Guaranteed.

Agents wanted in every State in the Union. We quote the very lowest prices on Ring Packing. Send for discount and price list.

ESTABLISHED 1882.

GEORGE B. BUXTON,
17 VIRGINIA ST., EAST SOMERVILLE, MASS.

HIRLIMANN BATTERIES.

Are Standard.—Only One that is Guaranteed.

The Regular, or Old Style Disque Leclanche Battery, made by C. J. Hirlimann, the original maker of Leclanche Batteries in the United States.

CHAMPION BATTERY Patented.

The Improved Patented Porous Cup Leclanche Battery.

SEND FOR CATALOGUE AND PRICE LISTS
BEFORE PURCHASING ELSEWHERE

Manufactured by C. J. HIRLIMANN, 117 Macdougall St., New York.
AGENTS WANTED.

You can	Lights	Thoroughly		Send
Put	Are Standard	Reliable	Prices	For
It up	And	And	Reasonable.	Illustrated
Yourself.	Full size.	Practical.		Pamphlet.

BAIN ELECTRIC MANUFACTURING CO.,

47 So. JEFFERSON STREET,

CHICAGO.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

Something Entirely New. NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED. **Simple, Efficient, Economical.**

Indorsed by the Electrical Press, and Prominent Electrical Engineers and Electricians. For Particulars and Prices write to

THE RIES ELECTRIC SPECIALTY COMPANY, Baltimore and Eutaw Sts., BALTIMORE, MD.

PATENTEES AND SOLE MANUFACTURERS REGULATING SOCKETS.

HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, **Rods, Tubing, Washers, Discs** and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.

OLBURN ELECTRIC MFG. Co.
No 180 MAIN St.
FITCHBURG, MASS, U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

SUBSTANTIAL. NEAT. ECONOMICAL.

ELECTRIC RAILWAY SUPPLIES EXCLUSIVELY

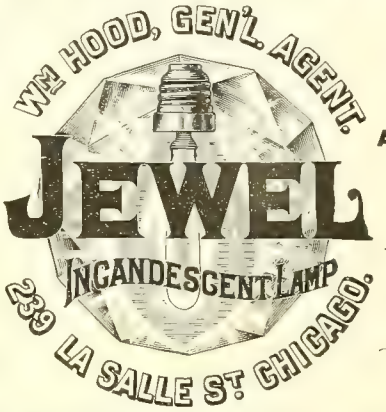
OUR BUSINESS.

ELECTRIC MERCHANDISE COMPANY,

CHICAGO,

11 ADAMS STREET. **ILL.** W. R. Mason, Gen. Mgr.

THE "JEWEL"



Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.
Any Socket.
Any Candle Power.

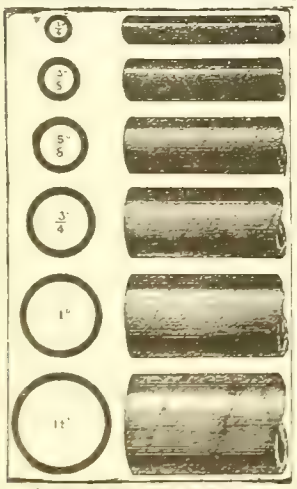
PRICES:

16 C. P. Less than 100 lots, 55 Cents.
" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Thos Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 226 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

MONITOR CARBON BATTERY

Unsurpassed in Strength and Durability.

LIBERAL DISCOUNT TO THE TRADE.
Write for Quotations.

G. A HARMOUNT, M'gr,
Monitor Electric Company
149 WABASH AVENUE,
. . . . Chicago, Ill.

Western Agents Alfred F. Moore's Wires and Cables.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

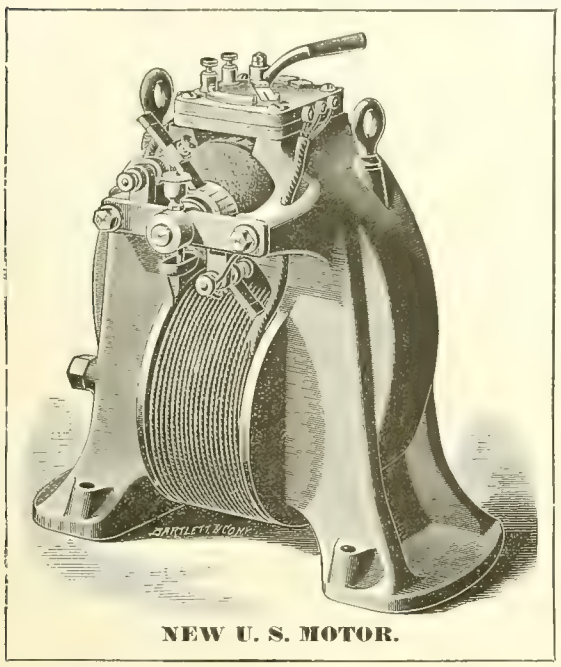
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

The Second Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

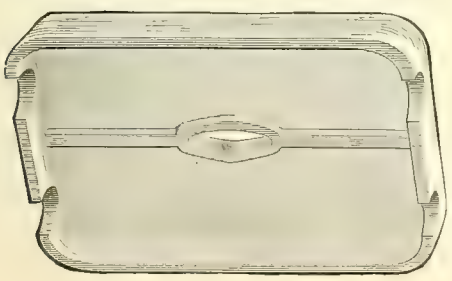
MOTORS and GENERATORS

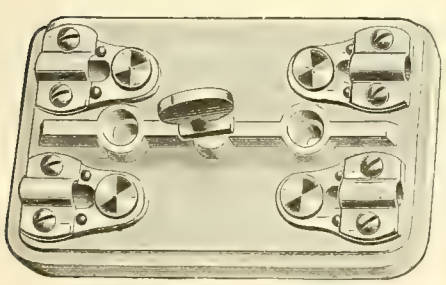
Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.





CUT-OUTS,

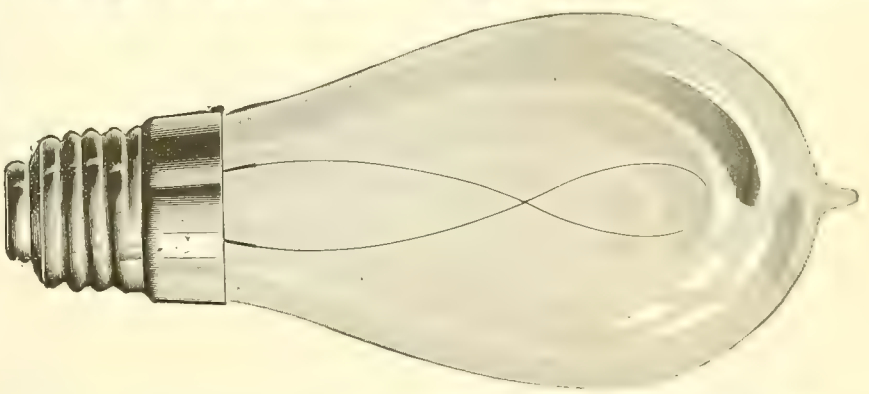
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

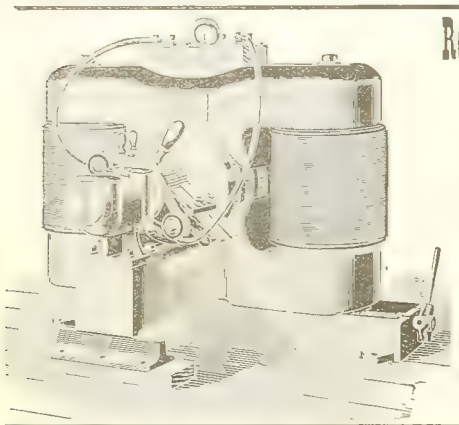
217 LaSalle Street, CHICAGO, ILL.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway).

Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 10 So. 18th St., Philadelphia, Pa.

See our full page advertisement in issue Sept 12, for illustrations, prices, etc.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

E. E. KELLER. F. E. DEGENHARDT.

Keller & Degenhardt,

ELECTRICAL ENGINEERS,

542 ROOKERY BUILDING, - CHICAGO, ILL.

THE ONLY

BUREAU of ELECTRICAL INFORMATION

IN THE WORLD'S FAIR CITY.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

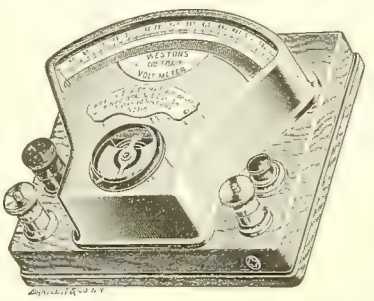
CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

NOW THEN! FOR SALE CHEAP!!

Six 4-light Thomson-Houston Incandescent Dynamos, 110 volts. Perfect order.

Three 25-light 2,000-candle power American Arc Dynamos. A 1 order.

Two 50-light 3,000-candle power Sperry Arc Dynamos. A 1 order.

700 Grease Sockets, Sockets, Lamps, etc., complete, new.

Some No. 10 American Electric Co. Wire, good as new, used one year. In ½ mile reels.

Two 400-light Thomson-Houston New Armatures.

50 American Single Carbon 2,000-candle power Arc Lamps. A 1 order.

Two 50 H. P., 700 volts, Edison Generators, used six months.

Ten 5 H. P. Sprague Motors, used six months.

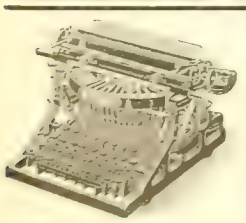
Two Edison Electric Mining Rock Drills, used six months.

High Speed Engines and Full Station Equipments, Poles, etc.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

REMEMBER

That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.



The "DENSMORE,"

The World's Greatest Typewriter,

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type-bar machines.

Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Steel throughout.

STANDARD KEY-BOARD, with shift carriage for capitals. Call or send for catalogue.

[illegible] To buy any other than the 'DENSMORE' [illegible] T. BARRETT-HILL, Stenographer, National Park Bank.

[illegible] dealer in all cities as soon as possible, and in the meantime will ship [illegible] a good commercial rating.

DENSMORE TYPEWRITER CO., 202 Broadway, New York.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

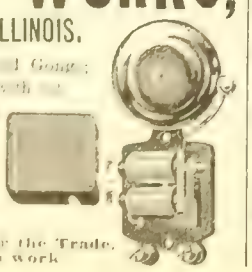
If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

UNION ELECTRIC WORKS,

207 South Canal St., CHICAGO, ILLINOIS.

The Best Electric Bell [illegible] Gong; [illegible] with [illegible] Dry Batteries. [illegible] Open Circuit Gravity Cells. [illegible] Annunciators. [illegible] Push Buttons. [illegible] Electric Call Bells. [illegible] Electric Door Openers. [illegible] Burglar Alarms. [illegible] Electric Bells. [illegible] Electric Gongs. [illegible] Electric Bell Wire. [illegible] Electric Bell Supplies.



WRITE FOR PRICES.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class work.

PLATINUM. JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

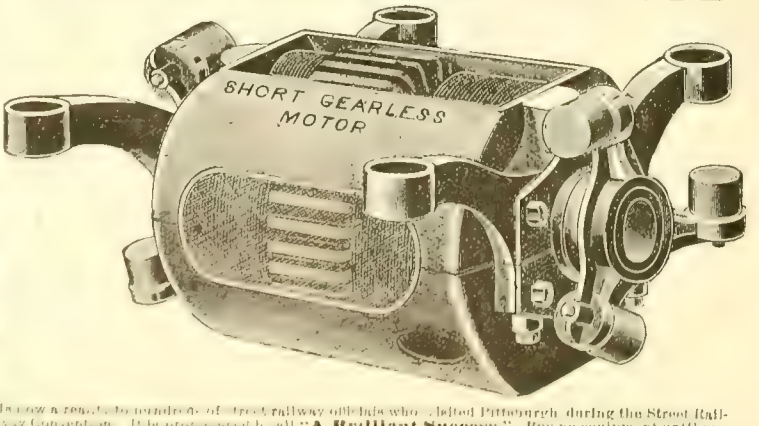
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

The Gearless Motor



In view a remarkable number of street railway officials who visited Pittsburgh during the Street Railway Convention. It is pronounced by all "**A Brilliant Success.**" Buy no equipment until you have examined Short Motors, and obtained prices from

THE SHORT ELECTRIC RAILWAY CO., CLEVELAND, OHIO

Light

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, NOVEMBER 21, 1891. No 21

Hunt Street Generating Station, Cincinnati, O.

The accompanying illustration gives a good representation of the central or Hunt street generating stations only recently built by the Cincinnati Consolidated Electric & Street Railway company at an outlay of $250,000.

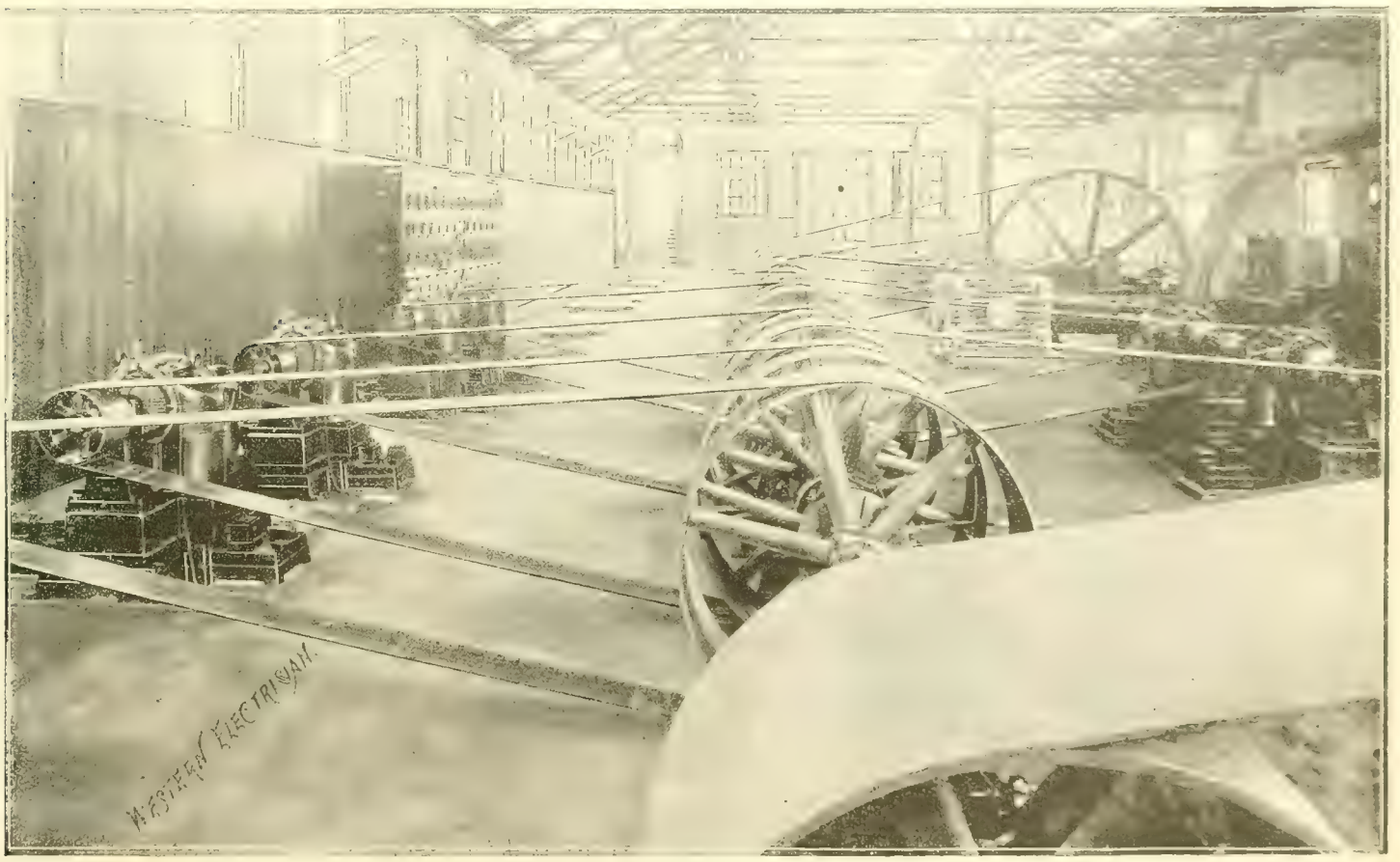
This station, which when completed will be the largest and most complete railway generating power house in the central states, furnishes the power for operating all the lines in the central part of the city, and for two suburban lines, the Norwood and Madisonville, extending several miles out into the country.

This company uses the Thomson-Houston double trolley system exclusively on all its lines, and so far the operation of this system has far exceeded its expectations, both as regards economy and smoothness of running.

The engines, shaftings, pulleys, floor stands and all the necessary attachments were purchased and erected by the Lane & Bodley company under the supervision of B. L. Baldwin, engineer for the Consolidated company. Bradford oak tanned belting is used throughout, the main driving belts being 150 feet long and 4 feet wide. The steam piping is quite extensive, there being a duplicate or double set arranged so that in case of an accident the station cannot be completely crippled. The McGowan Pump company did the piping. The Hine eliminator is used on all the steam pipes supplying the engines.

The switch board is compact and neat, and is built of hard wood. It is equipped with Thomson-Houston arresters, ammeters, voltmeters, safety plugs and snap feeder line switches.

A 100 horse power Buckeye engine, driving a 100 horse power generator, occupies one corner of the station, and is used for the night run after 12 o'clock.



HUNT STREET GENERATING STATION AT CINCINNATI, O.

The main building or generating room, herein shown, is 200 feet long by 78 feet wide, built of brick in a very substantial manner, and with a heavy truss slate roof. In this room, when completed, there will be one 1 500 horse power Lane & Bodley compound condensing Corliss engine, two 600 horse power, and one 500 horse power noncondensing Lane & Bodley Corliss engine, all driving a line shaft extending the entire length of the building, and so arranged by means of clutches that any or all of the engines may be cut in or out to suit the load, the line shaft being in sections, and so arranged that the different engines can be utilized to operate any particular section to suit its group of generators.

From this line shaft, on which are placed tight and loose pulleys, are driven the generators arranged on either side the entire length of the room.

The generators, twenty-six in number, are of the Thomson-Houston type, each of 80 horse power capacity operated at a pressure of 500 volts.

The boiler room, which is of similar construction as the main building, is 160 feet long and 40 feet wide. In it are conveniently arranged nine 250 horse power Babcock & Wilcox boilers in batteries of three, equipped with Murphy furnaces. The boiler feeders consist of one McGowan duplex pump, and nine injectors.

The stack is a very handsome affair, constructed of brick, 165 feet high, 24 feet square at the base, with an eight-foot shaft.

This station is in charge of Edward Ginter, engineer and electrician, late of the Colerain avenue electric road of Cincinnati, and is a model of good engineering throughout.

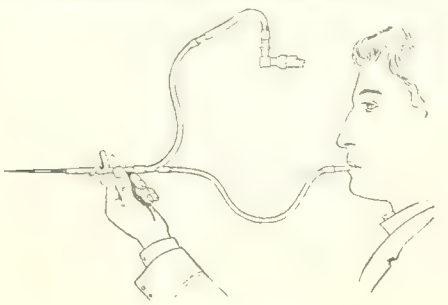
It is likely that the Banner and Wolverine mines in Idaho will be operated by electricity, the plant to cost $35,000.

Electricity at the World's Fair.

By reason of the [illegible] directory of the World's Columbian Exposition there has heretofore been [illegible] members of the committees on electricity and on grounds and buildings [illegible] two committees when contracts for electrical work necessary during the [illegible] The by-laws state that the committee on grounds and buildings "shall have [illegible] to grounds, leases, engineering, designs, plans, construction of buildings and works, maintenance of buildings and grounds; organization of guard, police, detective and fire departments; gas, electric lights, water supply, medical service, applications for space, telegraphy, insurance and supervision of buildings erected by outside parties." But it is also stated that the committee on electricity "shall have jurisdiction over all matters pertaining to electricity, electrical and pneumatic appliances, and all plants connected therewith." The same powers were [illegible] to some extent, conferred on two bodies, and there was [illegible] for endless friction. The situation was often discussed in the two committees mentioned and in the executive committee, in a friendly spirit, and various remedies were suggested. The committee on grounds and buildings had no desire to usurp the functions of the electrical committee, which was clearly the best [illegible] electrical supplies were to be let. But, on the other hand, all contracts for other work were let by the grounds and buildings committee, which [illegible] facilities for enabling contractors to meet the requirements imposed upon them. [illegible] some and inconvenient [illegible] like routine by which contracts might be awarded. A method has finally been [illegible]

however, by the appointment of a representative of the committee on electricity on the committee on grounds and buildings. A vacancy having occurred in the latter committee, Col. R. C. Clowry, chairman of the former, has been appointed to fill it. Col. Clowry will consult with the members of his own committee and will represent the electrical interests whenever matters of this character are brought up in the committee on grounds and buildings. It is thought that this plan will work to the satisfaction of all the gentlemen interested.

In the course of a letter to Col. Clowry from his friend, W. H. Preece, chief electrician to the government tele-



MOOR'S BLOWPIPE.

graph department in England, several interesting references to the World's Fair, as viewed from the standpoint of an English electrical engineer, are made. Mr. Preece dated his letter October 21st, and he had then just returned from a meeting of the English Royal Commission, which had listened to a full account of the observations of Sir Henry Wood and Mr. Dredge in Chicago. These gentlemen gave a most favorable description of what they had seen and of their reception. "We are getting quite excited over this exhibition," continued Mr. Preece, "and you may rely upon eveything being done on this side of the water to make it a big success." The writer refers to a visit from Secretary Hornsby, who, he said, had been "knocking about here with a go and energy that none but an accomplished Chicagoan can show." Mr. Preece's statement of the feeling of the English manufacturers is of especial importance. He says: "Our working manufacturers will want some assistance. The cost of mere exhibition is a very heavy item indeed, and to show the actual operation of our electric lighting methods would very much enhance the exhibition from an English point of view. Our two great firms—Willans & Robinson and Crompton & Co.—want to take part in the general illumination of the buildings, as they did in Paris." Here is a hint upon which the World's Fair authorities may ponder with profit.

The employment of an additional stenographer in Chief Barrett's office was authorized at last week's meeting of the committee on electricity.

An immense water palace on the Lake Front is proposed as a down-town entrance to the exposition. The building is much larger scale. When these lights are put into operation the exterior of the glass dome will present marvelous shifting color effects. As a climax of illumination the mainmast of the ship at the top of the dome will be supplied with a powerful search-light that can be used as a beacon for mariners."

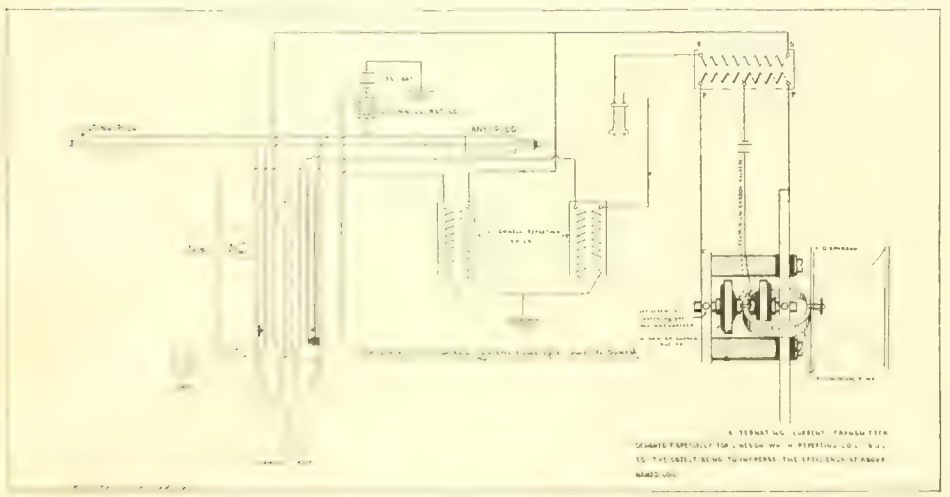
President Donnersberger, of the South Park commissioners, has been vested with authority to decide on plans for lighting by electricity the three boulevards leading to the exposition grounds. He says that the board will probably begin the improvements it has in view by putting in a new electric light plant at a cost of $75,000 or $100,000. "This plant," Mr. Donnersberger adds, "will give us power for 300 arc lights It probably will be built in Washington Park, as that is near the center of the district we propose to illuminate. We have talked about the disposition of these lights and decided that 104 of them will be needed in Washington Park. Forty will be put in Drexel and Grand boulevards and ten in Oakwood boulevard. That leaves about 100 of the 300 lights, and these will be put where they will do the most good." Midway Plaisance, leading from Washington Park to Jackson Park, will be lighted by the World's Fair people.

The *Chicago Times* publishes a dispatch from Buffalo to the effect that "Dr. Richard Gratzel, the well-known eletro-chemist of Hanover," is in that city. This gentleman, after citing the result of the Frankfort-Lauffen experiment, announces that "there is scarcely any doubt that 80,000 volts can be used and power transmitted from Niagara Falls to Chicago, New York, Boston, Philadelphia, or other large manufacturing centers." If Dr. Gratzel is correctly reported, he described the long distance test in very curious language. Here is a sample: "For the generation of this high tension two oil insulated transformators were connected, one before the other, to show the influence of such currents. The current was first used to produce an arc between two carbons, and its power was demonstrated by its burning a hole through a plate of glass. The lamps were then disconnected and the whole current, now increased to the enormous tension of 48,000 volts, was used for the formation of an arc light. The intensity was so great that the light was not as brilliant as when the 20,000 volts were used."

Boats propelled by electricity are to be a feature of the World's Fair. A company has been formed with a capital of $30,000 to run a fleet of electric pleasure craft on the lagoons at Jackson Park during the exposition. It is asserted that sixty boats will be employed, each capable of carrying 50 passengers. The motive power will be furnished by accumulators. One of the little vessels, the Eclipse, is now ready to be launched. The boats will not be run at a high speed and will make the circuit of the waterways in the park in an hour.

Moor's Blowpipe.

The illustration represents a simple blowpipe, which will be found useful by manufacturing electricians, chemists, etc., for hard or soft soldering or brazing. It is claimed



by the makers, the Cambridge Scientific Instrument company of Cambridge, England, that it is capable of pro- [illegible] easily regulated in size, and of great [illegible]. Rubber tubes lead from the gas supply and from the glass mouthpiece, and give perfect freedom of action in applying the flame to all parts of the work. It is stated that it gives a well-defined inner and outer [illegible] heat to melt silver or copper [illegible] by oxygen, fine platinum wire can be melted.

O'Connell's Alternating Current Telephone Transmitter.

The accompanying cuts illustrate a new form of telephone transmitter recently devised by J. J. O'Connell, electrical engineer of the Chicago Telephone company. This instrument was designed especially to work on lines on which the repeating coil is used, and also on long cable lines of high static capacity.

The peculiar action of the device will be better understood after reference to the diagrams, which will give the reader a very good idea of the manner in which the transmitter is applied in an operator's circuit on a mixed system multiple switch-board. The transmitter proper is shown to the right in Fig. 1. The construction is very simple. Attached to the fixed diaphragm is an aluminum ring, or yoke. As is clearly shown, one side of the ring is fixed to the diaphragm by a small bolt and nut, while the other side is set rigidly between two granular carbon buttons. These buttons are of the form well-known to telephone men, but those who may not be familiar with their construction would do well to refer to Fig. 2, which shows a button in detail.

This transmitter is used with an induction coil, but the connections are modified so that the action of the instrument is entirely different from that of the Blake.

Glancing at Fig. 1, it will be seen that one outside terminal of the coil connects with the right hand carbon but-

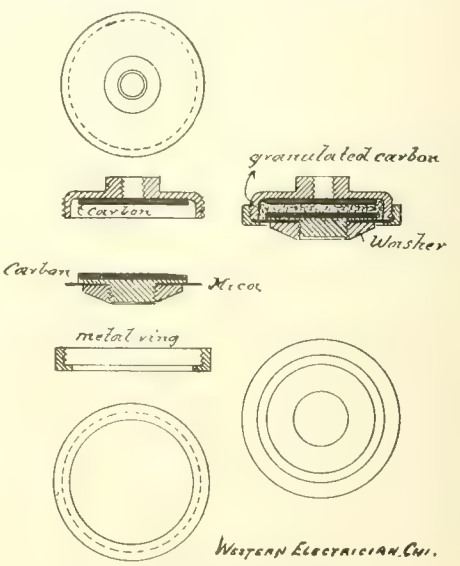


FIG. 2. O'CONNELL'S ALTERNATING CURRENT TELEPHONE TRANSMITTER.

ton, while the other outside terminal connects with the left hand carbon button. In the center of the coil there is another connection, or tap wire, which includes the battery, and runs to that side of the yoke which is between and in contact with both carbon buttons. The remaining connections from the secondary of the induction coil are the same as those employed with the Blake transmitter. The action of the instrument is described by Mr. O'Connell as follows: The backward and forward movement of the yoke, caused by the action of the voice against the diaphragm, varies alternately the resistance of the two circuits which constitute the primary of the induction coil. As will be readily seen the vibrating motion of the yoke acts in such a manner as to send the greater portion of the current from the battery in the center tap wire, first through one side of the primary in one direction, and then through the other side of the primary in another direction. This action, Mr. O'Connell states, sets up in the secondary, or line circuit of the coil, secondary currents of such a character that their use makes possible the operation of the transmitter on cable lines where the static capacity is very high and an ordinary Blake instrument is useless so far as getting any sort of satisfactory results.

It is claimed that the increase in the efficiency of operation of this transmitter over the ordinary, Blake or even the long distance instrument, is most marked. A comparative test was recently made over the lines of the Chicago Telephone company, and also with repeating coils. In a test over a 200 mile aerial circuit, including about three miles of Patterson cable, the operator at Oshkosh, Wis., reported that the transmission was perfectly distinct, but that it was not necessary to have it so loud. An experiment was then tried in the laboratory, which demonstrated that it was possible with this instrument to operate successfully through fifteen repeating coils. It may be stated that the long distance instrument failed on this test.

Removing Ice from Trolley Wires.

Some months ago there was illustrated in the WESTERN ELECTRICIAN a simple device by which oil could be applied to an electric railway trolley wire for the purpose of preventing the formation of a coating of ice or sleet on wire. This arrangement was attached to the upper end of the trolley pole near the wheel, and as the car moved along the oil was applied by means of another small wheel or roller, which took up the lubricant from a receptacle hanging below it. By this means it was expected to get rid of one of those numerous small difficulties which beset the electric railway man.

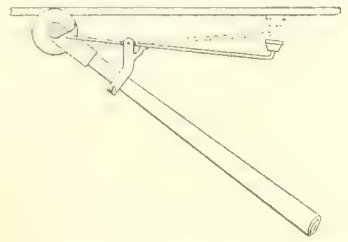


FIG. 2. REMOVING ICE FROM TROLLEY WIRES.

In the accompanying cuts, Figs. 1 and 2, is illustrated an arrangement through which it is proposed to attack and overcome this trouble in another way. Through the use of the new device the ice is to be removed from the wire after it has formed. The arrangement is the invention of George Hipwood of Boston, Mass. The diagrams are almost self-explanatory as to its construction and operation. Clamped in front of the trolley wheel and in contact with the wire, as shown in Fig. 1, is a roller with an eccentric affixed to its side. This eccentric plays, as indicated, in a slot at the end of a pivoted lever which carries a small hammer at its forward end. This is all there is of the device, not mentioning, of course, a few minor details of construction. The ice breaker operates as follows: As the car moves over the line, dragging its trolley wheel along the wire, the ice breaker roller carrying its little eccentric is put in motion, thus communicating to the hammer lever a rapid up and down vibratory motion. The ice on the wire is thus beaten to pieces as the car runs along. Fig. 2 is a modification of the device just described.

Interesting Patent Decision.

Judge Blodgett filed an interesting opinion in the United States Circuit Court, Chicago, November 9th, in the case of the Western Electric company against the Electrical Construction company and Gustave A. Harter.

On January 12th an injunction had been granted restraining the defendants from infringement of patent number 148,447, granted March 10, 1874, to Augustus Hahl, and patent number 172,993, granted February 1, 1876, to Elisha Gray. The opinion follows:

"The devices covered by these patents are what are known as electric annunciators for elevators or lifts in buildings, being the annunciators in common use in the cabs of passenger elevators whereby signals are given from each floor by means of a signal key which connects with a flexible electric cable attached to the cab, or with a vertical strip of wire extending from the bottom to the top of the elevator well.

"Since the injunction was granted the Hahl patent has expired, and the injunction may be said to have lapsed so far as the patent is concerned. But the Gray patent of February 1, 1876, has yet some time to run.

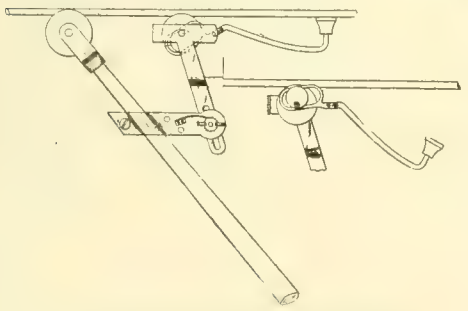


FIG. 1. REMOVING ICE FROM TROLLEY WIRES.

"The Hahl patent covered the flexible cable. The Gray patent was for the combination of a movable elevator car, the annunciator attached thereto and moving therewith, circuit closing and breaking signal keys on different floors, and mechanism whereby an electric current is maintained between the signal keys and annunciator without interruption by the movement of the car.

"These two patents were before this court in Western Electric company vs. Chicago Electric Manufacturing company, 14 Federal Rep., 691, and both present and valid.

"Proof shows defendants had notice of the injunction; and also shows that during the month of May last, and while the injunction remained in full force as to the Gray patent, defendants put an electric annunciator into the Haymarket theater building in this city, which was a direct infringement of the claim of the Gray patent, that is, the annunciator is attached to the cab and moves therewith, has circuit closing or breaking signal keys on each floor, and a mechanism whereby an electric circuit is maintained between the signal keys and the annunciator without interruption by the movement of the car.

"This claim is very broad, and the main fact that the Hahl patent on the flexible cable has expired does not allow the use of the annunciator which is attached to the cab and moves with it and is connected by means of signal keys at each floor with an electric circuit.

"The defendant has therefore violated the injunction, and thereby is guilty of contempt of the order of the court. Fined $50 and costs."

Barton & Brown appeared for complainant and J. H. Whipple for defendants.

Electricity in the Composing Room.

Orderliness is not a usual characteristic of composing rooms or of printing offices in general, but the composing room in the new *Herald* building, Chicago, which appears to be a model one in every respect, is a marked exception. Among other improvements is a system of electrical communication between the copy cutter's desk and the cases of the compositors. Late at night it frequently happens that the foreman is not in receipt of sufficient copy from the editorial department to keep all the typesetters at work. After these periods of "waiting time" it is customary to give the first "take" of the new copy to the man who has been waiting longest, and so on in rotation. Heretofore the order in which the men went out of copy has been simply indicated by plugs bearing the slug numbers inserted in a perforated board. When there was copy again, some one would have to shout out the numbers, each compositor coming forward in his turn. This caused considerable noise and confusion, which will be obviated in the *Herald* composing room. In the copy-room, below the foreman's platform, there is a series of electric buttons. In front of these buttons is the slate pierced with holes in which the pegs, each corresponding to the number of a man's slug, are placed. When a man is out of copy he slips his peg in the first vacant hole and the slug number is shown above the electric buttons. Just

The Transformer House of the High Tension Transmission System at Frankfort, Germany.

[illegible] published of the Frankfort electrical exhibition, that it seems almost an imposition to present even as interesting [illegible] While however the [illegible] been pretty thoroughly described, there is still a great deal to be learned relative to its greatest feature, viz., the high tension scheme. One glimpse of the picture reveals a lightness of construction in the pole line which one would hardly expect to see where the wires carried currents of such high voltage. It may be mentioned that the transformer house is kept locked and no one is allowed to enter until a "triangle," which is above the three wires, on the pole with the crossarm, has been lowered and the circuit cut out. At the points where the wires to the transformer enter the house one can see the pole and line construction with its small insulators. These insulators have only one oil cup instead of three, as in the larger ones. There are now only a few of the small insulators employed on the line near Frankfort. The larger ones may be seen on the lines near Lauffen. The skull and crossbones signs painted in red and black are to be found only in the country.

TRANSFORMER HOUSE OF THE HIGH TENSION TRANSMISSION SYSTEM AT FRANKFORT, GERMANY.

Chicago Society of Operative Electricians.

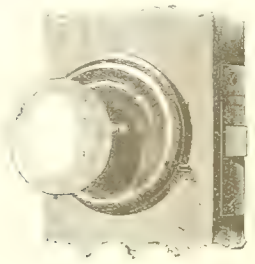
The Chicago Amateur Electrical Society [illegible] last meeting decided to change the name of the organization to the Chicago Society of Operative Electricians. The association has secured permanent headquarters [illegible] 120 Quincy street, Chicago. The objects of this society are the advancement of its members in the knowledge of electrical science by lectures to be given [illegible] electricians interested in the society, and by a thorough course of study. This work will be conducted under the personal direction of H. [illegible] Brown, [illegible] years' practical experience in electrical [illegible] the finances of the society will permit, a library will be started, in connection with which a laboratory will be fitted up in order that theory may be [illegible] practical experiment. The [illegible]

[illegible] representation at the World's Columbian Exposition. A committee is now engaged in this work. At a recent meeting J. Allan Hornsby, secretary of the electrical department of the World's Fair, made an address in which he assured the members that they would be given all the encouragement they desire by the department. He added that they would be given the same privileges that experts and manufacturers would be granted and that light, heat and power would be furnished them for the exhibit.

J. K. Pumpelly has agreed to address the association at an early date. Two meetings are held each month—on the first and third Thursdays—and each Monday evening the members assemble for study and discussion.

The Door Knob Alarm Bell.

Electricians will have to look to their laurels, for the E. S. Greeley & Co of New York is now introducing a mechanical alarm which operates without the aid of a battery. The little safeguard is simplicity itself, as can be seen from the cut. It may be applied to the knob, either inside or out, of any door where it is desirable to

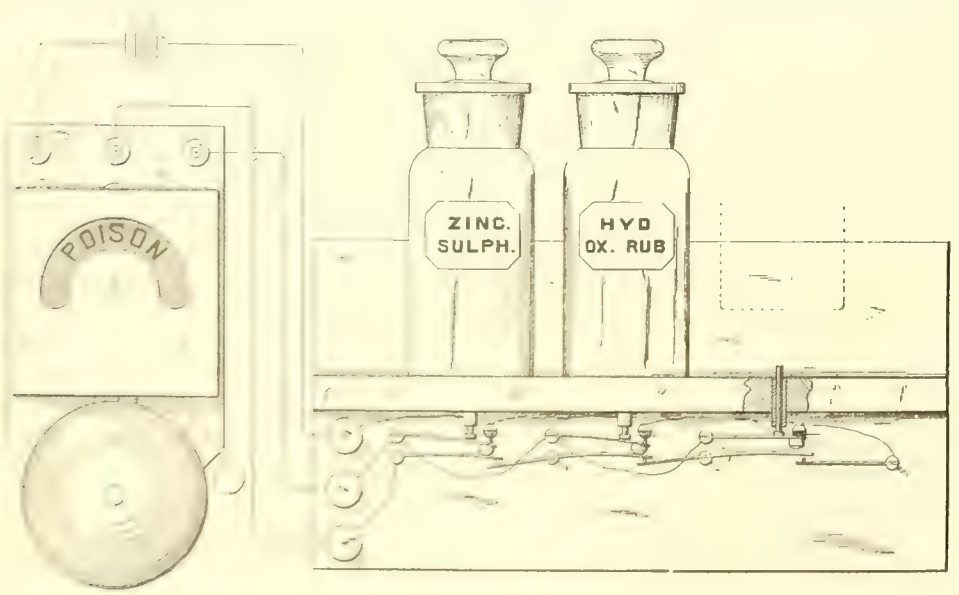


DOOR KNOB ALARM BELL.

have a signal given at any attempt at entry, whether the door is locked or not. A half turn of the knob in either direction will ring a signal giving notice within. A small lever attached to the bell secures silence when desired. The bell is only three inches in diameter and about one-half inch in thickness, and is not conspicuous when applied. No wires are required. It is entirely mechanical and complete in itself.

A Druggist's Danger Signal.

An ingenious electrical mechanism devised for the purpose of securing the automatic announcement of changes in the position of removable articles, such as bottles, is presented in the illustrations shown. It was the inventor's purpose in designing this apparatus to overcome one of the dangers incidental to the drug business. From time to time one hears of accidents due to some careless drug clerk compounding a prescription from the wrong bottles. For instance, expecting through habit to find a certain harmless ingredient in a bottle usually placed in a certain



This electrical poison indicator is the invention of Joseph B. Smith of Manchester, N. H.

Electric Development at Ottumwa, Ia.

The Electric Light, Steam Heating and Railroad company of Ottumwa, Ia., has been organized, and the capital stock increased by the acquisition of several Chicago capitalists. The capital stock now is $500,000. The company does all the municipal lighting as well as furnishing commercial lights. Two stations aggregating 175 arc and 2250 incandescent lamps are operated. The street car department of the company's business includes six and a half miles of tracks, five motor cars, and three trailers. The company is extending the tracks and increasing the number of cars.

The officers of the company are: President, W. R. Daum; secretary and treasurer, G. P. Daum. The company is doing a great deal toward developing the rapidly growing city of Ottumwa, and citizens there were greatly pleased at hearing that Chicago capitalists were becoming interested in its growth.

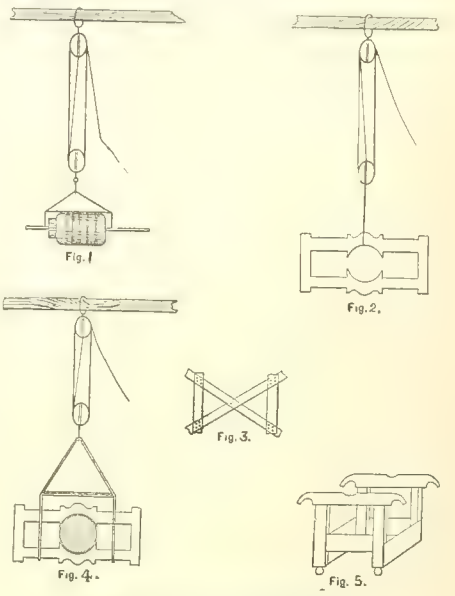
Edison on Patents.

Mr. Edison has had so much experience in patent office business and patent litigation that his opinion of the present system and the methods employed will be of interest. Mr. Edison recently expressed himself on patents in a way which will by some inventors be thought to be more pertinent than pleasant. Many of the readers of the WESTERN ELECTRICIAN will, doubtless, concur with him in the opinion so plainly set forth. Here is what he says:

"Our patent system puts a premium on rascality. I have taken out 700 patents for my own inventions, but I have never had one minute's protection. The people suppose I have made money out of my inventions. The truth is, I have never made one cent out of my inventions. All I have made has been out of manufacturing. My inventions have not been protected by the Patent office. The companies with which I am connected have spent millions in trying to defend them. I have spent about $600,000 myself, and I believe I would be $600,000 better off if I had never taken out a patent. What I have made has been because I have understood the inventions better and have been able to manipulate the manufacturing of them better than the pirates. I could not have made anything had I not had large capital back of me, and the ordinary inventor has no protection whatever. His certificate of patent is merely a certificate to the poorhouse, and hundreds of inventors are ruined. They spend all they have in getting out their inventions, and they die poor. Let me tell you how it works: The inventor has a good thing. He takes out his patent, thinks he is safe, and organizes a plant to manufacture it. He has to have special machinery, and he makes special experiments, and like as not it all costs him $200,000 before he is ready to begin manufacturing. The pirate sees he has a good thing. He decides to compete with him, organizes a company with no responsibility whatever, bribes his men, and starts in opposition. He can in most cases now put up for $50,000 what has cost the inventor $200,000. He begins to manufacture. The inventor prosecutes him, but the courts take three years before they will hear his case. If they decide against [illegible] to the Supreme Court, which is three years behindhand, and it is from six to twelve years before he [illegible] decision. By this time the pirate has made [illegible] the original inventor is in most cases bankrupt. If the case is decided in his favor the pirate is [illegible] and there is no chance for the inventor. What the courts should do is to prevent the [illegible] he can prove that he has a right to manufacture. The original inventor, the man who [illegible] spent his money, should have the benefit of the doubt. When this is done our inventors will have some protection. Then invention will increase in the United States."

Useful Hints for Dynamo Men.

In a recent issue of *Power* an article entitled "Running an Electric Station" contained descriptions of a number of perhaps well-known but nevertheless useful wrinkles. The dynamo tender and steam engineer are nowadays often called upon to quickly handle lighting machines and motors in places most inconvenient. The accompanying diagrams illustrate several of the simple methods and tools by the



USEFUL HINTS FOR DYNAMO MEN.

intelligent use of which a great deal of risk usually attendant upon such work may be avoided.

Fig. 1 suggests a safe and easy way of slinging an armature, with a stretcher between the parts of the sling, with waste or bagging or something similar between the board and wire.

Fig. 2 shows a way that a certain type of dynamos may be hoisted. This method cannot be recommended, though, for many machines are not put together securely enough to make it advisable to handle them in this way.

Fig. 3 shows a stretcher to be used in hoisting the entire machine, as shown in Fig. 4. This is a good, safe way when the rope is well padded wherever any pressure comes. It is better, though, to place a short piece of plank about the same width as the fields under the frame in the sling, so as to bring the pressure directly upon the solid iron of the magnets. When the armature is out the rope can be placed in the recesses directly beneath the armature, and brought over the same recesses in the top magnets. This arrangement will save the necessity of the stretcher and the trouble of padding. Of course the handling of the other styles of machines will differ slightly from the above, but the idea may be modified to suit the case.

Fig. 5 is a horse or a cradle to place armatures in while being repaired. It is set on heavy swivel castors with large wheels, so that a boy can easily push it to any part of the room. The weight of the armature should not be allowed to come upon the winding.

An Expert Opinion on Electricity in Mining.

"It is only a matter of time until electricity will revolutionize the mining industry," said F. M. Carpenter, of Devil's Run, Nev., in the *Chicago Herald*. "By conveying water in flumes to the mouth of a shaft on the Comstock and then letting it fall to the level of the Sutro Tunnel a force equal to a pressure of 680 pounds to the square inch was generated; the problem was how to transfer this power from the tunnel level, where it was not wanted, to the stamp mills, where it could take the place of steam. The problem appears to have been solved by the use of electricity. Electric motors convey the power with a loss of less than 40 per cent. from a point 1,600 feet below the surface of the ground to the mill on the surface, and when the power reaches the stamps it is found to be equivalent to 435 horse power, which would run any stamp mill in the world. With steam as a motive power it is impossible on the Comstock, even with the latest improvements in reduction, to treat economically ore which carries less than $15 of gold and silver to the ton. Where the ore lies on the surface and can be quarried out in enormous quantities, as in the Black Hills in Dakota, there is money in mining and milling ore which runs a few dollars to the ton. But where the ore has to be hoisted from great depths and considerable expense has to be incurred for pumping, ventilation, crushing, etc., the cost

of steam is so great that really low grade ore cannot be handled at a profit. If the new electric motors prove successful in practical use this cost will be saved. It is estimated that with the power furnished by them the Nevada mill can treat $10 ore satisfactorily, and with an ample water supply even $5 ore can be treated with profit."

A New Rotary Engine.

The Duplex Rotary Engine company, Chicago, is placing on the market a new rotary engine of novel design, an illustration of which appears herewith. The working parts,

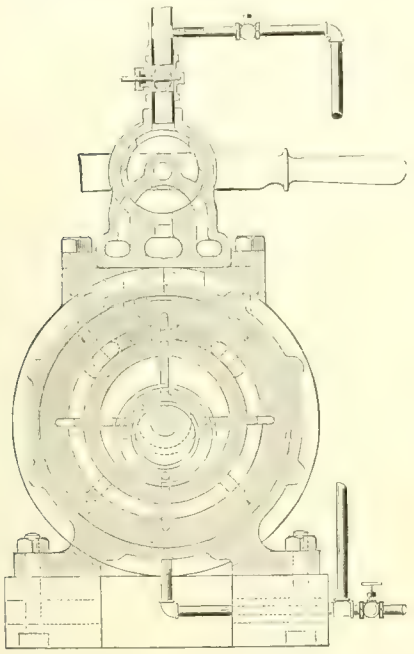


FIG. 2. NEW ROTARY ENGINE.

which are shown in Fig. 2, are confined to four pistons or valvs operated by an eccentric so arranged that the steam is used expansively, something that has not heretofore been possible in a rotary movement. The engine is a desirable one for small lighting plants, occupying but little space, and with a steam pressure of 200 pounds a speed of 2,000 revolutions is easily reached. Coupled directly to an incandescent dynamo in a recent test at the Exposition building, Chicago, a steady light was furnished, and it is claimed with a consumption of steam no greater than customary with any of the ordinary high speed engines. The engine has few parts and can be made at a comparatively low price. The same principle has been applied in the construction of a rotary pump with equal success.

Who Informed Morse of the Passage of the Telegraph Bill?

It has been generally supposed that Mrs. Roswell Smith, wife of the president of the *Century* company, was the first to inform Prof. Morse of the passage of the bill providing for the building of the experimental telegraph line, but now there appears a rival for this distinction in the person of Mrs. Harriet White, widow of Senator Albert S. White of Indiana. Mrs. White was at Morgan Park last week and gave her story to a reporter in the course of a chat about the distinguished men of the period when her husband was engaged in national politics at Washington. Here is the story, as reported by the interviewer:

"Mr. Morse had been importuning Mr. White for a long time to get the bill passed, and my husband did all he could. Finally he came home one night—it was at midnight, just at the close of a secret session of the senate—and said: 'I've got some news for you. The senate has just passed Morse's bill, and it will become a law.' Mr. Morse was stopping in the same boarding house, on the same floor with us. I hastily slipped on a wrapper and rushed to the door of his room. I pounded away on it until I woke him up. 'What's the matter?' he cried, thinking some accident had happened. 'Your bill has passed! Your bill has passed!' I shouted. Then I rushed back to my own room. Morse jumped from his couch and fairly yelled and danced with delight. Then he ran to our room and knocked at the door. 'You can't come in,' I told him, 'because we're just going to retire.' 'But I want to talk over the good news,' he pleaded; 'can't I see Mr. White?' Mr. White went out into the hall and talked with the excited inventor and convinced him that the news was true. A short time after that the trial line to Baltimore was in readiness and the test was made. I sent the third or fourth message that memorable day, the first one being written by a young woman with whom Mr. Morse had been very much infatuated, but who would never marry him."

Mrs. Smith, to whom reference is undoubtedly made by Mrs. White, informed Morse of the passage of the bill on the morning following the victory. She was a daughter of Henry G. Ellsworth, commissioner of patents at that time, and she certainly believed that she was the first to break the news to Prof. Morse. Her father had been a classmate of Morse at Yale, and as Ellsworth belonged to an influential Connecticut family his support of his old schoolmate's bill was most valuable. When Morse was informed by Miss Ellsworth of the passage of the bill he accompanied her to her father's home to learn the particulars of the victory from his old friend who had been present, and had greatly assisted in pushing the bill through.

Miss Ellsworth had been an enthusiastic advocate of Morse's bill, and when she informed him of its passage he promised her that he would permit her to send the first telegram over the new line. This message is still preserved.

The Hon. James D. Reid, who is certainly an authority on all matters pertaining to the history of telegraphy, gives Miss Ellsworth credit for being the first to bear the news to Prof. Morse, and this opinion has been shared by telegraphers generally. At the last meeting of the Old Time Telegraphers this was especially noticeable when Mrs. Smith was invited to participate in the proceedings, and many references were made to the encouragement which Morse received from the Ellsworths during the days of anxiety.

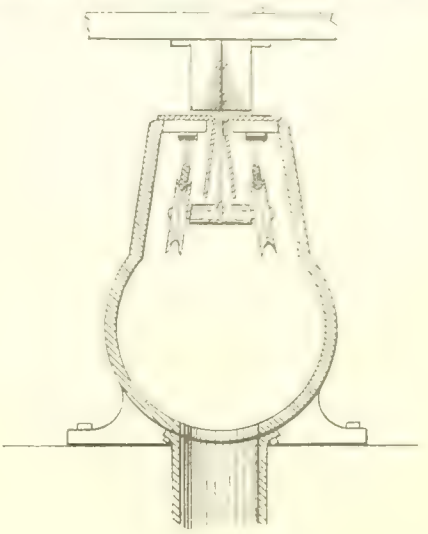
American Institute of Electrical Engineers.

Carl Hering, chairman of the delegation representing the American Institute of Electrical Engineers at the International Congress of Electricians at Frankfort, has made his report to the Institute. The fact that the proposition presented by the American delegation was not adopted is explained by the lack of time for proper discussion. In Mr. Hering's language, "It was thought better not to do anything than to do something which might afterward be regretted." It will be seen by the following extract from the report, that there was not unnaminity of opinion on the proposition:

"The English members appeared to favor the adoption of the name 'Henry,' Mr. Preece saying that he had received instructions from the Royal Society to advocate its adoption. The German, French and Swiss members opposed it on various grounds. Some thought it conflicted with the already adopted name, 'quadrant;' others thought it ought to be 'Franklin;' others 'Neumann,' and some did not acknowledge the work of Prof. Henry in this field. Quite a number had never heard of its adoption by this Institute. The names Gauss and Weber for the magnetic units appeared to meet with general approval. The disagreement was as to what numerical values should be.

Camp's Conduit.

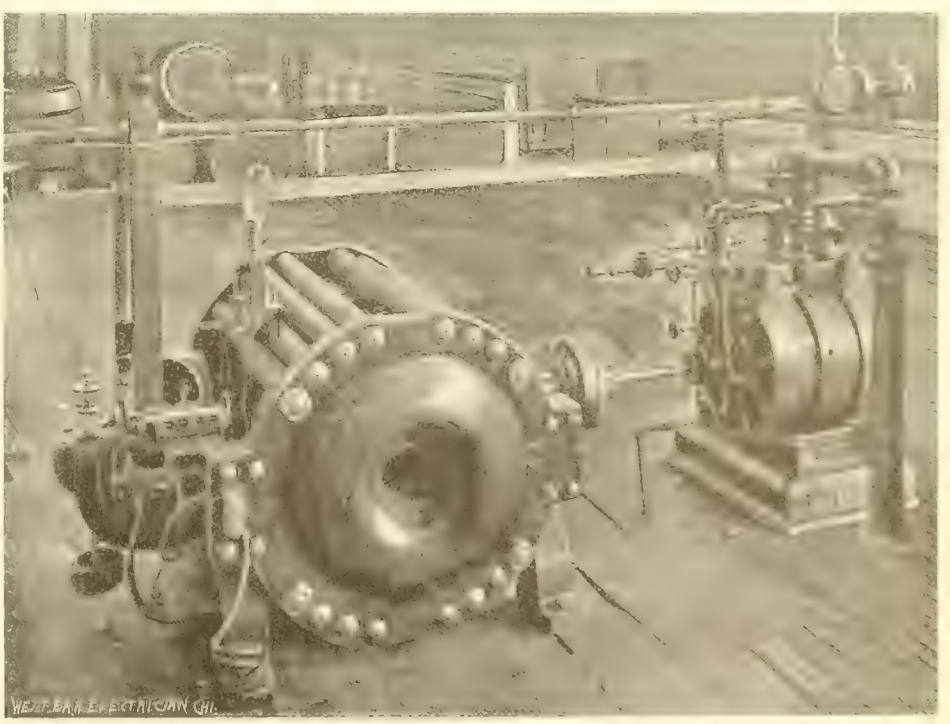
The construction of the conduit shown herewith will be



CAMP'S CONDUIT.

of a perfect circle when viewed in cross-section. The lower curved part affords an open space adapted to receive any foreign substances which may find their way into the conduit, and from which they may readily be swept by means of a revolving brush attached to the car. At the lowest points in the general grade of the track there are outlets, through which the drip and foreign substances may be conveyed away by connection with the sewer.

The conductors are hung by insulated supports from the lugs which support the cap-plates. The wires are set at such a point as to lie above the plane of the lower edge of the



depending [illegible] from interference [illegible] of the inverted [illegible] the conduit any water [illegible] of St. Paul, Minn, is the inventor.

The Great Northern Telegraph company announces that the Japanese land lines beyond Hiogo and Osaka were greatly damaged by the recent [illegible]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - Editor and Publisher

J. E. O'HARA, F. L. PERRY, W. E. KEILY, - - - - Associate Editors.

J. L. BAKER, - - - - - - - Business Manager

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK

W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT. Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3 [illegible] for a full year of [illegible] numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, [illegible] cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.
[illegible] Station, Cincinnati, O. Illustrated ... [illegible]
[illegible] World's Fair ... [illegible]
[illegible] Illustrated ... 3[illegible]
[illegible] Alternating Current Transmitter. Illustrated ... 30[illegible]
[illegible] Illustrated ... 30[illegible]
[illegible] ... 30[illegible]
[illegible] ... 30[illegible]
[illegible] of the High Tension Transmission System [illegible], Germany. Illustrated ... 301
[illegible] Electricians ... [illegible]
[illegible] Illustrated ... 30[illegible]
[illegible]
[illegible]
[illegible]
[illegible] Illustrated
[illegible]
[illegible] Illustrated
[illegible] Telegraph [illegible]
[illegible]
[illegible]

DEPARTMENTS.

[illegible]

[illegible]

is intimated that valuable invention secured by the great Boston corporation may have been withheld to be patented in this emergency. Mr. Simonds, the commissioner of patents, declares that no patent has recently been issued which can be construed as being in favor of the Bell company. There seems to be a widespread belief, nevertheless, that there is a scheme on foot that will make the Bell people masters of the situation for many years to come. It is not to be doubted that the Bell company would gladly avail itself of the advantage that a patent issued at this time for a desirable improvement would give it. Indeed, hints that such a course would probably be adopted leaked out long ago, and well informed persons will not be surprised at an announcement of that sort within a short time. It is likely that the prospective competitors of the telephone company will have, at the expiration of the original patents, more obstacles to overcome than they now imagine.

IN another column there is presented an opinion by Judge Blodgett in an interesting patent suit. The controversy arose over the patents of Augustus Hahl and Elisha Gray, which it was claimed had been infringed by the defendant in the case, both the Hahl and Gray patents being controlled by the plaintiff.

It appears that the earliest patent to issue, that of Augustus Hahl, covered only the specific construction of the flexible cable method of connecting wires between different floors of the elevator shaft. This flexible cable is seen everywhere in elevators provided with annunciators. The Elisha Gray patent, issued nearly two years later after an interference with Hahl's patent, contained a broad claim based upon Gray's invention of the frictional or sliding contact method of connecting the wires in the elevator shaft. Gray, being the pioneer, was entitled to a claim, broad enough to cover not only his frictional mechanism for making the connections but also variations and improvements. Therefore the court held that the respondent was guilty of contempt in violating the injunction as to the Gray patent after the Hahl patent had expired although the infringement consisted in making and selling the specific device of the expired Hahl patent.

The legal consequence is that the exclusive right covered by the Hahl patent is exended to practically nineteen years, that is until the Gray patent shall expire.

It believed that this is the first case in which this point has been involved

THE New York *World* reports that "between Aug. 17th and Oct. 21st of this year there were twenty-nine cases reported at police headquarters of persons who had been injured by the horse cars of this city. That is almost an average of one accident every other day. The accidents reported varied all the way from loss of life and loss of limb down to fractures and contusions of the body. A few of the unfortunates escaped with only bruises. Many were hurt internally; many more were seriously injured in other ways. Five were killed outright." This is a serious matter. What a hue and cry would go up from the New York press if an equal number had been injured in a like space of time on electric roads in any specified locality! We should have the changes rung on the "deadly trolley system" until everybody was tired and disgusted. But, as a matter of fact, experience has demonstrated that the electric system is as safe, if not safer, than the antiquated horse cars that have created such havoc in New York. Motor men are invariably more careful and cautious than drivers of horse cars, realizing the strength of the power under their control, and the rights of pedestrians are respected. As Mr. Beckley pointed out in his address before the New York State Street Railway association, the only tenable objection to electric railways in large cities is a sentimental one, "the looks of the thing." The public must judge whether it shall be allowed to outweigh such a record of the clumsy, untidy horse car as is disclosed by our New York contemporary.

ONE of the most perplexing problems confronting the management of the World's Columbian Exposition is the regulation of the manner of supplying light and power to the grounds and buildings. Undoubtedly all the principal manufacturers of dynamos and electric lighting appliances in the United States and Europe will have extensive exhibits at the fair. One or more of the systems thus exploited must be employed to light the grounds, and, in [illegible] amount of electricity must be [illegible] of power. What system or systems shall be employed for this work at the great central [illegible] with the understanding [illegible] contract for the whole [illegible] for arc lighting, [illegible] gain shall [illegible] opportunity to do some portion of the work at a rate of remuneration uniform for all? And, if the last named plan is decided upon, will the companies be allowed to show their systems complete, including generating apparatus, line construction and lamps? It is obvious that a satisfactory decision of these questions involves the exercise of a high degree of wisdom and the strictest impartiality—an impartiality, moreover, that shall know no bounds of nationality. The success of the electrical display will be very greatly influenced by the manner in which this matter is disposed of.

It must not be forgotten that American manufacturers are not the only ones to be considered. Foreigners are anxious to show their lighting apparatus in actual operation, and of course they expect pay for their services. W. H. Preece, chief electrician to the government telegraph department in England, writes: "Our working manufacturers will want some assistance. The cost of mere exhibition is a very heavy item indeed, and to show the actual operations of our electric lighting methods would very much enhance the exhibition from an English point of view. Our two great firms—Willans & Robinson and Crompton & Co.—want to take part in the general illumination of the buildings, as they did in Paris." That bears directly on a question that must soon be settled. It is this: What exhibitors will be allowed to take part in the generation of electric power for use in the grounds and buildings?

REFERENCE to the official report of the proceedings of the last meeting of the American Institute of Electrical Engineers just received from the secretary discloses an instance of unparaleled audacity on the part of that organization. Carl Hering, chairman of the delegation representing the Institute at the Frankfort Congress, made his report, in which the following paragraph appears:

> The announcement closed with an invitation to the members of this Congress, on the part of the American Institute of Electrical Engineers, to participate in the next International Congress to be held *under the auspices of this Institute*, in Chicago, in 1893.

It is to be presumed that Mr. Hering and his associates acted under instructions from the Institute in extending this invitation to the members of the Frankfort Congress. It is hardly possible they would take this liberty without authority, and the attitude of the Institute toward the coming congress supports this view. This organization assumed that the direction of the congress would be placed in its hands, and took the liberty to act upon this unwarranted assumption by inviting foreign electricians to participate in a congress, the invitations for which must, in fact, be issued from another source.

The Electrical Congress, like all other congresses to be held in connection with the World's Columbian Exposition will be held under the direct supervision of the World's Congress Auxiliary of the World's Columbian Exposition. The plan of organization of this department is that it shall be under the direct authorization of the exposition authorities and the United States government, and the plans have already been completed for the organization of several congresses. The special committees to arrange the details of the several congresses have been appointed by President Bonney. In the case of the Electrical Congress, at least, the preliminary organization has been effected, and the work is now well under way. All this has been announced heretofore, but the members of the American Institute of Electrical Engineers and some of the Eastern electrical papers do not appear to realize that the exposition authorities are in earnest. The Institute at its last meeting had the effrontery to appoint a committee to "formulate a provisional programme for the work of the congress."

It should not be necessary at this time, to point out the necessity of holding this congress under the direct authorization of the United States government, and inasmuch as the organization has been effected under this plan the efforts of the American Institute of Electrical Engineers to supplant Prof. Gray and his associates, can only bring the organization into ridicule. Petty squabbles of this kind are entirely out of place, and as they will unquestionably retard the progress of the work, they should not be countenanced by any one who has the interest of the congress and the exposition at heart. It has been decreed that the Electrical Congress shall be held under the direction of Prof. Gray and his local and advisory committees. If the American Institute has the interest of the congress at heart and not its own glorification, it will cooperate with Prof. Gray in whatever manner he may indicate. It is to be hoped that the members will look at the matter in this light, and silence those agitators who are now endeavoring to retard the work of the congress by the publication of such impudent and snobbish editorials as appeared in *[illegible]* in its issue of November 7th.

Magnetic Reluctance.

At the last meeting of the American Institute of Electrical Engineers, A. E. Kennelly read a paper on "Magnetic Reluctance," published in the WESTERN ELECTRICIAN of Nov. 7th. At the conclusion of the paper the following discussion took place:

CARL HERING: It is a great satisfaction to see from this interesting paper that there is after all a straight-line law in magnetic phenomena, and that it is so for just that range of values which is used most in practice.

I think it would have been clearer to many readers if Mr. Kennelly had added that the reluctivity, ρ, which he uses, is the reciprocal of μ. This is inferred in the paper, but as we are usually more familiar with μ than with ρ, I think it would have been clearer, to some of us at least, if that had been stated.

In referring to his curve, Fig. 4, he says, "The reluctivity of iron appears from these curves to commence at a certain definite and moderately large value." It seems to me it is a very indefinite value, because, according to the other curves it is the reciprocal of zero. That is to say, theoretically, this curve would start at infinity, and therefore it follows that the practical initial value would be a rather indefinite value. It certainly does not seem to be a very definite value, because the curve (Fig. 4) is the reciprocal of the curve shown in Fig 2, which appears to start from or near zero. If this initial value is a definite one, why is it not given in any of the Figs. 5, 6, 7 and 8?

Fig. 3 is not quite correct at the end of the curve, and is a little misleading on that account. The curve comes down as if it was going to cut the x line just beyond the figure, but that is not the case, as there is a point of inflection there, shown by the two last plotted values. If it were to cut that line it would have values here, of a negative conductivity or a source of magnetism, which, of course, is absurd. If the value had been carried out farther the line would tend to become tangent, I think, to a horizontal line a little above the x line. It is a little misleading and puzzling to any one to whom a curve expresses a law, to see this line start so definitely toward the x line as if it were going to get there.

Referring to Fig. 10, which gives Mr. Kennelly's interesting straight line, if I understand that the values of y are given in such units that the unit 1, near the top, represents the reluctivity of air, which I suppose is what was meant, it seems to me this line cannot continue to be straight. It would seem that it must tend to become tangent to the unity line; that it must curve off and never get above that line, for if it got above that line we would have a peculiar condition here, because, for such values of H it would follow that if you took the iron out of the field, the remaining field in the air would be stronger than when the iron was there. In other words, if you generate a field of that strength with some iron in it, and then take the iron away, the field will be stronger than it was before.

I think it would have added to the interest a little to have marked on these curves the values at which iron was usually used in practice, so as to give us an idea of what parts of the curves are most important. In Figs 1 and 3 it corresponds to values in the neighborhood of 15,000; in Figs. 2 and 4 to values of $H=10$. Fig. 2 is about *there* (indicating); and it is a somewhat curious condition shown here that we use iron where it has an apparent conductivity much lower than its maximum—about ⅓ of its maximum apparent conductivity.

It might also have been interesting to have added to these curves the corresponding curve for air, in order to show the relation between them. In Fig. 1 the curve for air would be a straight line very close to the x line, making a very small angle with it. In Fig, 2 the line for air is a horizontal line parallel to the x line, and I think it is the line which this curve appraches as an asymptote. In Fig. 3 the line is also a horizontal line very near the x line. In Fig. 4 it is also a horizontal line, but its location, according to the scales used, would be very far above this diagram.

The diagram was drawn to a scale in which the line for air is represented, This would be away down here near the origin, so that it could hardly be distinguished from the origin.

Near the end of his paper Mr. Kennelly refers to an analogy with an electric circuit containing an electrolyte. It may perhaps assist in understanding some of the phenomena. If, for instance, we take two platinum plates in dilute sulphuric acid and subject them to a difference of potential, beginning at zero and gradually increasing, plotting the value of the electromotive force as x and those of the current as y, we will get a curve very similar to Fig. 1. It will differ slightly at the origin; it will be a little steeper in the ascent and a little sharper at the bend. In this anology the electromotive force corresponds to h, the current corresponds to b, the apparent resistance corresponds to ρ, and the apparent conductivity to μ. Carrying out this analogy here we will find that the liquid will have curves almost exactly like those in Figs. 1, 2, 3 and 4. The curve approaches a horizontal line as an asymptote just as the curve in Fig. 2 does. It starts like that in Fig. 2, has a maximum near the y line and comes down in the form of a hyperbola. If this curve is worked out you will find it to be almost exactly like those shown in Figs. 1, 2, and 3. It will also be found to be very similar to that in Fig. 4, only that the line will not be straight. I did not have any definite values from which to work out the curves of this analogy, but assuming the first curve to be something like the one shown in Fig. 1, which will undoubtedly be the case, I worked out all the others and found they agreed very nearly with the magnetic curves.

J. STANFORD BROWN: Mr. Kennelly has spoken of the term "magnetic resistance," and of certain objections which have been made to the term "magnetic resistance." Authorities differ somewhat on the definition of reluctance, and it might be well to call attention to it. In other words, according to some, it is the ratio of magneto-motive force to the total magnetic flux. According to others, it is the ratio of magneto-motive force to the flux density. I believe the first definition is due to Hospitalier in the beginning, and is followed by Prof. Fleming in his "Alternate Current Transformer," while the other has been followed by Bosanquet Lathers. If such is the case it might be well for us to decide here which is the best, and have the Institute adopt one or the other as authoritative. It might give us a practical idea of it in another form to remember that in making use of this relationship in motor work or dynamo work we are dealing with ampere turns and the force lines per unit area.

DR. LOUIS BELL: With reference to the curves, Figs. 2 and 3 in the paper just read, I may be able to give a word of explanation.

I remember seeing Prof. Rowland use the curve, Fig. 3, as a horrible example of the danger of extrapolation beyond the experiments. He supposed, as others supposed, at the time his work was done that the permeability fell down to zero; that there was an end of the power of added force to produce effect; that permeability rose to a certain point, then dropping and stopped there; and it was something of a revelation to everybody when the investigations of Ewing showed that the curve became asymptotic. I had the pleasure of hearing Prof. Ewing read one of the classical papers on the subject at Manchester some three years ago, and it was generally remarked as surprising that the curve did become completely asymptotic. The interpretation to be put, then, on that particular diagram is that a man has no business to continue the deduced curve beyond the point where his experiments stop, unless he knows what is going to happen, which he seldom or never does.

CHAS. P. STEINMETZ: I cannot agree with the opinion expressed here, that the curve of magnetic reluctance does not start from a definite value, but begins at an infinite value. On the contrary, I entirely agree with Mr. Kennelly that the initial point of the curve of magnetic reluctance always must have an infinite value. For, if you consider the curves of dependence of the magnetism upon the magnetomotive force, the curve given in Mr. Kennelly's paper as Fig. 1, you see that this curve starts in the zero point with a finite angle, different from zero, and differen from 90°.

Now the magnetic conductivity is the tangens function, the magnetic reluctivity the cotangens function of this angle, and the angle being different from zero and different from 90°, both functions must have a finite value. That means magnetic reluctivity as well as magnetic conductivity start from a finite initial value.

And, that the "magnetic characteristic" curve, Fig. 1, of the paper intersects the axis of abscissæ under a finite angle different from zero and from 90°, is evident, and proved by the fact that, if you send an alternating current around this magnetic circuit, no matter how much you decrease this current, it will always encounter a finite amount of self-induction. Now self-induction of the alternating electric circuit measures the conductivity of its magnetic circuit, and therefrom you prove that this conductivity in the zero point, and thereby also its inverse value, the reluctivity is finite.

I am very much pleased to see that Mr. Kennelly prefers the term ' magnetic reluctance" to the term "magnetic resistance," which begins already to be used rather confusedly. For electric resistance is one thing, and magnetic reluctance is another thing, and both things have got a definite, but different dimensions and so we have no right whatever to call them both by the same name, if we do not want to cause confusion. It would even be better not to have the term electrical resistance at all. Even that is very misleading; it was introduced at a time when electrical science was still in a very crude state, and we knew nothing about the dimensions of these quantities, and so it came that the term "electric resistance" was introduced for that quantity which determined the loss of energy caused by an electric current in the same way as in mechanical engineering the term "mechanical resistance" was already applied to that force, which consumes in every mechanical motion a part of the energy, by converting it into heat. But now we have the mechanical resistance, which is a true force, of the dimensions of force, while electric resistance is of the dimension of velocity, hence quite a different thing; and if we introduce magnetic resistance we have another resistance again, of still another dimension, a reciprocal length, and so we have the same name for three different quantities, of different dimensions, which is anything but commendable. There is besides an essential difference between this term "magnetic reluctance" and the two other resistances, because the two other resistances are quantities which really determine the consumption of energy or rather the conversion of energy into heat. But the magnetic reluctance does not convert potential energy into caloric energy. Hence if we want to use the term magnetic resistance at all we should use more appropriately another quantity with this name. In the magnetic circuit a certain consumption of energy takes place, too, if the magnetism reverses. Hysteresis consumes energy. I think I shall be able at one of the future meetings to communicate to the Institute a number of experimental tests carried out in Mr. Eickemeyer's factory in Yonkers, on determinations of loss of energy by hysteresis, and its dependence upon the intensity of magnetization. These results seem to point to the fact that this consumption of energy by hysteresis can be expressed analytically by one coefficient, and this coefficient would, I think, more properly be called magnetic resistance than any other quantity, because it is really that coefficient which determines the consumption of energy, that is the conversion of magnetic potential energy into heat. It is better to avoid the name "magnetic resistance" altogether. Another point I wish to mention still. As known, elasticity is that physical force which is almost analagous to magnetism, so much, that almost every phenomenon of elastic forces finds its analogy in the magnetic circuit. This analogy goes even so far that, if Mr. Kennelly mentions that magnetic

spring and let it untwist itself, a certain amount of energy

which is converted into magnetic potential, and demagne

hysteresis.

By twisting or untwisting alternately a steel spring, a

ular friction.

The loss of energy by external friction per elastic cycle is proportional to the rapidity wherewith the cycle is completed to the "frequency." The loss by molecular friction is about constant, and is dependent upon the rapidity of elastic changes.

Now in the magnetic circuit you have the same—the external friction of the elastic cycle—or the resistance caused by the work done by the spring—corresponds in the magnetic circuit to the induced currents, viz., eddy currents set up by the alternating magnetism. Both are proportional to the frequency of the alternations, and depend upon outside conditions.

To the molecular friction of the elastic cycle corresponds in the magnetic cycle the molecular friction of hysteresis, both dependent upon outside conditions, and apparently upon the frequency.

CHAS. E. EMERY: I will add a word in relation to the expression 4π, which has been discussed by one of the speakers. In investigating the formulæ for the construction of motors and dynamos it becomes quite evident that 4π is nothing more nor less than a simple arithmetical coefficient which, in this connection, has nothing to do with its customary significance as expressing the surface of a sphere of unit radius. It is thought that this should be emphasized by writing the figures instead of the symbol or, for convenience of calculation, substituting a single special character, for instance a, for it, and stating its numerical value. The artifical conception that a line of force radiates from a unit of surface of a sphere of unit radius, may be comprehended so far as the unit is concerned, but has not the slightest applicability in practical work. The conception causes great difficulty in the minds of students, and to it may be very well applied the language used on the second page of Mr. Kennelly's paper, where he refers to "the remarkable construction of purely artifical frame-works of thought void of all attempts at reality, yet capable of affording useful applications and exact quantitative results," etc. This particular language refers to theories in relation to magnetism, but the books contain very similiar expressions in relation to 4π. It should be borne in mind that the criticism is not intended to apply to the electrostatic distribution of the potential on the surface of a sphere or other solid, for in such case the surface of the sphere is one of the elements considered, whereas "magneto-motive" force, as it is called by the committee on units, has no necessary relation to a sphere or to a system of lines radiating in all directions from a common center. The coefficient used in connection therewith, which has been called 4π, arises from the same causes that similar coefficients occur in almost all other formulæ, either rational or empirical. For instance, in the rational formula for the square of the volocity, we have in English units the coefficient $2g$. In the practical application of this formula certain resistances are frequently considered by substituting for $2g$ an empirical coefficient of less value. Some such coefficient is neccessary in nearly all formulæ. In the absolute system of electrical units it is made unity and therefore disappears, but in many of the practical applications of such units a coefficient of different value than unity is a necessity. For instance, the value of g in absolute units must be used as a multiplier when the absolute units of force and mass are reduced to weight or mechanical work. The multiplier called 4π in the formula we are considering, is required for a similar reason.

It is believed that the coefficient a can be properly called the mechanical equivalent of electromagnetic force and thereby correspond with the mechanical equivalent of heat. The value of the volt-ampere or watt is necessarily known in terms of mechanical work by definition, and is based upon the product of the absolute units of electromotive force and current. When, however, it is desired to substitute for the absolute unit of electromotive force in such product, the unit velocity of a conductor across unit field in a unit of time, a coefficent is necessary to reduce this modified unit of work to the customary unit of work. This arithmetical coefficient, when the absolute units are expanded to practical units, we call a, and its value has

certain multiple of π must be conbined with 981, the acceleratrix of gravity in metric measure, it seems impossible that any exact multiple of π should be the result, and it is believed that on further investigation, the value will be modified, and when this is done, of course 4π must disappear, but the proposed constant, a, would be retained for the value finally determined upon.

pressing an arithmetical relation between certain quantities

seen that is in some sense an imitation of the remarkable work of Weber and Gauss in referring the intangible phenomena relative to electricity to tangible measures of length, mass and time.

clothing it in the grab of a direct measurement relating to a physical object. Such a mathematical parable could have been obtained by representing one line of force by one of the units of any length or any surface which contained, or could be made to contain, the total number of units desired; for instance, very readily the tangent of an angle, when, if the angle corresponding to such tangent coincided with that between any notable lines of reference about the earth or in the heavens, for example, the dip of the magnetic needle or the inclination of the earth's axis or equator to the ecliptic, the physical relation would have been established. In this particular case, however, the number of units which it was desired to represent by a tangible well known object was equal to, or could be called, the number of units on the surface of a sphere of unit radius, so it was possible to follow the reasoning in relation to the distribution of potential and represent a line of force by the solid angle included by unit area on the surface of a sphere of unit radius, and as there were 4π or 12.6 units of area on the surface of such a sphere, the value of the coefficient was thus artificially fixed at 4π.

The objection to an artificial representation of this kind is evident. The mind is filled with conceptions which incompletely represent the phenomena, and consequently proper courses of action under the particular circumstances do not suggest themselves as readily as if more natural and customary methods were employed. It is not so much the use of π as it is the artificial atmosphere which 4π brings. The π by itself has a definite arithmetical value, but 4π implies a conception which carries the mind into the clouds. The attempt to use any unusual units in practical work has also much the same effect. The mind involuntarily grasps and suggests relations between the units of length and capacity which are customarily employed in the country of the investigator. It unnecessarily cripples his capacity and occupies his time in a cataclysm of arithmetical work to attempt to regularly use one set of units when accustomed to another. For instance, without deciding that metric are better or worse than English units, it is safe to say that a person should use those to which he is accustomed for ordinary lengths and weights even in electrical work, but that all should use the same units for strictly electrical quantities. This may appear contradictory, but the result is easily accomplished by using formulæ in the general form employed in all other branches of engineering, or of the kind in which an arithmetical co-efficient precedes the characters which represent the relations to be considered. Every formula, both rational and empirical, takes the general form: The quantity desired equals A (an arithmetical co-efficient) multiplied by a function of a, multiplied by a function of b, multiplied by a function of c, etc. In electrical formulæ the functions are very simple, many of them being represented by the characters themselves, but even in such formulæ the initial co-efficient is of the greatest value. It may in some cases be equal to unity, but the character should be retained for reasons yet to be stated. It may combine in itself all the arithmetical relations of the several quantities, and, more valuable than all for electrical work, it may show the arithmetical relations of the quantities when expressed in different units; for instance, have one value (A) when all the quantities are in absolute measure, another (A_1) when all are in English measure, but better it can have still another value (A_2) when part of the quantities are expressed in ordinary electrical terms referring to metrical measure and the remainder in English measure. For instance, the magnetic field may be stated in C. G. S. lines of force in the same formulæ where other quantities refer to English feet, inches or pounds, and yet the torque be brought out in pounds acting at the distance of a foot just as well as if the result were first obtained in dynes at the distance of a centimeter and then a process of arithmetic gone through to secure the final result.

[illegible] once heard a lecture by a very famous specialist, Prof. Winkler of the Berlin Polytechnic school, in bridge building and railroad building in general; it was a lecture on designing bridges. He said, if you want to be sure that your bridge will not break down under [illegible] make it three times as strong as your calculations require. Well, as a rule, that [illegible] engineering. Electricity is nothing if not an exact science. Mechanical engineering is not yet a perfectly exact science. Our methods of testing are exceedingly exact and electrical units are derived [illegible] means. [illegible]

[illegible] not perfectly clear [illegible]

starting point from zero. Fig. 2, it must be confessed, is erroneous in that respect. The first observation is shown by a black mark, and the lineshould not be carried back to the zero point. As regards Fig. 3, that does not terminate at the base line. It ends with the two little dots that you see there, and any person is at liberty to continue that line in any direction whatever. The exact direction of course, will depend upon how you construe the word permeability; whether you mean metallic permeability, or permeability in the mass. There is a difference on the vein theory, because we have seen that the flux is supposed, on this theory, to be the magnetizing flux added to the flux in the metal itself. It dissociates what goes on in the metal from what goes on in the space occupied by the metal, while the ordinary term, permeability, includes both.

In regard to Fig. 4 and also Fig. 10 in the paper it is quite true that in reluctance, as ordinarily defined, namely, as the reciprocal of permeability, $1/\mu$, the line could not go beyond unity, and would stop before the second line from the top of the diagram, Fig. 10. But that is mentioned on page 497. It is also pointed out that if we borrow from the vein theory, the conception that the reluctance in the mass, in the joint reluctance of two things in multiple arc, namely, the metal and the space occupied by the metal (it is an artificial hypothesis—granted; but it leads to a result which is easy to handle), one becomes an asymptote, the other, so far as we know, goes on forever; that is to say, it does not terminate at 24,500. Now the reluctance of iron is shown at 24,500 to be a little over 1.1—call it 1.2. The reluctance of air is supposed to be constant, namely, unity. The joint reluctance of these two is

$$\frac{1.2 \times 1}{1.2+1} = \frac{1.2}{2.2} = 0.545$$

Now, you see, .54 would be the apparent reluctance of the iron. It shows how very vital a change is introduced by that conception borrowed from the vein theory, for on the conception that there is a metallic reluctance, the line becomes straight. The whole object of the paper is to show that whereas the curves of flux in terms of magnetizing force, or of permeability in terms of flux density, are all complicated curves—they are curves which you would not like to define by any particular formula. The curve which follows from the conception of the inverse of permeability is, fortunately, a very simple one. It is one that although it may have no place in nature, happen to suit our purposes in a high degree. On Fig. 9, the dots there which show the observations, indicate that the reluctivity did commence at a definite value, namely, 0.75, in that particular example.

Now as regards the point that was mentioned of the vein flux having reached its full amount, that arises, does it not, from the fact that the total induction—the total number of lines of force in the metal per square centimeter of section can go on as far as 45,000. Whereas the intensity in the iron, that is to say, on the vein theory, the amount of magnetic material that you would discover by making a cut at right angles to the lines, the amount of magnetic fluid would reach a finite value, in other words the induction B increases indefinitely while I, the intensity of magnetization, reaches a maximum.

There is only one other point, I think; that is about this unfortunate 4π. It is a matter sincerely to be regretted that we cannot in dealing with the simplest magnetic circuits determine the flux from the magneto motive force, without the introduction of that very unfortunate co-efficient. As has been clearly pointed out by several speakers, it stands in the light of no more than a numerical factor, and is derived from the fundamental fact that the unit of quantity in magnetism is that quantity which would repel its equal with unit force at unit distance.

It would certainly be possible to suppress 4π from the practical side of the work. We could cause 4π to disappear from our equations of electromotive force and flux, but it would turn up in other places. If we force it out of the door it would come in at the window. The first effect would be that we would have to change all our ohms and volts. That is a task which is surely enough to deter almost any advocate of such a change.

The Chicago Electric Club.

The next meeting of the Electric club will be held November 23d. The programme for the evening has been prepared by Messrs. Degenhardt and Buckley. Under the able mananagement of these gentlemen, whose qualifications as humorists are so well known, the entertainment cannot fail to bring together a large number of fun lovers. The programme is as follows:

[illegible]

[illegible] report of the New Zealand postoffice and telegraph department for the year 1890 shows that 1,961,161 telegrams of all codes were forwarded, an increase of [illegible] over the number forwarded in [illegible] forwarded was in the [illegible] head of the population. The [illegible] The telegraph [illegible] ended March 31, 1891 [illegible] receptions, private [illegible] increase of [illegible]

Electrical Engineering as a Profession in England.

As indicating the position and remuneration of electrical engineers in England the following brief article, contributed to the *Electrical Engineer* of London by H. Cuthbert Hall, will be read with interest in the United States:

If a young man or youth leaving school, wishing to become an electrical engineer, seeks advice as to what course he shall pursue in order to achieve the desired end, he is usually told that one of three courses is open to him, either of which is calculated to provide him in a greater or less degree with the equipment which he needs.

If he is pecuniarily well off, he may go to a university and study mathematics and, perhaps, the theory of electricity, and then proceed, on leaving the university, to attach himself to a firm of electrical engineers as an articled pupil, there gaining that practical knowledge of his profession which his university training will enable him to receive to the greatest advantage. Or he can, without any special theoretical training, join a firm immediately on leaving school and endeavor to acquire such theoretical knowledge as is attainable after his day's work in the factory is done. The third alternative which is open to him is to join one of the numerous technical colleges which profess to combine theoretical with practical training, and to turn out efficient engineers after a one year's, two years' or three years' course.

Of these three courses the former is undoubtedly the best, as by following it a man is enabled to acquire both theoretical and practical training under the most favorable conditions. The second course probably comes next in order of merit, but the theoretical training is necessarily placed at a great disadvantage by the fact that it has to be pursued when the student is wearied with physical labor. The third course is perhaps the least advantageous of the three, as in the endeavor to simultaneously acquire practical and theoretical knowledge the student not infrequently fails in satisfactorily acquiring either the one or the other.

Whichever course, however, is untimately decided upon and pursued, involves the expenditure of a great deal of time and money, and the person in question not unreasonably looks forward to receiving, at the end of his apprenticeship, a return in some measure proportioned to the trouble and expense which he has incurred. But in this respect he is, in nine cases out of ten, most grievously disappointed, for some of the best firms of electrical engineers are not ashamed to offer men of exceptional education, ability and training, salaries which would be regarded as poor by the average city clerk.

To the uninitiated it would seem incredible that in order to properly qualify for the position of electrical engineer it should be necessary to spend several years in preparation without receiving any pecuniary advantage, and have to go to the expense of paying a premium and college fees, and that at the end of the term of preparation a salary should be offered very little higher than would be paid to a raw youth, fresh from school, on entering a commercial house. As an instance of what frequently occurs, the career, based on actual facts, of an electrical engineer may be cited, and may, perhaps, prove not uninteresting. It is briefly summed up as follows: Preliminary education at a public school; proceeded to Cambridge; came out in the mathematical tripos a fifth wrangler; spent three years as an articled pupil at a well-known firm of electrical engineers; became, on expiration of term of articled pupilage, a member of their staff, at a salary of £100 per annum. Cost of three years at Cambridge, about £800; premium to firm of engineers, £300; salary received after six years' training, £100 per annum.

Now here is the case of a man of considerable ability, as proved by the degree which he took, laying out over £1,200 in preparation, and after six years receiving a salary of only £100 per annum. And this is no exaggerated case, but quite as good, if not better, than is the fate of nine out of every ten.

In reply, it may be urged that the profession offers many prizes, which really first-class men obtain; but this is not the case, for positions in England worth over £500 per annum are decidedly exceptional.

A short time ago an important town in the west of England advertised for an electrical engineer to take charge of the central lighting station there, and in order to obtain so important a position a man would certainly have had to have been able to claim a considerable experience of this class of work, nor would it have been of much use for a very young man to offer himself for the post; yet for this important position the paltry salary of £300 per annum was offered. A director of several large electric lighting schemes recently admitted in conversation that he was surprised to find for what low salaries really efficient men could be obtained, and the enumeration of instances might be multiplied of men holding important positions in connection with electric lighting schemes and firms of electrical engineers, at a remuneration which would be considered insufficient for a responsible man engaged in a branch of commerce which required no technical training or education above that afforded by the board schools.

In the case of electric lightning sehemes some slight excuse may be offered for the payment of such low salaries, because in so many instances no dividend has been earned, but where a firm of electrical engineers and contractors is in question it is notorious that large fortunes have been made of late years, and similar excuses cannot therefore be offered by them for the underpaying of their employes which so frequently exists.

The reasons for the exceptionally bad position of electrical engineers, as compared even with other classes of employes, are several in number, and, perhaps, even a cursory inspection of them may suggest at any rate a partial cure.

The profession has undoubtedly many advantages. The immunity which it offers from the drudgery of the desk is a great attraction to many, and the fact that applied elec-

tricity, as a science, is comparatively in its infancy, induces many to join the ranks of electrical engineering, who would feel little interest in more beaten tracks. But in one sense this very attractiveness is a bane of the engineer, for many men are, at any rate, partially reconciled to receiving insufficient salaries because of their fondness for the work. But the primary cause of the low salaries which are paid is undoubtedly to be found in the fact that no test is imposed by any responsible body on those who wish to enter the profession. In fact, anybody can call himself an "electrician," from the local ironmonger upwards. The consequence is that the profession is crowded with a number of incapables, whom a very elementary examination would probably be the means of weeding out. Of course these men do not often obtain responsible positions, but the fact of the supply, although of an inferior quality, being so large, seriously detriments those who are really competent to hold positions of trust.

Ignorance and inexperience in an electrical engineer are productive of results quite as disastrous as would be the display of similar qualities in many professions which are now privileged. To be really a first-class electrical engineer demands much patient work and more than average ability, and it is quite time that some duly accredited body took in hand the task of putting the profession of electrical engineering on a footing better befitting its dignity and importance

Ohio Tramway Association.

The tenth annual convention of the Ohio Tramway association was held at Akron, O., November 10th. The attendance was much larger than that of the previous year, and considerable interest was manifested in the proceedings.

President Stewart made an interesting opening address, in which he said that several new companies had been added to the list of memberships, and that the association now had representatives of nearly every company in the state. Referring to the advancement made in the introduction of electrical equipment, he assured the members that there was no organized effort, despite appearances, to substitute "electric generators for hay and grain consumers," and while he acknowledged "that most of our members appear to have had an unusual 'fellow feeling' for electrical promotion during the last year, it was not to be taken as an indication of conspiracy against the Farmers' Alliance."

He announced a departure from the time honored custom of admitting only papers by members. This year it was proposed to have devices and apparatus of all kinds for street railway use explained by exploiters and advocates of the several methods. The proposition was read with approval. The president again called attention to the necessity of taking an active part in preventing adverse legislation.

F. B. Brownell, of the Brownell Car company, read an interesting paper on the subject of "Street Cars," in which he said the three important points in construction were design, material and workmanship.

Frank A. Rogers described the Short company's apparatus, and explained the operation of the company's motor. W. S. Elliott represented the Edison General Electric company, C. A. Benton the Detroit Electric Works, S. S. Leonard the Hill Clutch Works, Garson Meyers the Calorific Heater company, and F. H. Strieby the Thomson-Houston company. These gentlemen explained the apparatus of the companies they represented.

The officers of last year were re-elected without opposition, and Zanesville was selected as the place of meeting for next year.

The following is a list of the names of those in attendance:

H. B. Morgan, Munson Belting company, Chicago; Dwight B. Dean, Electric Merchandise company, Chicago; John L. Baker, WESTERN ELECTRICIAN, Chicago; Merwin Bulkley, *Electrical Review*, Chicago; L. W. Collins, Chicago; Daniel Coolidge, Johnson company, Johnstown, Pa.; F. A. Seiberling, Akron; F. B. Wagner, Cleveland; W. W. Hazzard, Cleveland; Garson Myers, Calorific Ventilating Heater company, Chicago; J. A. Hanna, J. B. Brill company, Chicago; F. H. Strieby, Thomson-Houston company, Cincinnati; W. S. Elliott, Edison General Electric company, Chicago; W. E Boughton, Johnson company, Cincinnati; H. A. Domer, Domer & Dutton, Cleveland; S. S. Leonard, Hill Clutch Works, Cleveland; P. G. Monroe, *Street Railway Gazette*, Chicago; Eldredge Packer, Rochester Car Wheel company, New York; N. H. Byam, Chas. Munson Belting company, Pittsburg; Wells Goodhue, Electrical Supply company, Chicago; Clarence E. Stump, *Street Railway Journal*, New York; E. V. Cavell, *Street Railway News*, New York; E. J. Carter, Fremont; F. S. Kenfield, *Street Railway Review*, Chicago; F. B. Brownell, Brownell Car company, St. Louis; T. B. Taltavall, *Street Railway News*, New York; M. Siersdorfer, Post & Co., Cincinnati; John N. Stewart, Cleveland; Will Christy, Akron; Alex. H. Lewis, Thomson-Houston Electric company, Cincinnati; Frank A. Rogers, Short Electric Railway company, Cleveland; John Harris, Cincinnati; Clark Rude, Mansfield; Reid Carpenter, Mansfield; A. D. Rogers, Columbus; C. A. Benton, Detroit Electrical Works, Detroit; H. W. Littell, Cincinnati; Horace E. Andrews, Cleveland; J. E. Metlin, Akron; J. B. Hanna, Cleveland; A. Everett, Cleveland.

The ever-popular Electric Merchandise company was represented by D. B. Dean, who presented the merits of the company's goods in his usually persuasive manner.

The Central Thomson-Houston company of Cincinnati was ably represented by A. H. Lewis.

Sam Stewart was present to represent the Westinghouse company.

The J. G. Brill company of Philadelphia was represented by J. B. Hanna.

The Rochester Car Wheel company of Rochester, N. Y., with New York office at 222 East Twenty-eighth street, was represented by Eldredge Packer, who has recently accepted a position with the above mentioned company.

C. A. Benton, general manager of the street railway department of the Detroit Electrical Works, was present, and distributed some of the handsome catalogues gotten out by this company.

The Calorific Ventilating Heater company was on hand with an exhibit under the direction of Garson Myers.

Making Love by Telegraph.

Interesting stories of courtship and even marriage over the telegraph wires are continually cropping up. Two good ones were related in an article entitled "Romances of the Telegraph," lately published in the WESTERN ELECTRICIAN. A number of others appeared in a recent issue of the New York *Sun*, said to have been told by an old telegrapher. "Do you see that bright, pretty face behind that counter, my boy?" this gentleman remarked. "Do you see it? Well, that face is spoken for, and the pre-emptor will be up here by the time she is ready to go, and will see that no one else gets his face anywhere near that face after it leaves here. That young lady is engaged. She is engaged to one of her own profession and its dollars to dimes that she fell in love over that telegraph wire. I did the same thing myself years ago—long before I got out of business—and, I tell you, it's charming. Most of the boys and girls who rattle keys intermarry and raise families of telegraphers. Of course, their children aren't born natural operators, but they come pretty near it. They pick up their knowledge of dots and dashes as soon as they begin to talk. And when they grow up you can pretty safely count upon their doing exactly as their fathers and mothers did."

In one of the big offices in New York there is a wire which is shunned as much as possible by every operator in the office. It has the reputation of being the hardest wire to work in the world. There are a large number of local railroad offices on the wire, and they all do more business than is ordinarily the case with small offices. For years the only person who could work this wire was a pretty young woman. It did not matter how good an operator a man was or how hard he tried to get along, his patience could not stand the strain for more than a few minutes. Then he was in a fight with some one. But the little woman never had the least bit of trouble. She was on the best terms with all the operators along the line, and was never behind in her work. One summer a new operator struck town, and it fell to his lot to relieve this young woman half an hour every day during lunch time. He had a fairly good disposition himself, but he wasn t on the wire ten minutes the first day before he was in a red hot row. It lasted until the young woman got back, when she graciously straightened matters out. Day after day he went around to relieve her with a very disagreeable feeling, and always with the same result. His attention finally became centered on the young woman herself. He knew that nothing short of an angel could work that wire, and he cultivated her acquaintance. They have been married a long time now. He has told the secret to his friends matrimonially inclined, and a number of them have been watching that wire ever since. But no young woman has remained there for any length of time, and the watchers all know what that means.

Ordinarily an operator can tell a woman the moment he hears her working the wire. He tells by her touch on the key. Women as a rule, telegraphers say, do not touch the key of their instruments as firmly as men do. Occasionally, however, there is one without this characteristic distinction in her style.

The Havana Electric Light Station.

The Havana electric light station, one of the best equipped electric light stations in Spanish-America, has lately been finished. The station is situated within the premises of the United Gas company of Havana. It was started with a small plant, consisting of one Westinghouse 1500 light incandescent alternating current dynamo, and two fifty light arc machines, early in the year 1889, merely as an experimental plant, and also to provide electric lights for those few people who desired that form of illumination in place of gas.

The demand for the new light increased rapidly, so that the directors of this company, after obtaining from the municipal authorities an assurance that they would agree to have certain public places and streets lighted by electricity for as long a time as the lights continued to give satisfactions determined to equip a station that would be ample for the prospective demand. A building 195 feet long by 90 feet wide, of brick, with an iron roof, one story high, has been erected, and in this structure have been placed ten engine, two Westinghouse compound condensing and eight Armington & Sims horizontal high speed engines, the collective motive power of which is 1,125 horse power. Steam to supply these machines is obtained from seven boilers of a capacity of 150 horse power each. The generating plant consists of four Westinghouse 1,500 light alternating current and eight 50 light arc dynamos, with the addition of one other incandescent and two arc dynamos, the entire capacity of the station therefore being 3,250 incandescent lights and 500 arc lights.

The incandescent switch board is of massive construction, being built of cedar. The board is supplied with the latest appliances, including current registering voltmeters, lightning arresters and testing instruments. The arrangement of the changing devices is very convenient, the attendant being able to change the load from one dynamo to the other, or to make any combination of the eight dynamos to the circuits leading from these without altering his position. The arc switch-board is arranged for twelve circuits. The interior of the station is floored with cement. The station is also equipped with an efficient service of pumps for feeding boilers, condensing and fire purposes; also with feed water heaters and separators for

[redacted]

nas, the general manager of the company in Cuba, in superintending the construction and completion of this station, the great success of the Havana electric light plant is [redacted] in Havana.

Extending the Telegraph in China.

A press dispatch from Shanghai says:

"The Chinese government has made a new departure from its usual policy of exclusion of foreign improvements and inventions, and is gradually introducing the two great civilizing influences of her western neighbors—the electric telegraph and the railroad.

"The telegraph system of China was never thought to be of any importance until the Franco-Chinese war of 1884-5 showed the necessity of this means of communication and of its being kept constantly in a state of the highest utility. Previous to this war China had few and short land lines—no cables whatever—and these were in poor condition, through want of repairs and lack of knowledge of the operators. The bombardment of the arsenal and destruction of the Chinese fleet and navy yard by the French fleet in August, 1884, so unexpected by China, and the appearing of these hostile ships off any portion of the empire without previous knowledge by the Chinese authorities, showed the great need of a means of quickly sending a notice of warning and preparation to the military and naval commanders of the coming of the enemy.

"Not to be caught napping a second time, the Chinese Government, immediately after peace was declared with France, began building telegraph lines throughout her empire and laying cables to Formosa and the principal outlying islands. The contract was given to the Danish Great Northern Telegraph association, and money in abundance furnished, so that to-day China has under her control a very comprehensive system of telegraph lines running to all parts of the country and connecting the interior cities with a network which, should occasion demand, would be able to give timely notice of a hostile attack, and could in a few hours set an army in motion.

"So much importance does China attach to the value of these lines that it has been preparing to build others in Tonquin—the province owned by France—to assist in forming a more direct and ready means of gaining information of the workings of the French troops on the Tonquin border. Gradually the government has urged the building of lines throughout Corea, and as gradually wormed her operatives into positions in the Corean service, until China has ousted all the Coreans, and now controls the lines herself."

Electric Power in California.

The announcement of the complete success of the Lauffen-Frankfort Experiment, says the *Mining and Scientific Press* of San Francisco, is exerting a most beneficial effect upon capitalists in this state, many of whom have been for a long time waiting with intense interest the outcome of this German enterprise. It indicates what may be expected in the near future from the unlimited amount of water power now running to waste all along the foothills of the Sierra Nevada and the Sierra Madre, which extend for a distance of some 500 miles along the eastern border of our state. The experiment at Lauffen has proven that the power of those streams can be carried all through our great valleys and made far more economical than steam, not only for driving machinery, but for operating railroads as well. The people of Sacramento and vicinity, of Stockton and all the growing towns of the San Joaquin, and the upper Sacramento valleys, as well as those of the San Gabriel and San Bernardino valleys, and those still farther south are already agitating the value of their neighboring waterfalls, and laying plans for their early conversion into useful purposes connected with their various industrial needs and possibilities.

The achievement which has been reached by German engineers is equally possible in all the localities referred to. Turbines set in any of our mountain streams may generate an immense power at a trifling cost which may be economically carried to the towns and cities of the neighboring valley, distributed indefinitely, and made to do all the work of costly steam engines, which have to be fed by coal at a cost two and three times that demanded in the eastern states. We are fully persuaded that the successful result reached in the [redacted] in mechanical science.

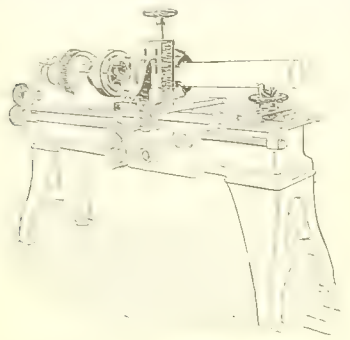
The [redacted] cident that happened in an electric car near that city. When the cars go under the railroad bridge on entering Hallowell from Augusta it is customary to pull down the trolley and [redacted] out. A pair of lovers [redacted] this temporary darkness [redacted] The result was disastrous, however, for when the lamps glowed once again, and the passengers got their eyes accustomed [redacted] and woman were seen [redacted] young people were [redacted] street.

Dubuque Storage Battery Road.

There is trouble over the Dubuque, Ia., storage battery road, which was opened with much enthusiasm last May. A United Press dispatch from Dubuque presents both sides of the controversy as follows: "An interesting suit was filed in the United States court on November 14th. The Accumulator company of Philadelphia, proprietor of the storage battery system of electric railways, has sued the Dubuque Street Railway company for $48,586. This action is to recover for the storage battery equipment of the line. Mr. Scott, representing the Philadelphia company, was here this week to get a settlement, but failed, and this suit is the result. President Rhomberg of the street railway company claims that his defense is that the storage battery system is a failure."

Pipe-Threading Attachment for Lathes.

Electrical machinists will appreciate the advantages of a pipe-threading machine for wrought iron pipe, fitted to be attached to lathes. In most machine shops this work is done on an ordinary lathe with the usual chasing tool. This is not only inconvenient on account of the length of



PIPE-THREADING ATTACHMENT FOR LATHES.

the pipe, but it is difficult to cut a thread that will give a good joint on account of the thread being tapered. Curtis' patent pipe-threading attachment, illustrated in the accompanying cut, has been put upon the market to meet this desire. Within certain limits of size it can be attached to any lathe.

CORRESPONDENCE.

New York Notes.

NEW YORK, November 21.—Whether or not it was the reaction after the election that made the last week an uneventful one in New York electrical circles, it is hard to say. The week has certainly been a dull one as far as news is concerned.

The rapid transit people are going ahead with their work with all possible dispatch. Property consents are now being obtained. According to one of the commissioners the work of obtaining consents cannot be begun until the Park department and Commissioner Heintz of the annexed district approve the plans. It is thought by some that a very determined opposition will be made by owners of property on the line of the proposed road where it is intended to [illegible] sidewalks. As it is planned to locate the station platforms close to the area line, and in some cases up to the building line, objection will, in all probability, be made that this construction will cut off access to cellars or basements except from the inside of the building. In any great enterprise like this, though, such troubles are [illegible] to a successful termination the *Times* publishes an inter-

[illegible]

the proposed railway; and in consideration of the importance of the scheme to the welfare and growth of London, the corporation agreed to subscribe, and did subscribe a sum equal in sterling to several millions of dollars.

"With this fund, and what little capital that could be obtained outside, the work was begun, and a section opened from Regent park to Farringdon street. The successful opening of this section proved that the scheme was practicable, and further capital required for pushing the work was easily obtained, and the line extended gradually, until, in the year 1884, the final link from the Mansion House station, under Cannon street, completed the whole circle around the city of London.

"In making the road every foot of the way was first dug out and the arch built over and the road constructed over the arch, the Greathead system of burrowing under without disturbing the surface being then unknown.

"The experience of the city of London was that the stock of the road, which cost the city par, was resold after its opening at 140. With regard to the expense, the total capital stock, funded and unfunded, of the underground road in 1881, was $72,500,000, and the capital per mile $3,295,000."

It is a noticeable fact nowadays that no theater is planned without a complete electric lighting plant, and Hammerstein's new opera house, which is now building on Twenty-fourth street, not far from Broadway, is to be no exception. The plans for this theater were prepared by J. B. McElfatrick & Sons, and it is said that the new play house will be a model of its kind. It will be five stories high. The auditorium will be 68x108 feet, and will be finished with leaf and scroll work in papier-mache. The general color is to be what has been described by an enthusiastic reporter "as a tender and sage green." The stage will be 45x60 feet wide, with 40 feet to the rigging floor. Over 1,000 incandescent lamps will be distributed throughout the house, and the ceiling, it is understood, will be lighted by six inverted domes of opalescent glass. It is estimated that the seating capacity will be 2,500.

A sad accident happened this week to one of New York's well-known electrical salesmen. T. H. Kennelly, with Alexander, Barney & Chapin, Cortlandt street, was overcome by illuminating gas, and now lies in a critical condition. Just how the gas was allowed to escape into his room is not certain, but the smell of the gas caused investigation, and Mr. Kennelly was found stretched on his bed senseless. He was removed to Bellevue hospital. It is thought though that he will recover.

Lieut. Fiske's range finder seems to be having a boom. It is stated that the Chilean armored war ship, Capitan Prat, is only waiting for range finder fittings to be ready for sea. The Capitan Prat is now at Toulon, France. The finder has already been supplied to one Russian vessel, two of Denmark, one of France, one of Chile, two of the United States, and according to the American Range Finder company, a set is now being made for the British war ship, Undaunted

The Commercial Cable company sent notices on Thursday to all firms doing business with Brazil that a censorship on all cable messages had been established at Rio de Janeiro The news of the establishment of the censorship was received as proof that there was some foundation for the reports of revolution and trouble. At the Brazilian consulate it was said that such a course of action was unusual, and indicated that the condition of affairs was such that it would be impolitic to publish it to the world. The general belief among the men interested in the Brazilian trade is that the trouble, whatever it may be, has been grossly exaggerated. Business dispatches have not been interfered with and it is not thought that the internal dissensions will affect the markets. Brazil exacts an export duty on her products. If there is trouble the government will need money, and will do all in its power to stimulate exportation.

There is a petition going the rounds asking that a franchise be given for the construction of an electric street railway between Fordham, Williamsbridge and Mount Vernon. It is said that the owners of two thirds of Williamsbridge along the proposed line have given their signatures, and a franchise for part of the way has been granted. It is believed that the new line is intended as a feeder to the electric road, to extend from Yonkers to the Sound, which is to be built by the Thomson-Houston company.

The cruiser, Newark, which was to leave Boston yard [illegible] for sea, with the exception of a few hours' work on her electric plant, which will be attended to at the Brooklyn yard. The *Atlanta*, which is in dry [illegible] expected to be ready for [illegible] the men were working at the [illegible]

[illegible] editor of the [illegible]

it booked to deliver a lecture before the New York Electric club at an early date. Mr. Rosewater, who is an old telegrapher, having made an enviable record as a member of the United States military telegraph corps during the war, and being now president of the Old Timers' Telegraph association, went this year to Europe to study the various systems of government telegraph. He made a very exhaustive investigation, and will now bring the result of his observations before the Electric club. Mr. Rosewater, it is understood, was specially recommended to the care of the various European governments by the United States, State and Post Office departments. The occasion, therefore, is expected to be one of more than usual interest, especially as Mr. Rosewater, who is an eloquent advocate of placing the telegraphs under national control believes that the facts and evidence in his possession fully justify the stand taken on this subject.

F. L. P.

San Francisco, Cal.

SAN FRANCISCO, November 9.—The San Francisco *Examiner* published an article recently which would lead one to believe that electric roads were not commercially successful, and that the embodiment of everything perfect, everything ideal, in the way of city transit lines, was to be found in the cable road. This remarkable "four head" article opens up with the following:

"The indications are that the cable system of street cars as operated in San Francisco will meet with general adoption throughout the cities of the United States. For a long time electric railways were looked upon by eastern engineers and capitalists as preferable to the cable roads, but it having been determined that the cable system is at once the most economical and productive of the best results generally, there has been a revulsion of feeling on the part of street railroad men throughout the country, in favor of the underground wire rope, and in many of the big cities east of the Rockies what were intended as electric lines of travel are now being converted into cable roads."

Then the opinion of J. C. A. Stut, a local mechanical engineer, who has planned many Frisco cable roads, is cited. He believes that the cable is superior to electric roads. The Omnibus cable line, he says, sent an engineer East to look into both systems, and as the result, the cable was adopted, but no mention is made of the fact that that was three or four years ago. Continuing, Mr. Stut is reported as saying that "trials of the electric system was also made on Folsom and Nineteenth streets, San Francisco, and the unanimous conclusion was in favor of the cable." Of course it is quite immaterial that the trials referred to were the experiments of some local enthusiasts who failed to perfect their ideas. The Third avenue road and the Broadway Cable company, both of New York, are referred to as having given preference to the cable, and then President Whitney of the West End Street Railway company of Boston, is credited with saying: "We are installing at our central station and will have in operation before next winter more than 13,000 horse power for driving our electric generators, and in Cambridge we are putting in 4,000 or 5,000 horse power more." The "monarch of the dailies," as the *Examiner* styles itself, then makes the observation that a single road in Boston takes from 17,000 to 18,000 horse power to operate by electricity "while in San Francisco the entire cable system, combined operates about 500,000 feet of cable, and all on less than 3,000 horse power" as though it were the sheerest folly for any city to presume it necessary to provide more extensive street car accommodations than those to be found here. As a wind-up is given the climax capping statement accredited to President Bowie of the Baltimore City Railway company, that "while it may be a little more expensive to put the cable in operation in the beginning, after it is once started there is a considerable difference in its favor as a motive power over electricity, the cable, we estimate, requiring about 42 per cent. for operating expenses, while with electricity it will take all the way from 60 to 95 per cent."

Electricity is just now accomplishing what the board of supervisors, grand juries and the entire police force of San Francisco have failed to do, and that is the reformation of an infamous street. The peculiar part of it, however, rests in the way it is being brought about. For years John Schuldt had a saloon on a corner of Pine and Dupont streets which held the custom of the depraved women of the neighborhood. All went well with Schuldt until about three months ago when a man named Dupont opened a saloon on an opposite corner. His business built up rapidly, while that of Schuldt went down "likewisely," but as the latter could not rule the roast he determined to ruin it. The way he is doing it is novel. He has placed a big arc lamp, with a crystal globe in front of his place almost over the curb. This master-stroke filled the feminine

denizens of that quarter with dismay. The blinding rays flooded the thoroughfare with an appalling effect, and the depraved residents on the now deserted street, finding bankruptcy staring them in the face have placed large wooden shields alongside their windows and doors to shade them from the light, but without avail. Only the footfalls of the policeman now break the solitude of the deserted neighborhood; Schuldt's business is ruined—but so is that of Dupont; Schuldt is revenged, and the city government has learned a most valuable lesson in moral electricity.

S.

St. Paul, Minn.

ST. PAUL, Nov. 14.—O B. Burbridge, a detective for the Yerkes system of street railways in Chicago, has been doing some clever detective work for the St. Paul City Railway company and has put that corporation in possession of considerable informationof pecuniary value. He is the man who was principally instrumental in ending the famous street car strike of the Twin Cities a couple of years ago, and his work in this last instance bids fair to be almost as valuable. The Twin City street railway companies have paid immense sums in damages for personal injuries during the last few years. The cable accident on Selby avenue in St. Paul in 1887 cost the company $80,000 in cash, a sum which was regarded as fully double the damages. The accident on the interurban line in September afforded the detective an excellent opportunity to secure evidence. The conductors' registers showed 118 passengers on board the two cars, and yet there were 239 claims for personal injury made against the company as the result of this accident. A woman living on Lafond street filed an affidavit with the company claiming $18.25 damages for injuries to her dress. Her affidavit, which was made in the presence of three witnesses, set forth that the tearing of her dress was all the injury she sustained. Afterward, however, a prominent firm of lawyers, it is charged, persuaded her to make a new affidavit alleging that she had sustained serious internal and external injuries; that her teeth were loosened and several knocked out. This was on October 10, 1891, and O. E. Pardee, special agent of the St. Paul City Railway company, paid her $100. In the meantime detectives had been working with the sweetheart of the claimant and found out the true facts. The sweetheart filed a claim for $5,000 alleged personal injuries. He claimed that his leg was hurt and shortened. The detective found positive proof that his leg was shortened when he was four years old and learned that the next night after the accident the young man and the lady went to a dance together. After the woman was paid she foolishly told her neighbors that she had succeeded in swearing $100 out of the street car company, and advised her lover to swear $5,000 out of it. The woman has since offered to refund the money, it is said, if the company will drop the case. Her lover reduced his claim of $5,000 to $500. This is only one case, and the railroad company now proposes to have its inning. Several prominent lawyers of St. Paul are said to have been exceedingly active in getting these damage suits instituted.

Richard Heckscher, a stockholder of the Edison Electric company, has been successful in his application to the court to compel the company to produce its books and accounts for inspection. He brought action against George H. Finn, the company's secretary and treasurer, for this purpose, and Judge Cornish held that he was entitled to examine the records as a stockholder. Hiler H. Horton, for the company, took a stay of thirty days.

The new Merriam Park electric line of the St. Paul city railway has commenced operation. The line runs from the center of the park to Milton street, where the passengers will be transferred to the Selby avenue cable line. The City Railway company has placed at that point the body of a sixteen-foot car as a waiting station. It is lighted by electricity and will be heated during the winter. This line is said to be regarded by Minneapolis business men as another cause for discontent with the street railway corporation in providing the interurban population with better facilities for doing business at St. Paul than at Minneapolis. This complaint, however, is a little farfetched. There is a strong and natural identity of interests between St. Paul and the interurban villages,as they are under one municipal government and the village populations are largely composed of men who are engaged in business in this city. The street railway company has built new lines only as business justified their construction without regard to the strategic advantages of either of the Twins in their contest for supremacy. But a little more time will effectually dismiss such controversies. Most of the St. Paul suburban lines, which are now the subject of contention will eventually become interurban lines, thus solidifying the connection between St. Paul and Minneapolis and contributing to their mutual interests by building up the interurban district. In this connection, however, it is interesting to note that the steam railways have again reduced the number of their trains between the cities, and that the interurban public is growing to depend more and more upon the electric lines. St. Anthony Park will early next spring have an independent electric line to Minneapolis by way of Como avenue, and possibly Merriam Park also.

A new corporation has just been organized in this city known as the St. Paul Electric Manufacturing & Construction company having for its principal object the establishment of a central station lighting plant for West St. Paul. This territory is developing very fast, embracing within its limits a large number of the leading manufacturing establishments of the city. This company will also erect a factory, and in a short time will commence the building of electric light and power apparatus covered by the patents of Henry Zaun,who is to be the electrician and superintendent of the new establishment. The apparatus to be exploited by this company will be patterned in a general way after the Siemens & Halske system, embracing many new features. Paul Martin, a well known real estate dealer, is president, Chas. L. Haas, vice-president and secretary, Chas. H. Lienau, treasurer, Jas. F. Hughes, general manager, and Henry Zaun, electrician and superintendent. Mr. Zaun is a graduate of the Frankfort Institute and has done good work in this country. West St. Paul has a population of 25,000, and is growing rapidly.

The Northwest Thomson-Houston company is preparing a statement of its season's business to December 1st, and a representative of the WESTERN ELECTRICIAN was informed that the total footings will exceed those shown in any previous year. Under the new management the business of the company has been pushed with great energy and now the corporation ranks as one of the great commercial and manufacturing establishments of the Northwest.

By a recent change in the affairs of Ames, Wright & Co., Mr. Wright retires and J. W. Ebert of the Western Electric company takes his place, the title of the new firm being Ames, Ebert & Co. This company will continue to represent the Western Electric company in this territory, much closer relations existing with the Chicago company than heretofore. The West Superior branch will be continued, several fine contracts having been taken at that place recently. These contracts include the introduction of about 2,500 feet of interior conduits in three buildings.

General Manager Humphrey of the Columbia company, announces that the business is to be pushed with all possible energy. This company has a well stocked store room at 207 E. Fourth street, with a very complete factory at Upton Grove,a St. Paul suburb. The factory is perfect in all its details, no expense having been spared in purchasing the best class of machinery, permitting the manufacture of high grade work with the greatest economy. The Columbia company purpose making dynamos, electric motors, power generators and specialties; and the outlook for a successful business is most promising.

Mr. Carpenter of the Carpenter Electric Heating & Manufactering company has just returned from Pittsburg, where his company made a very interesting display at the American Street Railway convention. This company has perfected a street car heating device that is claimed to have a high efficiency at a minimum cost. A wire of high resistance is embedded in white enamel while in a plastic state, after which intense heat is applied, making the substance very hard. A large number of devices in which this principle is utilized have been perfected, and others are under way. The company is showing a heater for street railway use and other purposes, a sadiron, tailor's goose and various laundry machines, a griddle, several forms of soldering irons, etc., etc. A large order for laundry and ironing implements was received a few days since from a London firm.

The Watrous Engine company has recently installed a number of isolated plants and report an active demand for their electric apparatus.

The Electric Engineering & Supply company is now quite at home in its elegant new quarters opposite the Ryan, and is doing an unusually large business. Among recent sales of Eddy motors in St. Paul is one of one horse power, two of three horse power, and one of five horse power, while the sale or Packard lamps for October will exceed ten thousand. A contract has just been closed with the Great Northern Railway company, for 120 accumulator cells as an extension of a lighting plant for their general offices in St. Paul. The switch-board for this plant is to be built on a marble base with oak finish and is to be equipped with the Weston voltmeters and

that his company is doing the largest business since it reaching nearly one thousand per cent. Several important promising.

Paul and Chicago has recently closed a contract to install Summit avenue, St. Paul., that will probably have no equal on this continent in the world. The plant will Hood, Chicago representative of the Accumulator company pole National generator of 36,000 watts capacity. This dynamo will be driven by a hot air engine of 65 horse power. One thousand 16-candle incandescent lamps will be installed, requiring 300 feet of 10-inch vitrified tile, with cemented joints laid in sand, and 5,400 feet of No. 0000 lead covered cable. The switch board will be 4x3 feet, with marble base mahogany finish, the instruments all being silver plated, to cost, fully completed, $1,600. In addition to the lighting plant there will be installed a power plant, consisting of five Eddy motors, to be used for the following purposes: One 3 horse power to run a pipe organ in the art gallery, one of the same capacity to run laundry machinery; one of 5 horse power to run ventilating fans; one of 10 horse power to run an artesian well pump, and one of 5 horse power to run a Gould triplex cistern pump. The electroliers and fixtures are to be of the most elaborate kind, and when completed the plant will be a model one.

D. H. O.

Cincinnati, O.

CINCINNATI, Nov. 14.—The Western Electric company has completed the installation at the new eleven story Neave building. The plant consists of one 450 light and one 250 light Western Electric incandescent dynamos coupled in multiple and driven direct by two Buckeye engines A handsome black walnut switch-board mounted with marble base switches stands near the machines, and is so arranged to cut out or in any or all the various floors, and to run the dynamos together in multiple or separately to suit the load. Two Heine safety boilers equipped with the Roney mechanical stokers and furnaces are used, with Laidlaw and Dunn pumps. This plant was planned and installed by Thomas Clanfield of the Western Electric company.

W. H. Stikeman, inspector for the Edison General Electric company, has been in the city inspecting the plant of the Edison General Electric Light & Power company, now under construction. The temporary plant is about completed and ready for operation.

The Thomson-Houston company has secured the contract for wiring the Perin building recently erected at the corner of Fifth and Race streets; also for the apparatus. The contract price was $10,000. The wiring is about completed.

The Moerlein brewery is being wired throughout with the interior conduit system.

F. D. Schopper has secured the contract for wiring the residence of Collin Gardner, at Middletown, O. The contract calls for the interior conduit system throughout and for electric lighting, burglar alarms and bells.

G.

Minneapolis, Minn.

MINNEAPOLIS, November 14. —W. S. McKee, a lawyer of Indianapolis, Ind., has commenced an action against the city of Minneapolis to recover royalty for the use of the Bragg patent electrical arrangement for opening and closing the doors of fire engine houses. The device has been in use in the city about six years. Recently the department has been experimenting with other and similar devices which the representatives of the Bragg interest claim are also covered by their patents. A large amount of money is involved, and the matter will be the subject of careful investigation by the city authorities.

The suit of Miss Mary A. Noot against the Standard Underground Cable company, to recover $450 damages for injuries received by falling over a rope, has been dismissed in the municipal court, Miss Noot having accepted $200.

The street railway company is experimenting with two electric heaters, one of which it expects to adopt for use in its cars. The heaters under consideration are the Burton and the Carpenter, the latter one being the invention of Chas. E. Carpenter, of this city, which is manufactured by Carpenter & Nevins. The Burton Heater company manufactnres the Burton heater at Baltimore, Md.

The new power house of the street railway company

being pushed rapidly. The addition, which is nearly completed, is 73x87 feet in ground dimensions and one story high. This will provide room for five engines and five dynamos. The boiler room is about completed, but the smoke stackwill be made fifty feet higher than it is at the present time. New steam plants are being added to the car houses at Nidway, East Side, Minnehaha and Bloomington avenues. The oil tank tracks at Thirty-first street are finished, and the Westinghouse engines are in place; the center poles have been taken out of Twenty-ninth street and side poles erected, the same as on Fourth avenue south, to facilitate the handling of freight from the Hastings and Dakota tracks. The new plant out at the junction will comprise an electrical and repair shop when completed.

The street railway company is considering the advisability of making a decided change in the operation of its Sixth street and Chicago avenue line by taking off the double train, motor and trailer which run every ten minutes and putting on single larger motors, which will run every five minutes. It is believed that this will be as satisfactory to the patrons as the service of the big single motors on the Hennepin, Bloomington, Western, University and Southtown lines. The conversion of old horse cars into trailers is now accomplished, and a dozen snow-plows are about ready for winter emergencies, those for the inter-urban line having 36 inch wheels and the other 24-inch. During the winter the summer cars will be refitted for service next year and all the rolling stock will be placed in the best order possible. F.

Milwaukee, Wis.

MILWAUKEE, November 14.—The special committee of the Common Council appointed to look into the electric light question went to Chicago after looking over the books and plants of the Badger Illuminating and Milwaukee Light and Power companies. Some of the members of the committee had been of the opinion that the city, by owning and operating its own plant, could get electric lighting at a cost of $75 per lamp per year, but in Chicago their theory was exploded, from all accounts. The committee found that at one of the Chicago stations the chief engineer receives a salary of $1,200 a year, his assistant, $1,030; four firemen, $2 880 in all; six trimmers, $3,240; line tester, $720; three linemen, $2,520. Carbons cost $3,800 a year; fuel, $12,000; the interest on the investment of $280,000 is put down at $14,000; the depreciation of the machinery at $8,750, being 2½ per cent., and the outlay for oil, waste, repairs, globes, etc., at $7,000, making a total of $57,190 per year, or $190.63 per lamp per year, without allowing for accidents or damages. It was learned, however, that Electrician Barrett does not take into consideration the salaries of linemen who are paid by the fire department, or the items of interest, taxes, water rent, insurance, repairs, depreciation, and yet is unable to bring the price per lamp below $83. In the outskirts, it was found, Chicago pays $170 a year per lamp to private corporations. The price at which the Badger Illuminating company offers to renew its contract with the city for five years is $112.50 per lamp per year. Racine is paying $75 per lamp per year. It is probable that the committee will visit Racine and a number of other cities before it makes its report. Ald Ziegler, the chairman of the committee, is said to be in favor of returning to gas rather than pay the Badger Illuminating company $112.50 per lamp per year. The contract with the Badger [illegible] December 15th. The company, however, is cheerfully furnishing new lamps in accordance with the resolutions of the Common Council, and does not seem to be very much afraid of losing the city's custom. The indications point to a renewal of the Badger contract.

[illegible] trio lights cheaper than Milwaukee, he states, is that there

pensing with the services of the girls. It is no easy task, he declares, to accomplish telephone connection automatically, except at the subscriber's office. Mr. McLeod makes the announcement that some time ago a Milwaukee insurance man began to work out a design for a device similar to the Chicago contrivance. The Milwaukee man's idea was to enable each subscriber to manipulate the connecting device at the central station by the use of push-buttons representing units, tens, hundreds and thousands. Thus, if he wanted to call No. 2412, he would press the thousand button twice, the hundred button four times, the ten button once, and the unit button twice. The shifting or connecting apparatus itself would necessarily be very complicated. In the telephone business the great item of expense is the cost of repairs necessary to keep up the apparatus, and anything that would make the apparatus more complicated, would doubtless cause a corresponding increase in the repair bills. It would be necessary to use the telephone wire to do all of the extra work, for any arrangement involving an increase in the number of wires would be out of the question. To multiply the number of wires and connections would be to multiply the chances of leakage and trouble.

The proprietors of the Republican House have decided to light that hostelry with incandescent lights, which will be furnished from a private plant in the basement of a $50,000 annex to the hotel.

The owners of property at Schwartzburg, which promises to become a flourishing manufacturing suburb, are making an organized effort to secure an extension of the Villard electric railway system to that point, via Fond du Lac avenue.

In a short time Racine will be doing its telephoning to Chicago by way of Milwaukee. It has been decided to extend the improved long distance service, with a metallic circuit, to Racine, and instead of building a new line from Racine to Chicago, the Racine people will be allowed to use the Chicago-Milwaukee line by "talking around a corner." The new metallic circuit between Milwaukee and Chicago has been put in operation, and works satisfactorily.

The street cars on the Villard system, which includes all of the lines in Milwaukee, are likely to be heated by electricity during the coming winter. At the company's shops a car is being constructed which will have appliances for the generation of heat by means of the same current that will furnish power for propelling the car. It is said that the Carpenter heater will be used. The expense of equipping each car will be $40. Henry C. Payne, speaking for the Villard company, states that the expense will cut no figure. It will be adopted on all the Villard lines, he says, if it is successful. The public here is very much interested in the outcome of the experiment.

The Wisconsin Electric club was guaranteed a course of lectures on "Electricity," by Dr. H. B. Loomis, of Madison, in the University Extension scheme. The lectures are six in number, as follows: "Electrostatic Induction," "Electric Current," "The Electro-magnet," "Electro-magnetic Induction," "The Dynamo and Motor," and "The Electric Discharge in a Vacuum." C.

Prof. Barrett's attention was called to the statements attributed to the Milwaukee officials regarding municipal lighting. He said: "I told the Milwaukee delegation in substance that the cost of construction for each post of a plant of 1,000 lights would be $499. This, of course, includes everything, the power house, dynamos, lines, and every single detail. The cost of maintaining such a big plant would be between $60 and $70 for each lamp per year, and not $190. I also gave them figures on a 300-lamp plant, in which case the annual maintenance would be about $85 per lamp. I advised very strongly, however, against putting up any plant of less than 500 lamps, because the larger the plant the lower the maintenance for each lamp. As a matter of general advice I told the gentlemen to delay putting up any plant for the city until after the World's Fair. By such a delay much investment and labor would be saved. If they, in the meantime, could rent light at the rate of not exceeding $100 per lamp annually they would do decidedly better than by immediate construction on the city's account.

Toledo, O.

TOLEDO, Nov. 14.—The Circuit court has made a decision, by which the injunction restraining the Consolidated Street Railway company from putting up a wire over the [illegible] already have one was provisionally dissolved. The court ordered the companies to try the [illegible] set of electric wires. One com[illegible] that it cannot

The first thing that the attorneys of the Toledo Electric Street Railway company [illegible] did after the Circuit Court had given the Consolidated the right to run another set of trolley wires along Summit street, if it should in no way interfere with the working of the Robison wires, was to hold a consultation as to what could be done to further block the operations of the arival company. In arguing against the motion of the Consolidated to dissolve the injunction brought by the Robisons, the attorneys of the latter urged that the ordinance forbade more than one set of wires over the street. The Circuit Court, however, held in regard to this that the railroads being themselves interested parties could not raise this point. It would have to be done by the city. But the city solicitor last week signed the declination, probably to permit a person practically representing the railroad to bring the suit, for the law provides that if the city refuse to enforce the ordinance this may be done by any taxpayer. Dennis Coghlin was chosen as the name in which the injunction was brought and Judge Lemmon granted it.

After the decision handed down by the Circuit Court dissolving the injunction granted the Robisons, which restrained the Consolidated from putting up its wires on certain city streets, it seemed that rapid transit on some of the Consolidated streets was, at last, near at hand. This second injunction granted Dennis Coghlin has not only dampened the prospects for rapid transit, but another legal fight is probable before the Consolidated will be enabled to run motor cars along the main streets of the city. Mr. Lang, the general manager, said he was very much surprised that any injunction should be granted by the Common Pleas Court, which temporarily obstructed the working of the Circuit Court's decision. He said: "The effect of the Circuit Court decision would have been to allow an additional wire to be put up over our tracks on Summit and Monroe streets, and to leave both companies in a position to apply to the court for further relief if necessary, after the two wires were put up." He said further that it was feasible for each company to maintain separate wires and operate them successfully as was done in Cincinnati and other places. On one street in Cincinnati four wires were maintained over one track.

The Toledo Electric Street Railway company has received and is now placing in position its second 500 horse power double traction Corliss engine; these engines have a twenty foot drive wheel which carries a forty-eight inch belt. The company will also place two more Edison generators of 80 horse power soon, making the capacity 1,000 horse power. F. C. H.

Stillwater, Minn.

STILLWATER, Minn, Nov. 14.—The prolonged controversy between the Stillwater Electric Railway company and the city council has had a new developement which has caused considerable commotion. Some time since an ordinance was passed requiring the company to pave between its tracks on North Main street, and the company did not do the work in a manner satisfactory to the city fathers. So they passed a supplementary resolutian at a recent meeting requiring the company to repave the tracks. To a disinterested observer it looks as if the street railway company is the victom of control so rigorous as to amount almost to persecution. Stillwater is a very hilly town, and the operation of electric lines is attended with many difficulties. A few months ago the motors in use were decided to be too light for their work and new ones were substituted on some of the lines at considerable expense. Just now the company is preparing to equip its cars with electric heating apparatus, and shows a disposition to perfect its service as rapidly as possible. The council ought to appreciate the difficulties and give the company credit for its efforts. N.

Hot Springs, So. Dak.

HOT SPRINGS, Nov. 14.—W. M. Lenhart of the Brush Electric company, Chicago, is arranging for an enlargement of the Hot Springs Electric Light company's plant. The latter company has a magnificent water power 4½ miles down Fall River and it is understood is going to use this to its full capacity next season. It is intended to use two 1,000 light alternators for the incandescent work and 100 horse power generator for quarry work.

F. T. Evans has made arrangements with the Short Electric Railway company for a full gearless motor street railway outfit, which is to be put in early next spring. The generator will be driven by water power. The wheel is of the James Leffel horizontal type and is 26½ inches in diameter. It has been placed in position already and has a pressure of 40 ft. W. H. T.

An electric plant is now being completed on the U. S. S. Newark, one the cruisers spoken of as a part of the fleet that may possibly be sent to the South Pacific to teach the Chilians a lesson in good manners.

PERSONAL.

J. E. Lockwood of the Detroit Electrical Works was in Chicago last week.

J. M. Fisher, general manager of the Mosher Arc Lamp company, has become a resident of Chicago, his family arriving from Kansas last week.

F. A. Perret, of the Elektron Manufacturing company, Springfield, Mass., has recovered from his sickness, which necessitated an absence from his business since July 1st.

C. A. Hussey has taken a suite of rooms in the Electrical Exchange building, New York, which he is fitting up in fine style Mr. Hussey has just returned from an extended business tour through the West. He reports the result of his trip as being most satisfactory.

NEW INCORPORATIONS.

Long Island City Electric Illuminating company, Long Island City, N. Y; capital stock, $50,000; manufacture and use of electricity.

Queens County Light & Power company, Oyster Bay, N. Y.; capital stock, $50,000; producing electricity for light, heat and power.

Allegan Light & Power company, Allegan, Mich.; capital stock, $10,000 ; electric lighting and manufacturing ; H. F. Marsh, Allegan, Mich.

National Electric Brush company, Portland, Me.; capital stock, $500,000; to manufacture and sell electric hair brushes; Geo. C. Hopkins, Portland, Me.

Electric Appliance company, Chicago, Ill.; capital stock, $30,000; manufacturing, buying and selling electrical appliances, Ela & Grover, 115 Dearborn street, Chicago, Ill.

Tanaqua & Lansford Street Railway, Tanaqua, Pa.; capital stock, $50,000; operating a street railway by electric power in Schuylkill county, Pa.; J. R. Coyle, Shenandoah, Pa.

San Angelo Light, Power & Irrigation company, San Angelo, Texas; capital stock, $20,0 00; to supply light and power for the public; Ed. Duggan, San Angelo, Texas.

Lancaster & Strasburg Railway company, Lancaster, Pa.; capital stock, $125,000; operating a street railway by electric or other than locomotive power; Walter M. Franklin, Lancaster, Pa.

Santa Paula Water Works, Santa Paula, Cal.; capital stock, $150,000; to construct water works and utilize water power; to generate electricity and other power; W. L. Hardison, Santa Paula, Cal.

Latrobe & Derry Electric Street Railway company, Latrobe, Pa.; capital stock, $40,000; operating a street railway by electrical or mechanical power in Latrobe, Pa.; David J. Bush, Latrobe, Pa.

Bellefonte Street Electric Railway, Bellefonte, Pa.; capital stock, $18,000; operating a street railway by electrical power in the borough of Bellefonte, Center county, Pa.; Louis E. Reber, Bellefonte, Pa.

Morgantown Electric Light & Power company, Morgantown, W. Va.; capital stock, $100,000; establishing an electric plant at Morgantown to supply light and power to the consumers; H. S. Sands, Fairmont, W. Va.

Montrose Electric Light & Power company, Montrose, Pa.; capital stock, $12,000; furnishing light, heat and power by means of electricity to the public at the borough of Montrose, etc.; Samuel S. Wright, Montrose, Pa.

Wilder Duplex Electric Burglar Alarm & Messenger company (incorporated in W. Va.), New York, N. Y.; capital stock, $500,000; using inventions patented by E. R. Wilder; Simson Wolf, Times building, New York, N. Y.

Triple Multiplex company (incorporated in W. Va.), New York, N. Y.; capital stock, $1,000,000; making, holding and selling electrical and mechanical devices, inventions and machinery; J. F. Reynolds, 45 Broadway, New York, N. Y.

Astoria Electrical Manufacturing company (incorporated in W.Va.), New York, N. Y.; capital stock, $500,000; to acquire and hold and grant licenses, letters patent, etc., and to dispose of the same; Alexander & Green, 120 Broadway, New York, N. Y.

Mitchell Electrical Railway Cable company (incorporated in W. Va.), New York, N.Y.; capital stock, $5,000,000; manufacturing and dealing in electric cables and selling and leasing rights to use the same; A. C. Shenstone, 120 Broadway, New York, N. Y.

East Liverpool & Wellsville Street Railroad company, Cleveland, O.; capital stock, $300,000; constructing, maintaining and operating an electric street railroad between East Liverpool and Wellsville, Columbiana county, O., etc.; Russell & Rice, Cleveland, O.

Early Electric Light company, Richmond, Wayne county, Ind.; capital stock, $25,000; to operate an electric light plant, manufacture and sell electric light in the city of Richmond, and to transact all other business incident thereto; Lee Yaryan, Richmond, Ind.

Connecticut Smokless Fuel Gas company, Chicago, Ill.; capital stock, $1,500,000; manufacture, supply, sale or distribution of gas, electricity or other product for the furnishing of light, heat, fuel and power; C. C. March, room 16. 182 Dearborn street, Chicago, Ill.

The International Electric Railway company, Chicago, Ill.; capital stock, $2,500,000; to construct, build and operate electric railways and manufacture electrical appliances, and furnish electric light and power; International Electric Railway Co, room 16, 260 S. Clark street, Chicago, Ill.

United States Rapid Transit company of Chicago, Ill.; capital stock, $5,500,000; build, equip, operate, buy, use and sell mechanical and electrical constructions and devices for rapid transit of the U. S. mail, passengers and merchandise ; F. C. Anderson, 311 Rookery building, Chicago, Ill.

Phoenix Electric company, Duluth, Minn.; capital stock, $10.000; to manufacture and deal in articles and supplies for the production, utilization and application of heat, light and power; construction and equipment of factories, plants and lines for supplying, using and storing electricity; Henry S. Mahon, 304 First National Bank, Duluth, Minn.

TRADE NEWS.

The Bryant Electric company of Bridgeport, Conn., report good business. Its working force is to be increased.

Laminar Fibre company, New York, is about to offer for sale a new conduit which has met the approval of all electrical people who have seen it.

The Ashton Valve company, 271 Franklin street, Boston, reports a brisk demand for its product, especially from locomotive works and central stations.

The Wilmot & Hobbs Manufacturing company, Bridgeport, Conn., reports the manufacture of bells for electrical purposes as being unusually brisk.

H. Ward Leonard & Co., New York have just issued a neat pamphlet containing testimonials and references, together with a list of the plants installed under the supervision of the members of the firm.

The Akron Electric Manufacturing company of Akron, O., manufacturers of dynamos, motors, fire alarm, telegraph, and street car signal systems and electrical supplies of all kinds, reports a lively and growing trade.

The Franklin Electric company, New York, has recently been awarded a contract to furnish 50 storage cells to be used in a catamaran owned by Dr. H. Wier of New York. The Riker motor will be used to drive the boat.

H. N. Bates & Co., Boston, are figuring upon a number of contracts to be placed from the West and South. The new quarters, corner of Purchase and Congress streets, give ample facilities to meet a growing business.

G. B. Buxton, East Somerville, Mass., whose Universal packing, it will be remembered, was called the "engineers' favorite," is very busy at present filling orders. An inquiry as to "sample" orders will reveal something of interest to buyers.

The Consolidated Electric Manufacturing company, 154 Franklin street, Boston, manufacturers of electric supplies, has just put out its indexed catalogue. The information relative to Grimshaw wires will prove valuable to those ordering.

The firm of Gould & Watson, Boston, is busy with orders for mica. This concern recently established a branch agency at Chicago. It was found that an increasing trade in the West necessitated a representative in that section of the country.

C. B. Elliott, the manager of the Revere Rubber company, Boston, is completing several appliances to be used in street railway work. It is said that as far as simplicity and general convenience is concerned they will be a surprise to many.

The W. S. Hill Electric company, Boston, is now completely organized, and it already has a large number of orders on the books. It is working over-time. The company is prepared to furnish anything in the way of switches, motors and dynamos.

The Globe Carbon company of Cleveland, O., announces the removal of its works to Ravenna, Ohio. The factory will have a capacity of 100,000 finished carbons per diem. It may be stated that freight rates from Ravenna are the same as from Cleveland.

H. L. Pierce of Pierce Bros., Leominster, Mass., is now in Austin, Tex., where he recently completed work upon the large street railway contract awarded him June last. Pierce Bros. are expecting to complete work upon the Worcester electric street railway December 1st.

Thos. Towne has resigned the position of buyer for the Garvin Machine company, New York, and is now engaged with the Union Drawn Steel company as eastern sales agent. Mr. Towne explains in a circular to the trade the numerous iron and steel products he is handling.

C. J. Hirlimann, manufacturing battery expert and inventor, No. 117 McDougall street, New York, whose Champion cell was recently the subject of a most flattering testimonial from Prof. Henry Morton, has just issued a circular descriptive of his various batteries.

The Redding Electric company of Boston recently completed a new watchman's register. Its main points of excellence are simplicity and a perfection of mechanical construction, which maintains a correctness of registration. A new circular regarding this invention has been issued.

The Hine Eliminator company, New York, has recently furnished the electric light works at Jackson, and the Cedar Rapids Electric Light company's station, Michigan, with eliminators for the purpose of securing dry steam for their engines. This separator is meeting with remarkable success.

The illustrated price list of incandescent lamps, manufactured by the Buckeye Electric company of Cleveland, O., is, in its way, a work of art. This company is building a new factory with nearly four times the capacity of the present works. The Chicago office has been removed to 437 Rookery.

"A dynamo without a commutator wouldn't need brushes, but since they do have commutators and must have brushes,

or soft wood, also for the Keller steel pole, for which there

port, Conn., on account of the large number of orders received for their new silicon bronze span wire, have concluded to make a new grade which will be known as "No. 2" and will possess all the high mechanical qualities of the regular silicon bronze wire.

The La Roche Electric Works, Philadelphia, are now introducing a new volt and ampere meter for both direct and alternating currents. These instruments are calibrated with special care. They are dead-beat, and are made so that they can be left in circuit without injury. They are constructed, for the most part, of aluminum.

It seems that the deadly car stove is on its way to oblivion, for the Electric Merchandise company, Chicago, is constantly receiving messages indicative of its speedy demise, at least as far as street car service is concerned. "Heaters working satisfactorily. Hurry the others along soon as possible," from the Ottumwa Electric Railway company, is the latest in favor of electric heating.

The organization of the New England Electric company at Bridgeport, Conn., with Messrs. Perry and Griffin as managers, will offer a number of advantages to prospective builders and parties desiring first class electrical work. Mr. Perry was formerly identified with the United States Electric Manufacturing company. This concern has a large amount of work already, and the prospects for success are excellent.

President George F. Page of the Page Belting company, Concord, N. H., reports that the factory is running fifteen hours a day. Trade in the West is proving very satisfactory, it being much larger at present than at the same time in any previous year, showing that it pays to offer first-class goods for sale in that portion of the country. The Page company also has a number of foreign orders for shipment between now and January 1st.

T. J. Murphy, Electrical Exchange building, New York, manufacturer of slate for electrical purposes, displays slate of at most every conceivable finish. He is now constructing a large switch-board of Italian marble, 8x8 feet, to be used at the Presbyterian hospital in New York. It may be mentioned that it was Mr. Murphy who furnished the handsome marble-faced switch-board in use at H. B. Claflin's wholesale dry goods house in New York.

A pamphlet has recently been issued for free distribution by C. A. Snow & Co., patent attorneys of Washington, D. C., containing directions for procuring patents and the cost of the same in the United States and foreign countries; information about the registration of trademarks, copy-rights, caveats and designs; also abstracts of court decisions in patent cases, and much other matter of interest to inventors, patentees, manufacturers and others interested in patents.

The Crown Electric Manufacturing company has been recently reorganized at Bridgeport, Conn., with F. H. Bryant as president; C. J. Norton, secretary; E. L. Smith, general manager, and G. C. Foster, electrician. All of the above gentlemen are well known to the trade. It is their intention to manufacture a full line of sockets, switches, and cut-outs, branching into the manufacture of other electrical apparatus. The present quarters are at 99 Cannon street. Operations are to begin about December. 1st.

The Universal Arc Lamp Company, New York, announces that it has appointed the Interior Conduit & Insulation company exclusive agent from November 1st, for the manufacture and sale of its apparatus, which includes the Universal constant potential lamp, the Short decorative lamp, and the railway circuit incandescent lamp, also the Universal series high potential lamp, and the theatrical and focusing lamp. The Conduit company has taken the Universal company's current customers and other accounts, and will also pay the few outstanding bills of the company.

James W. Queen & Co. of Philadelphia have removed their offices and showrooms to 1010 Chestnut street, where larger quarters have been secured. The departments of philosophical, electrical and chemical apparatus will occupy the entire second floor, extended through from Chestnut street in front to Sansom street in the rear, thus covering a floor space of 5,300 squre feet, well lighted and ventilated. The entire building contains 26,000 feet of floor space, which will be [illegible] by electricity. A very [illegible] which will [illegible] each, two Westinghouse compoud engines of 60 horse power [illegible] motors for running elevators and for special work, and the apparatus for steam heating.

[illegible]

sometimes changing from nothing to over 600 horse power in less than one minute. This has caused the boilers to foam, and on two occasions it is reported that the large Corliss engine would certainly have been wrecked had it not been for the Pond separator, which is located in the main steam pipe, near the engine. Two additional Corliss engines are being installed, and they, also, will be protected by the Pond separator. This device is manufactured by the Pond Engineering company, St. Louis, which reports additional orders from M. Beatty & Son, Welland, Ont.; Union Manufacturing company, Champaign, Ill; DuPont Paper company, Louisville, Ky.; Cicero & Proviso Railway, Chicago, Ill; St. Louis Smelting & Refining company, St. Louis, and John Ramming, St. Louis.

The Clark search light has been attracting considerable attention at the American Institute Fair, New York. This apparatus was exhibited by the Clark Electric company, of 192 Broadway. The arc lamp used was made especially for search lights designed for marine service. It is most ingeniously arranged, being mounted on swivelled trunnions so that it can be turned instantly to throw light in any direction. Ernest P. Clark, the inventor of this lamp, illustrated its operation to a representative of the WESTERN ELECTRICIAN by revolving and placing it in every conceivable position. At first it was difficult to see just how it was that the wires which connect the lamp with the incandescent circuit did not become disarranged and entangled by the various revolutions. Mr. Clark explained that there were no flexible cables used, but all connections were made through the trunnions by means of well insulated joints. As no cords or weights are employed, this lamp's action is entirely independent of the effects of gravity. It works as freely and as perfectly on a vessel in a heavy sea as on land.

The Electric Appliance company, the latest electric supply house in the field, is rapidly filling its large store at 242 Madison street, Chicago, with a complete and desirable line of general electrical wares, and will be in a position, very shortly, to meet the demands of at least the city trade. Secretary and Treasurer Thos. I. Stacey states that his company has already closed negotiations for the general western agency for Paranite wires and cables. Paranite is a new rubber insulation of high grade, and is said to possess merits not found in other insulators. The wire is made of an inner layer of absolutely pure Para rubber, hence the name of the insulation. This layer prevents the slightest corrosion of the wire, and at the same time adheres with a wonderful tenacity, preventing any peeling in drawing over rough corners. This inner layer is covered with a thick layer of rubber, to which just enough sulphur has been added to permit the vulcanizing process. When the process is completed there is left an insulation composed of a pure white Para Core and an outer layer of black rubber possessing the highest insulating qualities and a wonderful toughness. In fact, it is stated, that it is so tough that it can only be cut with a sharp knife or other edged tools. After being thus prepared, the wire is finished with a serving of either a strong tape or braid. The Electric Appliance company considers that it possesses in this wire a very valuable specialty.

BUSINESS.

W. H. Archer, of Buffalo, N. Y. has prepared plans for seven depots for the Buffalo, Tonawanda, and Niagara Falls electric railway.

The Goodrich Hard Rubber company, Akron, O., is determined to make the "greatest show on earth." A hand bill recently issued would make P. T. B. turn in his grave.

The New York & Ohio company which manufactures the Packard high grade incandescent lamp has transferred its Chicago agency to the Elecrrical Engineering & Supply company, 931 the Rookery, which will immediately lay in a stock of Packard lamps so that it can fill all orders promptly from stock.

A familiar sight in the streets of Chicago at present is the handsome new horse and truck of the New York Insulated Wire company, bearing the familiar sign of Grimshaw white core wire, and carrying loads of vulca wire ducts. Geo. H. Meeker, western manager of this company, is at present making a trip through the South in the interests of the Chicago office.

A great deal has been written about a paint called "Isolatine." The electrical papers in particular have indulged in considerable verbosity as to its merits, but after all there [illegible] as to worth, and that [illegible] Hasslacher [illegible] New York, will place [illegible] of some value.

[illegible] company, of New York, will commence laying, during the present week, its duplex [illegible]

[illegible]

[illegible] re Valves," recently illustrated in the [illegible]

valve of much larger size than those in ordinary use, and will arrange to build under contract sizes up to 16 inches in diameter. The Chicago Arc Light and Power company, Hannah & Hogg, the Boston Store, Mandel Bros., *The Herald*, Carson, Pirie, Scott & Co., and many other owners of electric lighting plants in Chicago have this useful steam appliance in use.

The Sioux City Engine Works of Sioux City, Ia., has opened a branch office at room 511, Commercial building, St. Louis, Mo. The office will be in charge of A. M. Morse, recently of the firm of English, Morse & Co., Kansas City, Mo., who, during his eight years of residence in that city, has gained a wide acquaintance among the steam users of the Southwest, and has been awarded many important contracts for engines, boilers for complete steam plants for electric lighting stations, railways and manufacturing establishments. The company is prepared to furnish on short notice Sioux City Corliss and Giddings' automatic engines with suitable boilers. It will make a specialty of complete steam power plants for any service.

Wm. Sellers & Co. of Philadelphia, last week tested a motor operated under the new principle invented by H. Ward Leonard. The motor used was a ten-horse power shunt-wound Sprague motor, the normal speed of which was 1,500 revolutions a minute. The motor was belted to a countershaft, and upon the countershaft was placed a brake, and in addition to the brake there was placed on the countershaft a large fly wheel, such as is used upon punching machines, the purpose of the fly wheel being to duplicate the inertia and momentum met with in practice in a great many kinds of work. The motor was made to operate in either direction at any rate of speed desired, and it was found possible to run the motor perfectly and regularly under the full brake load, at fifteen revolutions per minute, that is, one per cent. of its full speed. While operating at full speed in one direction the motor could be instantly reversed, the reversal being perfectly gradual and entirely without any spark or troublesome feature of any kind. In order to get the most marked effect in overcoming the momentum of the fly-wheel the brake was taken off, and when the fly-wheel was running at its full speed of 300 revolutions a minute, the motor was instantly reversed. In thirteen seconds the motor had brought the fly-wheel to rest, and in thirteen seconds more had it running at full speed in the opposite direction, the entire operation being effected with the greatest smoothness and without any spark whatever.

ELECTRICAL PATENTS.

Issued Nov. 10, 1891.

462,681. Electric Conductor. J. A. Barrett, Brooklyn, N. Y.

This invention consists of the combination of a conductor, an insulating cover or serving about said conductor, an envelope consisting of a strip wound about the served conductor and sized with a material that is adhesive when moist, and flexible when dry, and sealing material outside the envelope.

462,688. Electric Railway System. Henry C. Camp, St. Paul, Minn.

462,693. Secondary Battery. Nathan H. Edgerton, Philadelphia, Pa.

462,698. Electric Arc Lamp. John E. Giles, Hazleton, Pa.

The object of this invention is to enable an arc lamp to be used on regular arc circuits where a constant current is used, or on circuits of constant potential, as those in which incandescent lamps are used.

462,707. Device for Removing Ice from Overhead Wires. George Hipwood, Boston, Mass.

462,720. Telegraph Table. Katie V. Miller, Lewisburg, Ohio.

The object of this invention is to provide a simple, cheap and effective table in which the parts are so arranged as to economize space and produce a compact support for the instruments without such complication as would render frequent repair and adjustment necessary.

462,729. Machine for Holding and Sewing Fabrics. Lansing Onderdonk, Chicago, Ill.

462,732. Electric Belt. E. Peterson, Minneapolis, Minn.

462,741. Police Signal Telegraph System. Charles A. Rolfe, Chicago, Ill.

462,751. Electric Railway Motor. Charles J. Van Depoele, Lynn, Mass.

462,756. Carbon Holder for Arc Lamps. James J. Wood, Brooklyn, N. Y.

Of the six claims the second is given:

"2. A carbon holder consisting of a hollow shell, two clamping jaws adapted to grip the carbon between them at their lower ends, crossing each other and terminating at their upper ends in contact with the internal surface of said shell, and a [illegible] acting on said jaws to press their lower ends together and their upper ends apart."

462,785. Call-box. Edmund R. Wilder, Kansas City, Mo.

Of the six claims the third is given:

"3. In a call box, the combination of a signaling mechanism, [illegible] the station, a ground circuit [illegible] connected with the ground or metallic circuit [illegible] in operation."

462,[illegible]. Fire Alarm Box. Edmund R. Wilder, Kansas City, Mo.

462,[illegible]. Electric Car Brake. James D. Collier and James K. P. Miller, Woodville, Tex.

[illegible]

462,[illegible]. [illegible] Connection and Signal for Railway Cars. James D. Collier and James K. P. Miller, Woodville, Tex.

462,795. Method of Producing Rain-fall. Louis Gathmann, Chicago, Ill.

Of the five claims the fourth is given:

"4. The method of producing rain-fall, which consists in elevating a highly-compressed gas into the upper regions of the atmosphere and liberating said gas by a concussion."

462,807. Electric Car Coupling. James D. Collier and James K. P. Miller, Woodville, Tex.

462,808. Police Signal System. Nathaniel B. Cregier, Chicago, Ill.

Of the six claims the fourth is given.

"4. In a signaling system, the combination, with the central station and the street-box, of a main line circuit connecting said box and station, a magneto generator at the box, a shunt for automatically closing said main-line circuit through said generator when the door of the box is open, and the visual and magneto-bell signals at the station, both normally included in the main line circuit."

462,813. Signaling Device for Telephone Pay Stations. William Gray, Hartford, Conn.

462,834. Signaling Device for Elevators. Charles G. Armstrong, Chicago, Ill.

This invention consists of the combination, with an elevator shaft and car, of a visual signaling device consisting of an electric lamp located at a doorway of the shaft within the latter and a push-button or equivalent device located at said doorway of the shaft outside of the latter and controlling the lamp-circuit.

462,835. Electrical Indicator for Elevators. Charles G. Armstrong, Chicago, Ill.

The object of this invention is to provide an electrically operated mechanism by means of which the position of the elevator will be simultaneously indicated at a suitable point on each floor of the building, so that the location and direction of movement of the elevator car may be known by a simple inspection of the indicator.

462,836. Mechanical Cut out. Harry W. Burnet, East Orange, N. J.

462,850. Electric Circuit Closing and Breaking Device for Railway Tracks. Thomas H. Patenall, Rahway, N. J.

462,862. Press for Molding Glass Insulators. Lawrence B. Gray, Boston, Mass.

462,880. Commutator. Sidney H. Short, Cleveland, Ohio.

462,881. Armature for Dynamo-electric Generators Sidney H. Short, Cleveland, Ohio.

462,882. Armature for Dynamo-electric Machines. Sidney H. Short, Cleveland, Ohio.

The last claim is given:

"5. An armature for a dynamo-electrical machine, comprising a laminated core and a flat metal ring or rings outside the bobbins secured in place by a single row of bare rivets arranged in a line of equi-potential."

462,883. Brush Holder for Dynamo electric Machines. Sidney H. Short, Cleveland, Ohio.

462,901. Duplex and Quadruplex Telegraphy. Francis W. Jones, New York, N. Y.

Of the four claims the third is given:

"3. A combination of a neutral relay, a compensating coil, secondary coils connected therewith, and primary coils connected into the main and artificial lines."

462,926. Heating and Lighting System. Rudolph M. Hunter, Philadelphia, Pa.

Of the eight claims the fourth is presented:

"4. In an electric railway, the combination of an electrically propelled vehicle, two secondary batteries on the vehicle, a motor circuit, a local lighting circuit, and switches for coupling the motor circuit with one battery and lighting circuit with the other battery."

462,973. Brush Holder for Dynamo-electric Machines. Elihu Thomson, Swampscot, and William O. Wakefield, Lynn, Mass.

The last claim reads as follows:

"7. The combination of the brush arm and brush with the followers having pivotal bearings on opposite sides of the brush and adapted to swing down beside one another upon the brush, pressing the latter into engagement with the commutator."

463,001. Electrical Annunciator. Joseph B. Smith, Manchester, N. H.

463,020. Electric Railway System. Granville T. Woods, New York, N. Y.

The first claim reads as follows.

"1. In electric railways, a system of electrical distribution composed of a group of electro-magnetically controlled contacts outside of the road-bed and accessible, each contact being electrically connected with one exposed terminal head in the road bed."

463,024. Reversible Electric Trolley. Joseph W. Bates and Carlostine E. Blake, Minneapolis, Minn.

Of the fourteen claims the eleventh is presented:

"11. The combination of the mounted oscillating trolley supporting arm, the oscillating frame, the tension-spring means, and pull cords extending to both ends of the car, whereby the trolley can be reversed without going around the car."

463,635. Electric Arc Lamp. James E. Gaston, Sparta, Ill.

463,072. Station Indicator. Joseph M. Nelson, Coleman, Mich.

Of the eight claims, the third is given:

"3. In an indicator, the combination, with an indicating device, of means for actuating the same in opposite directions, and a latch consisting of two members oppositely inclined, with which the actuating means engage."

463,079. Electric Conductor. Charles T. Snedekor. New York, N. Y.

463,086. Electric Safety Cut-out Device. Addison G. Waterhouse, Hartford, Conn.

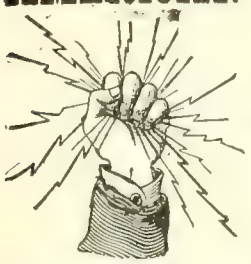
463,107. Electric Conductor. Frederick E. Degenhardt, Chicago, Ill.

The invention consists of the combination of a series of two or more conducting wires, each one surrounded by a covering provided with alternate depressions and elevations, said wire being laid up into a core, and a close cover surrounding the core.

463,121. Steam Dynamo-electric Machine. Frank M. [illegible]che Garland, New Haven, Conn.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. 136 Liberty St. NEW YORK

Parties Controlling Corporation

[illegible] N. Y. Z.

REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and [illegible] weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and so is [illegible] have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our [illegible] durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables [illegible] to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and [illegible] and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible cables with Clark Insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

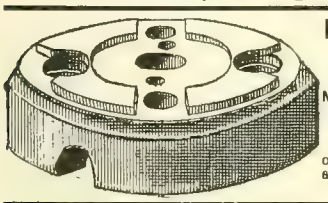
HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

CHICAGO AGENTS: The Electrical Engineering Co., 320 Dearborn St. **TORONTO, ONT. AGENTS: The Toronto Electrical Works**

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. **Telephone, 1718.**



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

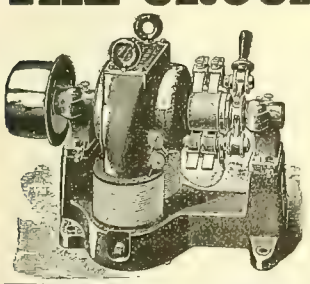
MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

THE CROCKER-WHEELER



PERFECTED MOTORS.

Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

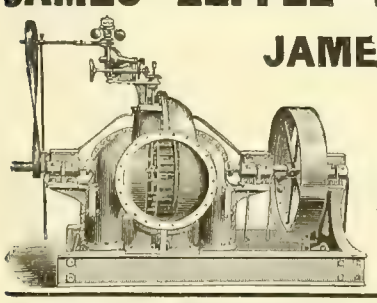
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK

JAMES LEFFEL WATER WHEELS



BUILT BY THE

JAMES LEFFEL & CO.

UPRIGHT AND HORIZONTAL,

FOR

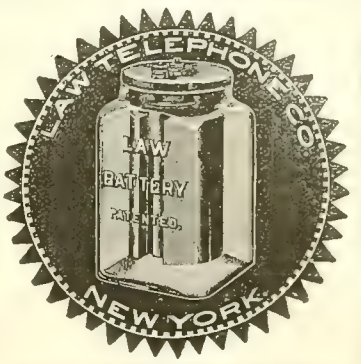
ELECTRIC, MINING AND MANUFACTURING

PLANTS.

Easy working gates. High percentage and even speed at full and part capacity. Equally adapted to high and low heads. Large number of sizes and styles. Send for descriptive pamphlet to

THE JAMES LEFFEL & CO.

SPRINGFIELD, OHIO. | OR 110 LIBERTY ST., NEW YORK CITY



The Winner of 1890 will win again in 1891.

Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Binders FOR THE Western Electrician $1.00.

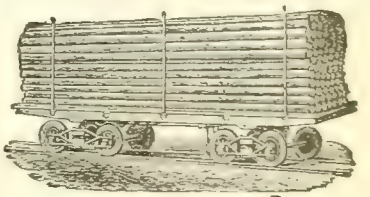
MICA ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light
CROSS ARMS
POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

Queen's "1891" Portable Testing Set.

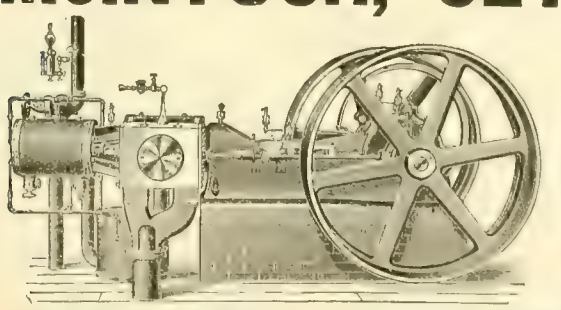
For Illustration see THE WESTERN ELECTRICIAN, Sept. 19, page 183.

The galvanometer in this set is made of the D'Arsonval type, and is extremely sensitive, without being affected by *mechanical vibrations*, as on shipboard, or by intense *magnetic disturbances*, as in proximity to a dynamo. It is especially recommended for making tests where a galvanometer with fibre suspension cannot be used.

Send for Illustrated Descriptive Catalogue 1-66.

QUEEN & CO., PHILADELPHIA.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

For Particulars Inquire of

ARGENT & LUNDY, SELLING AGENTS, 339 Rookery Bldg., CHICAGO.

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION.
One	12½x12	80	Edison General Electric Co., Grand [illegible], N. Y.
Two	18½x17	500	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rio Janeiro, [illegible]
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 19x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Rollins & Co., Chicago, Ill.
One	15 and 21x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Lewis Engine.
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One	11 and 19x15	150	Fritz Wilen, Helsingfors, Finland.
One	16x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 26x17	400	Baltimore Electric Refining Co., Baltimore, Md.
One	14½ and 23x22	500	Georgia Electric Light Co., Atlanta, Ga.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

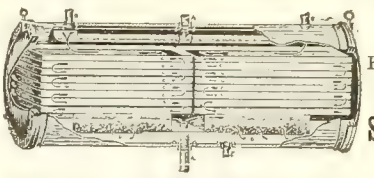
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingots, Slabs, Sheet Wire and Castings at lowest market rates.

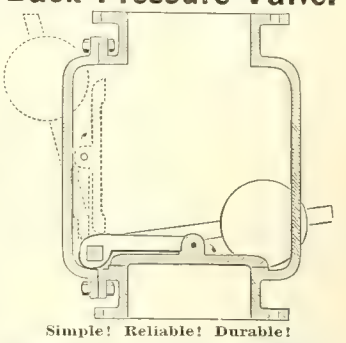
Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.

THE EXCELSIOR

Straight-Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,

229 S. Franklin St., Chicago.

A GREAT RAILROAD.

By the absorption of the Chicago & Atlantic Railway between Marion and Chicago, the ERIE has at last effected its entrance into Chicago, and now occupies the through position of being the only line between Chicago and New York entirely under one management.

One result of this is the arrangement whereby all the through trains of the Erie are now run solid between Chicago and New York without change. Passengers holding through tickets, whether first or second class, are able to go from Chicago to New York without changing cars.

Pullman's most modern Sleeping Cars are run on all through trains via this line, and on their Vestibule Limited, Pullman's Dining Cars. No extra fare charged on this train. In fact, the rates via the ERIE are lower than via any other route offering equal facilities.

SEALED PROPOSALS.

Notice is hereby given that sealed proposals will be received at the office of the Clerk of the City of Peru, Indiana, up to 7 o'clock P. M. of the 8th day of December, 1891,

For furnishing and maintaining of fifty or more arc lights as the Council may deem necessary; said lights to be of 2,000 candle power each and to burn all night, and be placed in such parts of the city as the Common Council shall designate, the Council having the right to add one or more lights to any contract they may make, at any time during the life of such contract at contract price of same, said contract to take effect on the 1st day of June, 1892.

The Council reserves the right to reject any or all bids.

By order of the Council October 13, 1891.

Address, JOHN TOLL,
City Clerk.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar 10, 1891 THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the standard grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on Belting, Free.

ELECTRIC LIGHT AND BATTERY CARBONS.

MOTOR BRUSHES.

CLEVELAND, OHIO.

SUBSCRIBE FOR THE WESTERN ELECTRICIAN.

Manufacturers of

OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

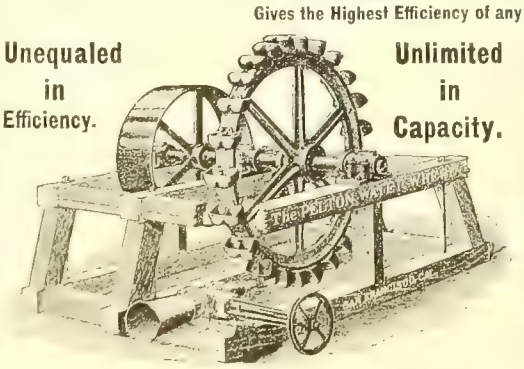
H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 10 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,

121-123 Main St., San Francisco, Cal., U. S. A.

143 LIBERTY STREET, - - NEW YORK.

☞It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

Gleason & Bailey Mfg. Co.,

(LIMITED.)

GENERAL WESTERN AGENTS FOR THE

STEUBEN INCANDESCENT LAMPS,

The best in the Market,

Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.

Rubber Covered, Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and catalogues.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT

IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP

FULLED LEATHER BELTING

Shultz PATENT Leather Woven Link Belt

ALL LEATHER

NO IRON ROD OR HINGE OLD STYLE LEATHER LINK AND IRON ROD BELT, AND ROPE TRANSMISSION SUPERSEDED

SAVE YOUR POWER. YOUR BELTS. YOUR MONEY.

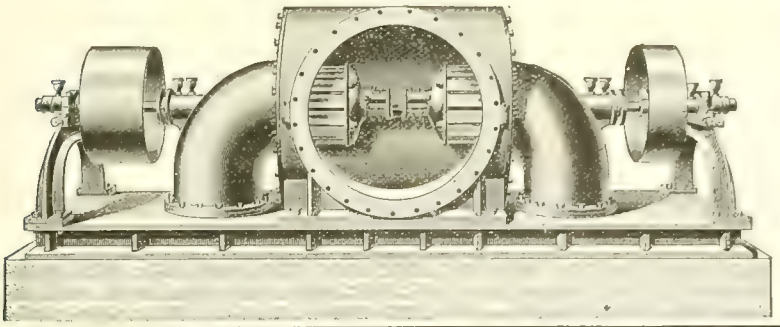
BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER

BRANCHES: 104 Summer St., Boston, Mass.; 225 Pearl St., New York City. 139 N. Third St., Philadelphia, Pa.; 60 W. Monroe St. Chicago. | **St. Louis, Mo.**

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES is called to our CELEBRATED WATER WHEEL, on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** for diameter, being **double** the **Power** of many wheels of the same diameter. By a number of the leading water power companies in the country the economical use of water is guaranteed, and the highest percentage of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended for small powers, and it can be belted directly to dynamo.

The accompanying engraving represents a pair of **VICTOR TURBINES** arranged on a single shaft. Each has its own Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs as above described, wherever the head admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO., RAVENNA, OHIO. MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

GOING TO CALIFORNIA?

If so, and you want to make the journey quickly and have the most comfort en route, purchase your tickets via the Chicago & Northwestern, Union Pacific and Southern Pacific Railways. Pullman drawing-room sleeping cars are run on fast trains Chicago to San Francisco, without change, and all meals are served in dining cars. Completely furnished tourist sleeping cars are also run, in which accommodations can be procured by passengers holding either first or second class tickets at a cost of only $4.00 per berth Chicago to San Francisco, and other California points. All classes of tickets at the most favorable rates, including first class excursion tickets good returning six months from date of sale, reservations in sleeping cars, and full information can be obtained at ticket offices of the Chicago & North-Western Railway, No. 208 Clark St., Oakley Avenue Station, and Passenger Station, Corner Wells and Kinzie Sts.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO.

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

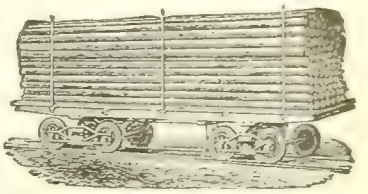
HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing.
Will carry two different kinds of material in opposite directions at the same time.
Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

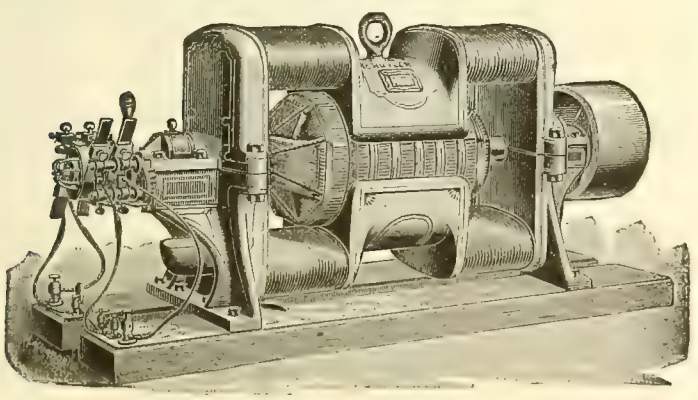
FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

THE ELEMENTS OF

DYNAMIC ELECTRICITY

AND MAGNETISM.

A Book For Learners. **JUST OUT!** Price, $2. Postage Free.

ELECTRICIAN PUBLISHING CO.,

6 Lakeside Building, CHICAGO.

C. & C. ELECTRIC MOTORS and DYNAMOS.

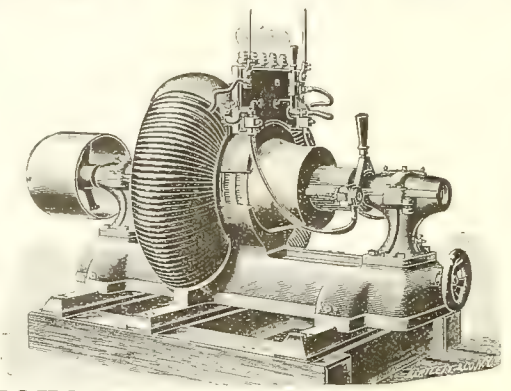
ELECTRIC MOTORS in all standard sizes, up to and including 100 H. P., for operating elevators, pumps, printing presses, and machinery for general manufacturing purposes.

POWER GENERATORS.

ELECTRIC MINING MACHINERY of all kinds, Hoists, Tram Cars, etc.

FAN OUTFITS. Electric Plants for pumping Church Organs.

We call the special attention of Station Superintendents to the fact that our machines are absolutely unsurpassed for economy of electric current.



DYNAMOS for isolated plants and the equipment of Mills, Banks and Office Buildings with Electric Lights.

ELECTRIC BLOWERS for ship ventilation. Have equipped 18 U. S. and foreign War Ships with ventilating apparatus.

NEW ENGLAND Office, 63 Oliver St., BOSTON.
PHILADELPHIA Office, 38 S. Fourth St.
CHICAGO Office, - Phenix Building.
SAN FRANCISCO Office, - 35 Market St.
ST. LOUIS Office, - - 421 Olive St.
NEW ORLEANS Office, 78 Customhouse St

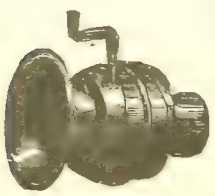
THE C. & C. ELECTRIC MOTOR CO., 402-404 Greenwich Street, NEW YORK.

Goodrich-Coleman Electrical Works,

NEW ELECTRICAL THEORIES DEVELOPED.

Manufacturers of Specialties and Novelties under Contract.

31 South Canal Street, - CHICAGO.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

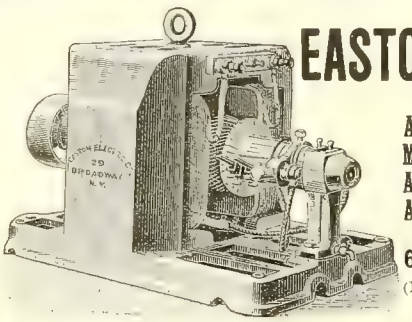
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.



THE EASTON ELECTRIC CO.,

MANUFACTURERS OF

Arc and Incandescent Dynamos, Motors, Generators and Separators And Arc Lamps adapted for use on Arc or Incandescent Circuits.

ADDRESS:

643 Kent Ave., Brooklyn, N. Y.

(Near Roosevelt, Grand and East 23d Street Ferries from N. Y.),

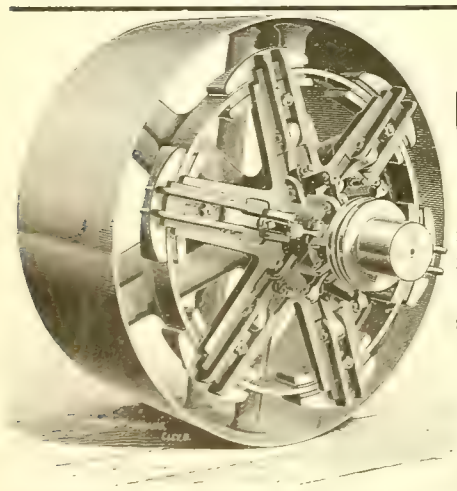
For Circulars, Prices and Information.

REMEMBER That the Western Electrician enjoys the distinction of having been selected by one of the shrewdest of advertisers as the medium for carrying the largest advertisement ever placed in an electrical journal. This tells its own story, and points its own moral.

WE ARE HEADQUARTERS IN THE WEST
FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC.

All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,

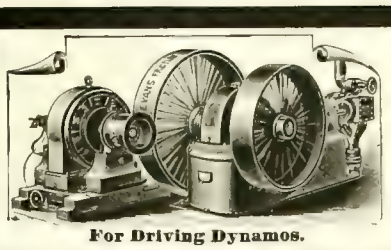
78-80-82 Franklin Street,

CHICAGO.

MAIN OFFICE.
649 and 651 Broadway,
New York

Geo. H. Meeker,
Western Manager.

AND CHICAGO.



For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.

Evans' Cones, For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

EVERYTHING IN
WIRE—FUSE— STRIPS.

MANUFACTURED BY
The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY
MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

ELECTRICAL INSTRUMENTS

RECALIBRATED. REPAIRED.

CHICAGO ELECTRIC MANUFACTURING CO.,
73 WEST JACKSON STREET.

H. WARD LEONARD & COMPANY.

For full information regarding the application of electricity for any purpose, write to us. Ask for our pamphlet. Address,
Electrical Exchange Building,
NEW YORK CITY.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

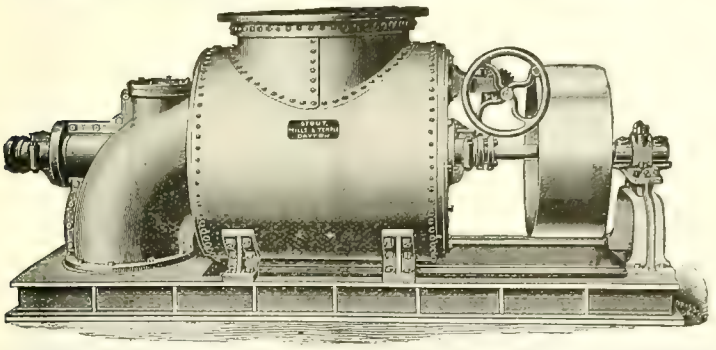
Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

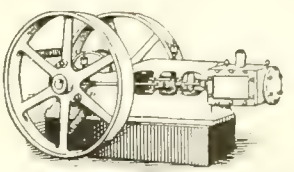
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



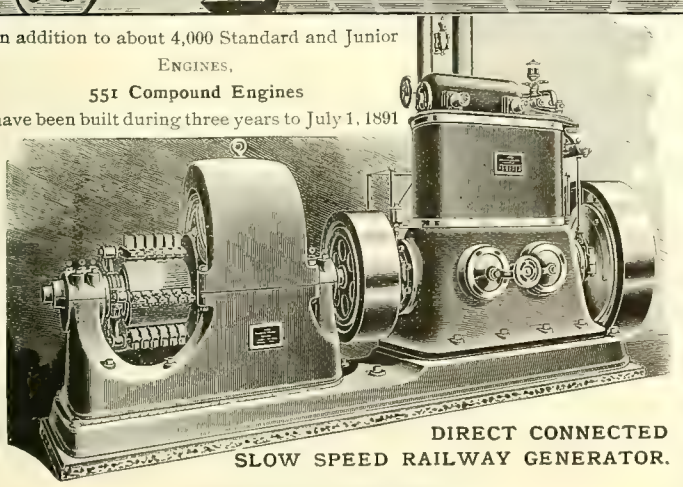
WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 447 North Street, BALTIMORE, MD.

FOR SALE.
New 10 and 25 Light
Arc Dynamos and Lamps.
HIGH TENSION. CHEAP.
JAS. McLAUGHLIN, Mfg. Electrician,
50 N. Clinton St., Chicago.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES

In addition to about 4,000 Standard and Junior ENGINES,
551 Compound Engines
have been built during three years to July 1, 1891



DIRECT CONNECTED
SLOW SPEED RAILWAY GENERATOR.

125, 250, 500 HORSE-POWER.

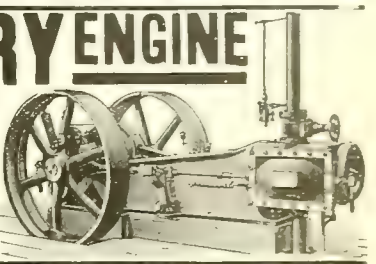
Also Direct Connected Slow Speed Alternating Dynamos of equivalent capacity.

For Circulars and Estimates on Complete Plants, address our Engineers.

THE WESTINGHOUSE MACHINE COMPANY.
BARTLETT & CO. N.Y. PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application.
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST.
HALF TONE PLATE A SPECIALTY
CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

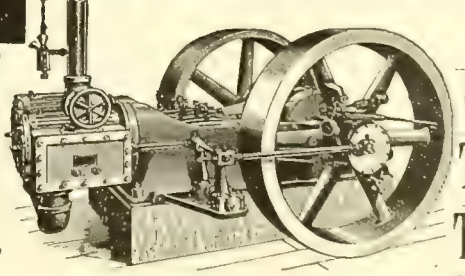
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

THE BALL ENGINE CO. Ball Engine REGISTERED TRADE MARK.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 18 Cortlandt St., New York; J. W. PARKER & CO., 38 South Fourth Street Philadelphia, Pa; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY Co., Tacoma, Wash.; CROOK, HORNER & CO., Baltimore, Md.; E. G. GILBERT, Atchison, Kan; COOLEY & VATER, 224 Washington Ave., South, Minneapolis, Minn.

BRANCH OFFICE, Room 506 Rookery Building, CHICAGO, ILL. ALBERT FISHER, Manager.

DID YOU SEE IT
AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.,

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.

THE TURNING POINT

With all Electric Lighting Stations is the day the first dividend is declared. If you have reached that point, why not increase your next dividend? If you have not, there is no reason why you should not. You can do it by using

PERKINS' - INCANDESCENT - LAMPS.

BAIN'S

COMPENSATING

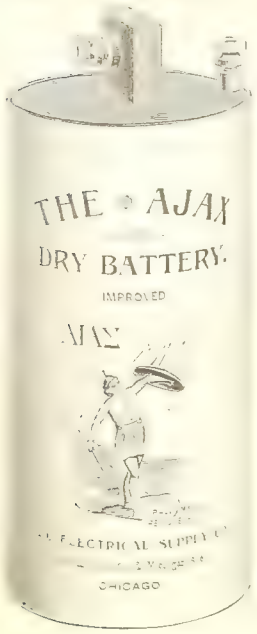
Voltmeters and Ammeters

Are Accurate, and do not get out of Calibration.

THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS AND DEALERS,

54 and 56 Franklin Street, CHICAGO, ILL.



NO man who ever personally "set up" a battery of the ordinary fluid cells and had to carry water and mix solution, and perhaps break a jar in the operation, but wished away down in his heart for some neater, better way.

NO MAN who ever packed glass jars for "his man" to take out on a job, and thought sure he had *everything*—the zincs, the carbons, the sal ammoniac, all—but wished for something better, something compact, unbreakable, with *NOTHING* to *forget*.

NO MAN WHO ever bought a bell and fluid battery, and pushed the button and *expected* the bell and the battery to do the rest, but sooner or later was disappointed, because the fluid had evaporated or frozen, or the zincs eaten up, or the connections corroded, and wished for something *better*.

THE AJAX DRY BATTERY
IS BETTER

And combines all the desirable qualities of fluid cells with *none* of their disadvantages. It possesses many good features distinctively its own. It is Strong, Durable, Compact, Reliable.

The DIAMOND BELL is a Model of Ingenuity, surpassing in its mechanical and electrical construction any bell ever offered to the trade. All Metal. Dust and Bug proof. Neat and Ornamental.

For Prices of Batteries and Bells address the Manufacturers,

Eastern Offices & Factories, ANSONIA, CONN.

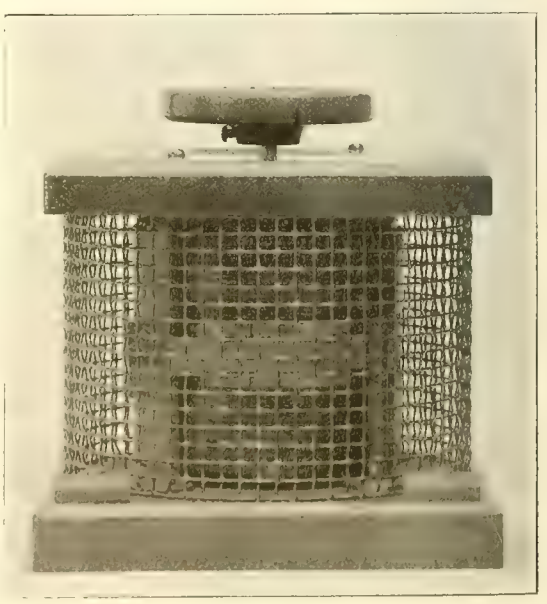
THE ELECTRICAL SUPPLY CO.,
Randolph St. and Michigan Ave., CHICAGO.

Send for Illustrated Catalogue of House Goods.

THE WIRT RHEOSTATS.

For many purposes the use of a rheostat or adjustable resistance is indispensable, and consequently the variety of forms in which these are made is very great. The chief difficulty has been to produce a sufficiently gradual increase of resistance and to insure good contact at the successive points, and at the same time have sufficient resistance and ample current capacity within reasonable space.

We are confident that these various points have been well combined in the Wirt Rheostats, two forms of which we illustrate here. We can make these in various sizes adapted to any special purpose for which they may be intended, such as photometric testing, dynamo and stage regulators, etc. They are finished either in hardwood polished, or mounted with marbleized slate. We will be pleased to answer any inquiries relating to these or special instruments.



The Electrical Supply Co.,

WESTERN OFFICE AND WAREHOUSES

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

Eastern Offices and Factories
Ansonia, Conn.

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.,

—MANUFACTURERS OF—

VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES.

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES and CABLES. very pliable. Every variety of INCANDESCENT CORES.

HABIRSHAW

RUBBER COVERED.

WIRES.

CABLES AND CORES.

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High Insulation and Long Life. all milage

If you are not acquainted with the merits of Habirshaw Insulation we shall be pleased to send you samples upon application.

W. M. HABIRSHAW, Gen'l Mgr. OFFICE: 315 Madison Ave., Cor. 42d St., New York.

FACTORY: Glenwood, Yonkers, N. Y.

Western Agents: THE ELECTRICAL SUPPLY CO., Corner Randolph St. and Michigan Ave., CHICAGO, ILL.

TAKING THE LEAD.

THOUGH ONLY

ON THE

MARKET

—FOR—

SIX MONTHS,

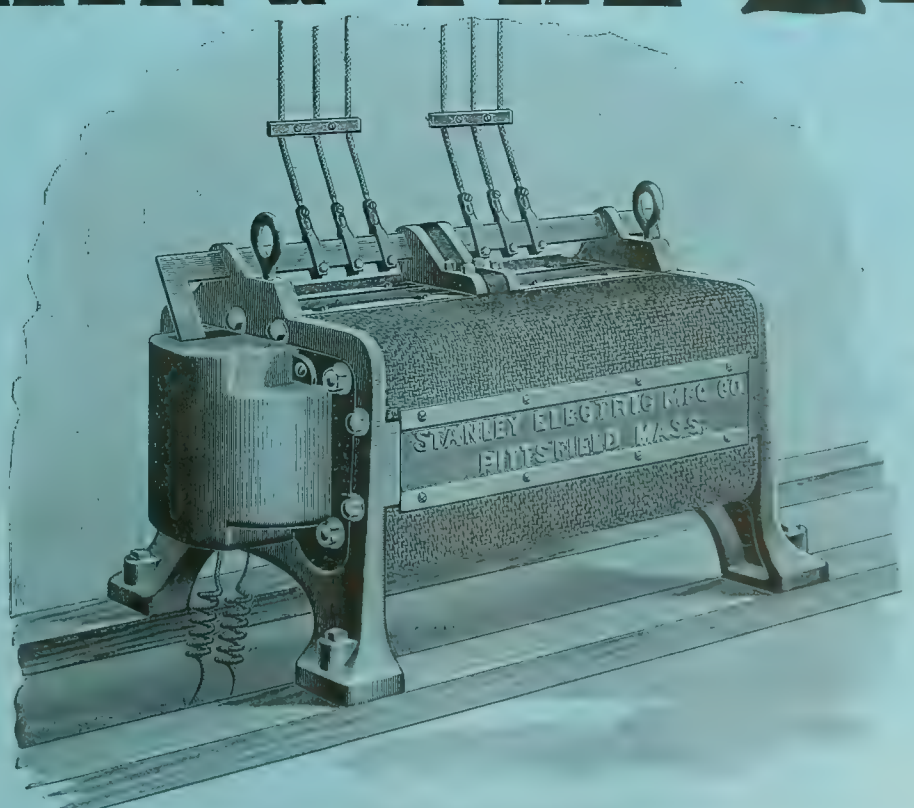
THE

STANLEY

—IS—

NOW KNOWN

—AS—



THE

BEST

Transformer.

CORRESPONDENCE

SOLICITED.

CUT OF 300 LIGHT TRANSFORMER.

STANLEY ELECTRIC MFG. COMPANY, PITTSFIELD, MASS.

WESTERN AGENTS: The Electrical Supply Co., Corner Randolph St. and Michigan Ave, Chicago, Ill.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

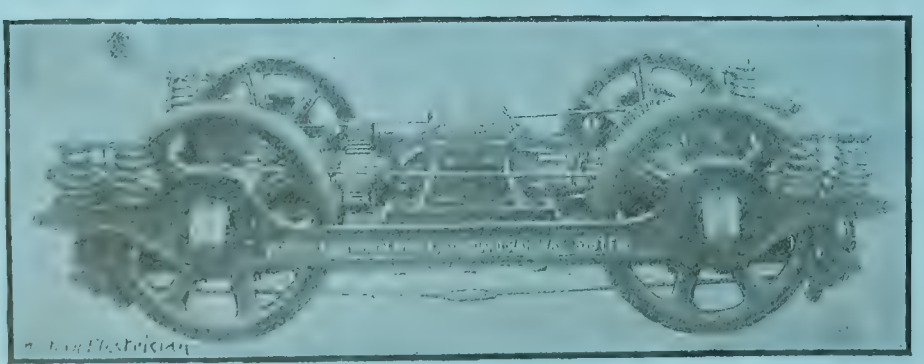
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

ONE MOTOR DRIVING BOTH AXLES

Of a street car, is the same principle as having all driving wheels of a locomotive connected, which is the AMERICAN SYSTEM.

Sizes: 15, 30 and 40 Mechanical Horse Power.



One Heat Proof Motor, Driving Both Axles.

This cut represents the latest construction of our Standard Apparatus equipped with our HEAT PROOF MOTOR. Attention is invited to the work being done by these equipments on the Merrimac Valley Street Railway, Lawrence, Mass.; Consolidated Street Railway Company, Grand Rapids, Mich.; and the People's Electric Street Railway, Springfield, Ill.; where, in each place, the two largest electric companies have put their latest equipments against them, with the result of proving our claims and strengthening the advantages derived from utilizing the full traction of the car, and driving all wheels simultaneously.

PATENTEES AND SOLE MANUFACTURERS:

DETROIT ELECTRICAL WORKS,

DETROIT, MICH., U. S. A.

Also Manufacturers of Electrical Power Machinery, Standard Line Appliances and General Electrical Supplies.

CORRESPONDENCE INVITED.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, NOVEMBER 28, 1891. No. 22

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building, - - CHICAGO.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE
Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

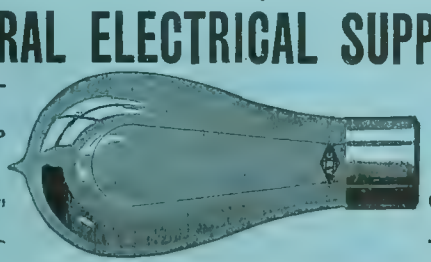
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use.
Concealed Wiring in all Locations.

GEORGE B. PRESCOTT, Jr., Gen. Agt., 16 Dey St., New York.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."



WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

See Upper Half of Page vii, and Page xxiii.

E. E. KELLER.
Keller & Degenhardt, ELECTRICAL ENGINEERS.
542 Rookery Bldg., Chicago, Ill.
THE ONLY BUREAU OF ELECTRICAL IN ORMATI N IN THE WORLD'S FAIR CITY.

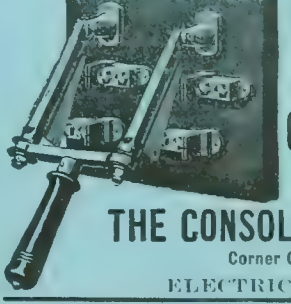
WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers. F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.

OKONITE TRADE MARK

INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

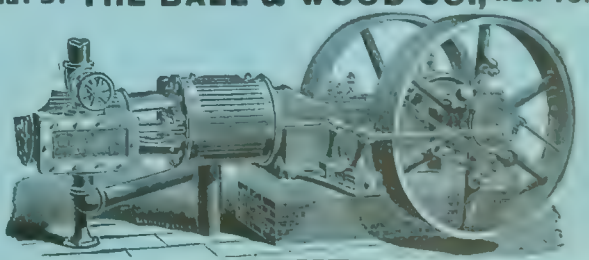
WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.



WM. ROTCH, Prest. CHAS. G. WINTER, Treas.
CHAS. E. BIBBER, Gen'l Manager.
DO NOT
Equip your Switch-board with cheap Switches.
BUY THE
C. E. M. Jack-Knife Switch.
It is a Record Breaker and a reliable Circuit Breaker.
Manufactured Solely By
THE CONSOLIDATED ELECTRIC MFG. CO.,
Corner Congress and Franklin Streets, BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS.

IMPROVED BALL ENGINES,

BUILT BY THE BALL & WOOD CO., NEW YORK.



AGENTS
W. B. Pearson & Co., Home Insurance Building, Chicago, Ill.
Thos. G. Smith, Jr., 11 Hammond Building, Cincinnati, Ohio.
W. A. Day, 128 Oliver Street, Boston, Mass.
A. M. Morse & Co., St. Louis, Mo.
Cooley & Vater, Minneapolis, Minn.
Mead & Stringham, 321 Hammond Building, Detroit, Mich.

The Thomson-Houston ELECTRIC CO.,

MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co.... xiii
Alexander, Barney & Chapin.... i
American Electrical Works.... xiii
Andrews & Co., A. H.... xix
Baggot, E.... xiv
Bain Electric Mfg. Co.... xvi
Ball Engine Co.... xix
Ball & Wood Co, The.... i
Beckerleg, Jas. G.... xiv
Beggs, J. E, Mfg. & Supply Co. xii
Bernstein Electric Co.... xvi
Blatz, L.... xiii
Borden & Selleck Co.... xv
Braun Illustrating Co.... xix
Brownlee & Co.... xii
Brookfield, Wm.... xii
Brush Electric Co.... xvii
Burton Electric Co.... iv
Butler Hard Rubber Co.... xiv
Buxton, Geo. B.... ix
C. B. & Q. R. R.... xv
C. & E. R. R.... xiv
C. & N. W. R. R.... xv
C. & C. Electric Motor Co.... xvi
Card E. Motor & Dynamo Co.... ix
Central Electric Co.... v
Chicago Electric Mfg. Co.... xvii
Chicago Electric Motor Co.... —
Chicago Insulated Wire Co.... xvii
Colburn Electric Mfg. Co.... x
Consol. Elec. Mfg. Co., The.... i
Cowles Elec. Smelt & Alum. Co. xiv
Crocker-Wheeler Elec. Mo. Co. xiii
Day's Kerite Insulation.... i
Dayton Globe Iron Works Co.. xix
Delaware Hard Fibre Co.... xii
Detroit Electrical Works.... xxiv
Densmore Typewriter Co.... —
Eastern Electric Cable Co.... xiii
Easton Electric Co.... —
Edison General Electric Co.... vi
Edison General Electric Co., Cable and Wire Department.... vi
Electric Construction & Sup. Co.. vii
Electric Merchandise Co.... iv, x
Electric Secret Service Co.... x
Electrician Pub Co.... ix, xvii
Elec. Construction Co., The.... xii
Electrical Engineering Co.... xii
Elec. Eng. & Sup. Co., The. vii, xii
Elec. Supply & Contracting Co.. ix
Electrical Supply Co., The... xx.i
Elektron Mfg. Co.... iv
Empire China Works.... xvi
Evans Friction Cone Co.... xvii
For Sale.... xii
Foster, O. A.... —
Fort Wayne Electric Co.... xxiv
Gleason & Bailey Mfg. Co. Ltd.. ix
Globe Carbon Co.... xv
Great Western Elec. Supply Co.. ix
Greeley & Co., The E. S.... i
Goodrich-Coleman Elec. Wks.. —
Heisler Electric Co.... —
Hill Clutch Works.... —
Hirlimann, C. J.... —
Hine Eliminator Co.... xii
Holmes, C. H.... xiii
Holmes, Booth & Haydens.... xix
Hood, Wm.... x
India Rubber & Gutta Percha Insulating Co.... —
Interior Conduit & Insulation Co... x
International Okonite Co.... i
Kartavert Mfg Co.... xiv
Keller & Degenhardt.... i
Knapp Electrical Works.... xxi
La Roche Electric Works.... iv
Law Telephone Co.... xiii
Leonard & Co., H. Ward.... xii
Loud, H. M. & Sons Lumber Co.. xiv
McLaughlin, James.... —
Milliken Bros.... xvii
Monitor Electric Co.... x
Mosher Arc Lamp Co.... xii
Munsell & Co., Eugene.... xiii
Murphy, T. J.... xii
National Carbon Co.... xiv
National Electric Mfg. Co.... xvii
N. Y. Belting & Packing Co.... xii
New York Insulated Wire Co.. viii
New York & Ohio Co.... I, xxiii
N. W. Elec. Specialty Co.... xvi
Nuttall Company, R. D.... i
Ostrander & Co., W. R.... x
Palste, H. T.... xii
Page Belting Co.... —
Partrick & Carter Co.... —
Payne & Co., Geo. W.... —
Pearson & Co., W. B.... xix
Pelton Water Wheel Co.... xiv
Phoenix Glass Co.... —
Pond Engineering Co.... xix
Powell Co., The Wm.... xii
Queen & Co.... xiii
Ries Elec. Specialty Co., The... x
Rockford Electric Mfg. Co.... —
Royal Electric Co.... xii
Samson Cordage Works.... xii
Sargent & Lundy.... i
Sawyer-Man Electric Co.... xv
Schawel & Co., Jas.... xii
Schieren & Co. Chas. A.... xii
Schoonmaker, A. O.... xii
Schuyler Electric Co.... iv
Sealed Proposals.... xiv
Short Electric Railway Co.... xii
Schultz Belting Co.... —
Sperry Elec. Mining Mach. Co. xvii
Standard Underground Cable Co.... I
Stanley Electric Mfg. Co.... —
Star Electrix Co.... —
Stearns Mfg. Co.... xix
Sterling, W. C.... xv
Steuben Elec. Mfg. Co., The.. —
Stilwell & Bierce Mfg. Co.... xiv, xv
Sunbeam Incand. Lamp Co.... viii
Taussig, S.... xvi
Temple, J. C.... xv
Thomson-Houston Elec. Co... ii, xx
Union Electric Mfg. Co., The.... ix
Union Electric Works.... —
Union Hardware Co.... xii
U. S. Electric Lighting Co.... —
Van Nuis C. S.... —
Vulcanized Fibre Co.... xv
Wasatch Asphaltum Co.... xii
Western Electric Co.... viii
Westinghouse Elec. and Mfg Co.. xi
Westinghouse Machine Co.... xix
Weston Electrical Instrum't Co. —
Williams Engine Works.... xix
Woodbridge & Turner Eng. Co. xv
Woodhouse & Rawson, Ltd.... —
Worthington, Henry R.... —

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Cowles Elec. Smelt. & Alum. Co.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Samson Cordage Works.

Asphaltum
Wasatch Asphaltum Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Hirlimann, C. J.
Law Telephone Co.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.* The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Western Electric Co.

Castings, Brass.
Blatz, L.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Electrical Engineering Co.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Steuben Electric Mfg. Co.
Temple, J. C.
Thomson-Houston Electric Co
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Palste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Eastern Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Burton Electric Co.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co., The
Star Electrix Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co
Ball & Wood Co., The.
Beggs, J. E. Mfg. & Supply Co
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electric Construction & Supply Co.
Electrical Supply Co., The
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co
Steuben Electric Mfg. Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Wasatch Asphaltum Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co
Gleason & Bailey Mfg. Co. Ltd
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co
Sawyer-Man Electric Co.
Steuben Electric Mfg. Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene
Schoonmaker, A. O.

Mining Apparatus, Electric
Bain Electric Mfg. Co.
Easton Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Card Electric Motor & Dynamo Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Engineering Co., The
Electrical Eng. & Supply Co.
Electrical Supply & Contracting Co.
Electric Manufacturing Co.
Fort Wayne Electric Co.
La Roche Electric Works.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Consolidated Electric Works

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd.

Packing
Buxton Geo B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas

Poles
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Type Writer Co.

Valves
Beckerleg, Jas G.

Wire, Bare.
American Electrical Works
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Sperry Elec. Mining Machine Co.

ELECTRIC HEATING.

BURTON ELECTRIC CO.,

RICHMOND, VA.

WONDERFUL IN ITS EFFICIENCY.

THE BURTON ELECTRIC HEATER costs less to operate than a stove, and requires **NO REPAIRS.**
THREE YEARS' SERVICE has demonstrated its practicability.

Circulars upon application. Information furnished.

WRITE TO THE SELLING AGENTS:

ELECTRIC MERCHANDISE COMPANY,

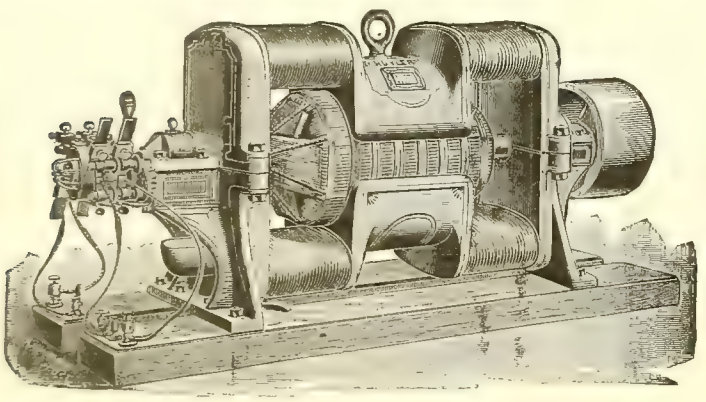
11 ADAMS ST., CHICAGO, ILL., U. S. A.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

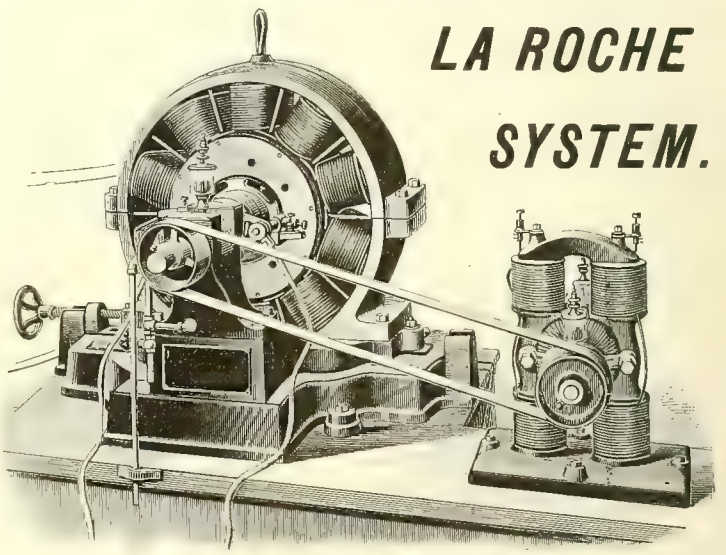
THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,

FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

YOU GET THE BEST

WHEN YOU BUY

PERRET ELECTRIC MOTORS AND DYNAMOS,

— Manufactured Only By —

The Elektron Manufacturing Co.,

NEW YORK OFFICE, 89 Liberty St. **SPRINGFIELD, MASS.**

SELLING AGENTS:

Washington, D. C., [illegible] & Co., 1409 New York Ave. **New Orleans, La.,** George Baquie, 140 Gravier St. **Chicago, Ill.,** The Electrical Engineer- [illegible] **St. Paul, Minn.,** F. J. Renz, 95 East Fourth St. **Philadelphia, Pa.,** Pennsylvania Machine Co., 29 North Seventh St.

WHAT'S THE USE OF BUYING SWITCHES?

WE ARE GIVING THEM AWAY.

READ THIS.

We will for 30 days from the date of this notice, give away ten, five ampere, or nine, ten ampere Paiste switches to any one sending us an order for one hundred dollars worth of goods, accompanied by this blank filled in and signed.

CENTRAL ELECTRIC COMPANY,

November 23, 1891. CHICAGO.

Central Electric Company,

CHICAGO.

Please send with accompanying order .....ampere Paiste switches, for which you agree to make no charge.

Signed.....

....1891.

ST. LOUIS BRANCH.

OKONITE

TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,
823 Locust St., St. Louis, Mo.

KANSAS CITY BRANCH.

OKONITE

TRADE MARK.

GATE CITY ELECTRIC COMPANY,
522 Delaware St., Kansas City, Mo.

TRADE MARK.

OMAHA BRANCH.

OKONITE

TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,
418 S. 15th St., Omaha, Neb.

DENVER BRANCH.

OKONITE

TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,
722 Lawrence St., Denver, Colo.

TO OUR CUSTOMERS:

CHICAGO, November 16, 1891.

We have just completed arrangements with the Swan Lamp Manufacturing Company to handle their goods, and will, in future, sell this Company's lamps in preference to any others. We have heretofore been selling the Packard lamp, and in making the change, we do not wish to be understood as retracting any of our claims for that lamp. We are simply keeping pace with the wishes of our patrons, who demand a lamp of high efficiency and good average life, rather than one of low efficiency and extra long life.

As the electric lighting industry becomes one of the stable dividend paying interests of the world, station managers are obliged to pay more attention to every source of waste, and there has heretofore been none more prolific than that of low efficiency lamps, especially when the capacity of the station is about full.

The Swan lamp is one of high efficiency and good average life, say from 600 to 1,000 burning hours, while it does not blacken to any appreciable degree, even when it is nearly burned out. These lamps are made to fit any socket, and as we will carry a stock of all ordinary candle powers and voltages, orders can be promptly filled.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

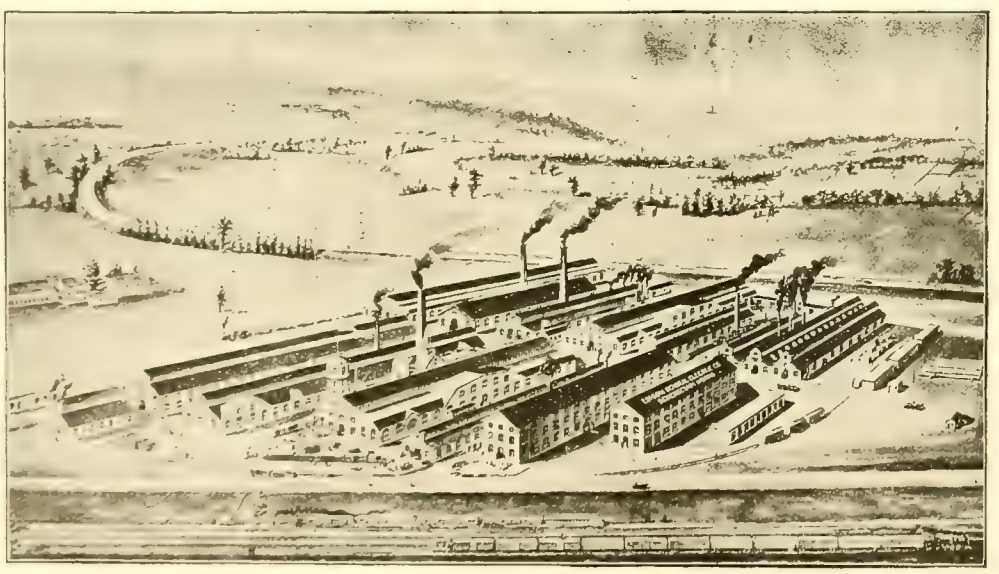
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

The "Packard" Lamp

Agency has been transferred to

The Electrical Engineering and Supply Company

931 Rookery - Chicago, Ills.

The exclusive use of a strictly High Grade Lamp only will satisfy both patrons and Stockholders.

"WARD" ARC LAMPS.

The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

GRIMSHAW
TRADE MARK
WHITE CORE
INSULATED WIRE

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC,
All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,
78-80-82 Franklin Street,
CHICAGO.

MAIN OFFICE,
649 and 651 Broadway,
New York.

Geo. H. Meeker,
Western Manager.

NEW YORK INSULATED WIRE CO. NEW YORK
MOISTURE-PROOF
VULCA
ELECTRICAL
WIRE-DUCT
NON-INFLAMMABLE
TRADE MARK.
AND CHICAGO.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.

SUNBEAM INC. LAMP CO.
SUNBEAM
INCANDESCENT LAMP
CHICAGO ILLINOIS U. S. A.

THE SUNBEAM INCANDESCENT LAMPS

Can be furnished of any desired efficiency or life to suit our customers. We make two standard styles of lamps, as follows:

High efficiency lamps, from 3 to 3 1-3 watts, which maintain their rated candle power from 750 to 1,000 hours.

Long-lived lamps, from 3 6-10 to 4 watts, which maintain their rated candle power from 1,500 to 3,000 hours.

Each style will be found to give more light per dollar expended in current than similar lamps made by other manufacturers.

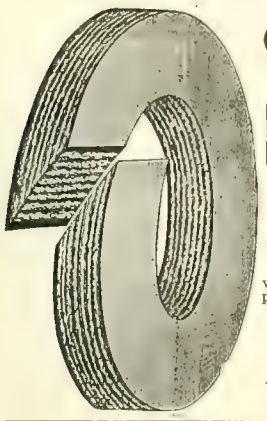
SUNBEAM INCANDESCENT LAMP CO.,
805 Chamber of Commerce Building, Chicago.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.



GIVEN AWAY!!

SAMPLE ORDERS OF

Buxton's Packing

At Only 50c. Per Pound.

"The Engineer's Favorite."

All Orders Guaranteed.

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

ESTABLISHED 1882.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

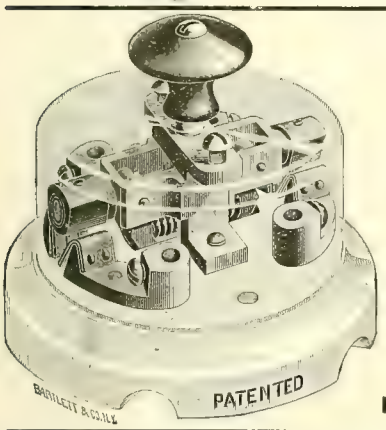
ELECTRICAL AND MECHANICAL ENGINEERING AND SUPPLIES.

REPAIRING ELECTRICAL MACHINERY

The Electric Supply & Contracting Co.,

Nevada Building,

S. E. Cor. 5th & Sycamore Sts., CINCINNATI, O.



OF SOME THINGS ONLY THE BEST!

Three years ago we brought out what was THEN the best switch on the market—now we are doing the same thing again,

BRINGING OUT THE BEST.

THE UNION ELECTRIC MFG. CO.,

BRIDGEPORT, CT.

NEW YORK: Alexander, Barney & Chapin. BOSTON: Eastern Electrical Supply Co.

Gleason & Bailey Mfg. Co.,

(LIMITED.)

GENERAL WESTERN AGENTS FOR THE

STEUBEN INCANDESCENT LAMPS,

The best in the Market,

Manufacturers of Electric and Combination Fixtures and a General Line of Electric Supplies.

Rubber Covered, Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and catalogues.

The Card Electric Motor and Dynamo Co.,

CINCINNATI, OHIO.

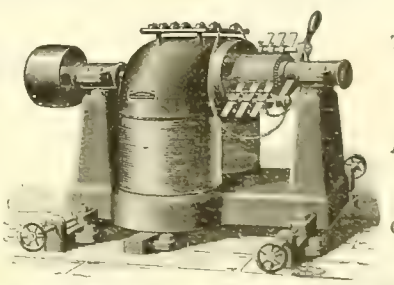
MANUFACTURERS OF

ELECTRIC MOTORS AND DYNAMOS.

Incandescent **Dynamos** from 20 to 350 Lights.

Arc or Incandescent **Motors** from $\frac{1}{8}$ to 30 Horse Power.

Motors for the Arc Circuit a Specialty.



These Motors have the Highest Efficiency, Low Speed and Self-Oiling Bearings.

AUTOMATIC, SIMPLE, DURABLE AND CLEAN

Correspondence Solicited.

AGENTS.—Boston: The Eastern Electrical Supply and Construction Co., 65 Oliver Street. Chicago: The Thos. L. Johnson Co., 312 Dearborn Street. Milwaukee: Henry Ramien, 411 Third Street. Washington, D. C.: J. Geo. Gardner, 1005 H. Street. St. Louis: Stagl Electrical Engineering Co., 1106 Pine Street. Montgomery, Ala.: W. F. Murphy. Detroit, Mich.: The Michigan Electric Co., 212 and 214 Griswold Street. Minneapolis, Minn.: J. M. Lenton, 32 Loan and Trust Building.

A NEW BOOK.

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE $1.00.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

Regulates the Light. Saves the Current. An Innovation in Electric Lighting.

Something Entirely New. NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED. Simple, Efficient, Economical.

Indorsed by the Electrical Press, and Prominent Electrical Engineers and Electricians. For Particulars and Prices write to

THE RIES ELECTRIC SPECIALTY COMPANY, Baltimore and Eutaw Sts., BALTIMORE, MD.

PATENTEES AND SOLE MANUFACTURERS REGULATING SOCKETS.

SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

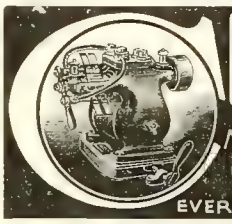
FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

Send for NEW CATALOGUE. Out August 1st.



OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.

FITCHBURG, MASS., U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

SUBSTANTIAL. NEAT. ECONOMICAL.

ELECTRIC RAILWAY SUPPLIES EXCLUSIVELY

OUR BUSINESS.

ELECTRIC MERCHANDISE COMPANY,

CHICAGO,

11 ADAMS STREET. ILL. W. R. Mason, Gen. Mgr.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.

Any Socket.

Any Candle Power.

PRICES:

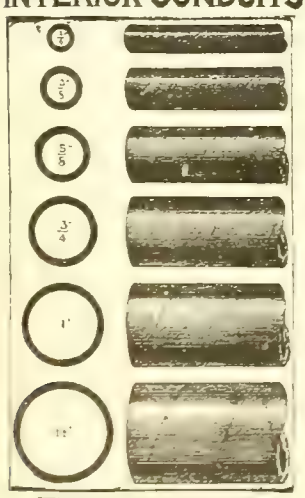
16 C. P. Less than 100 lots, 55 Cents.

" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding

ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND

CONDUITS

MANUFACTURED BY

INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Thos Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 256 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

G. A. HARMOUNT, MANAGER

MONITOR ELECTRIC CO.,

149 WABASH AVE., CHICAGO, ILL.

WHOLESALE DEALER IN GENERAL

ELECTRICAL SUPPLIES.

WESTERN AGENT FOR

ALFRED F. MOORE

(ESTABLISHED 1820.)

ELECTRICAL WIRES AND CABLES.

Electric Light, Annunciator and Office Wires, Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

Westinghouse Electric & Mfg. COMPANY,

Pittsburg, Pa., U. S. A.

Makers of Electric Light and Power Apparatus for all Purposes.

PIONEERS OF THE ALTERNATING SYSTEM.

CONVERTER.

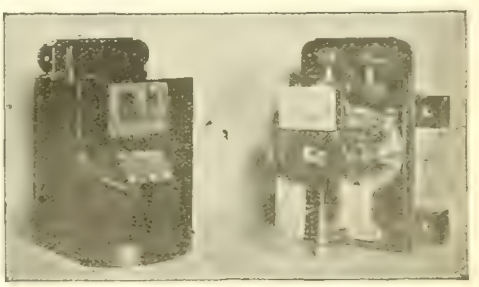
OUR **Converters** COMBINE

HIGHEST EFFICIENCY,
ABSOLUTE SAFETY,
PERFECT REGULATION,
LOW PRICES.

OUR **Meters** ARE

SIMPLE,
ACCURATE,
RELIABLE,
DURABLE.

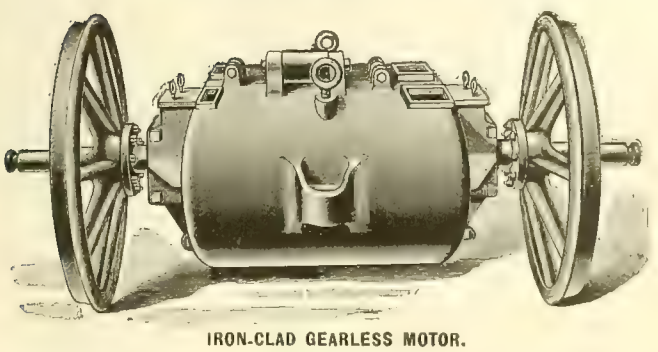
OVER **700,000** 16 C.P. Lights' Capacity of METERS IN USE.



METER.

The Westinghouse Meter is the only A. C. Meter which has been adopted as standard by the London (England) Board of Trade. Synchronous System for the Long Distance Transmission of Power in large units claims the attention of every one having available Water Power within twenty-five miles of a market.

RAILWAY DEPARTMENT.



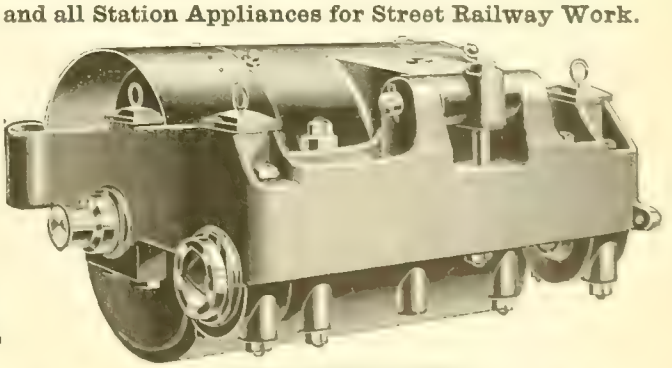
IRON-CLAD GEARLESS MOTOR.

YES, WE MANUFACTURE AND SELL GEARLESS and SINGLE REDUCTION

RAILWAY MOTORS,

MULTIPOLAR AND 2-POLE GENERATORS,

and all Station Appliances for Street Railway Work.



SINGLE REDUCTION MOTOR.

Percentage of increase in roads using our apparatus greater than that of any other company.

Send for Latest Catalogue.

OFFICES IN ALL OF THE LEADING CITIES. Correspondence Solicited.

Address,

WESTINGHOUSE ELECTRIC & MFG. CO.,

Pittsburg, Pa., U. S. A.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

BUY THE BEST!

The Mosher Arc Lamp.

DIRECT OR ALTERNATING INCANDESCENT CIRCUITS.

READ THE FOLLOWING TESTIMONIAL:

NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS., October 5, 1891.

Mosher Arc Lamp Co., Chicago, Ill.

GENTLEMEN:—Replying to your inquiry of the 3d inst. we beg to state that the lamps you sent us some time ago are giving us better satisfaction than any other lamp we have ever tried to burn on an incandescent circuit. We inclose herewith an order for 10 of them to be shipped to Elgin, Ill. Yours very truly,

NATIONAL ELECTRIC MFG. CO.

Noted for Simplicity and Steadiness.

5 to 5,000 candle power, making superior lamp for photo-engraving purposes.

Write for price, circular, and sample lamp.

MOSHER ARC LAMP CO., 125 Ontario St., CHICAGO,

Or to F. P. Little & Co., Buffalo, N. Y.; Creaghead Engineering Co., Cincinnati, O.; Chas. F. Lindner, San Francisco, Cal.

NOW THEN! FOR SALE CHEAP!!

Six 400 light Thomson Houston Incandescent Dynamos, 12 volts. Perfect order.

Three 25 light 1,000 candle power American Arc Dynamos. A 1 order.

Two 50 light 1,000 candle power Sperry Arc Dynamos. A 1 order.

700 Goose Necks, Sockets, Lamps, etc., complete.

50 miles No. 10 American Electric Co. Wire, good as new, used one year. In ½ mile reels.

Two 400 light Thomson-Houston New Armatures.

70 American Single Carbon 2,000 candle power Arc Lamps. A 1 order.

Two 70 H. P. 500 volts, Edison Generators, used six months.

Ten 5 H. P. Sprague Motors, used six months.

Two Edison Electric Mining Rock Drills, used six months.

High Speed Engines and Full Station Equipments, Poles, etc.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

MICA.

For all Electric Insulating Purposes East India Mica is the best on the market.

I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

H. WARD LEONARD & COMPANY.

For full information regarding the application of electricity for any purpose, write to us. Ask for our pamphlet. Address,

Electrical Exchange Building, NEW YORK CITY.

Wasatch Asphaltum COMPANY.

Proprietors of the largest and richest Asphaltic Limestone mines in the world.

MANUFACTURERS OF

ROCK ASPHALT MASTIC,

For Paving, Roofing, Basements, etc.

ASPHALTINE

(Or Liquid Asphalt),

For Coating Piles, Ties, Poles, etc.,

ALSO SOLE AGENTS FOR

The Salt Lake Gilsonite Co.'s

"Uintaite," "Grahamite,"

OR

PURE GUM ASPHALTUM

For all INSULATING Purposes.

Office, 71 Culmer Block,

SALT LAKE CITY, UTAH.

Correspondence solicited, and samples furnished

KNOW WHAT YOU'RE GETTING!

HINE'S ELIMINATOR,

Extracts Oil from Exhaust, Separates Water from Live Steam.

In a series of test known "separators" recently made at Cornell University the ELIMINATOR demonstrated percentages of efficiency over ALL competitors ranging from 11 to 17 per cent. The full report of test with drawings, etc., sent upon application.

HINE ELIMINATOR CO.,

106 Liberty Street, NEW YORK.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

Royal Electric Co.,

911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURERS OF

Alternating and Continuous Current Dynamos and Motors,

AND ELECTRIC MACHINERY.

Will Many Customers Accumulating System now on the Market.

Agents Wanted for Exclusive Territory.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

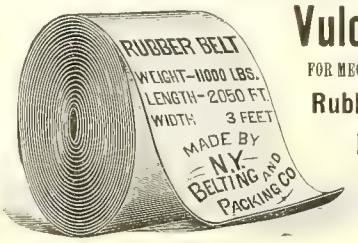
Also New York, Boston, Philadelphia, } 46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, } Managers. (LIMITED.)
C. D. CHEEVER, }
J. CAZENOVE JONES, }
WM. T. BAIRD, Sec'y.

15 PARK ROW, NEW YORK.

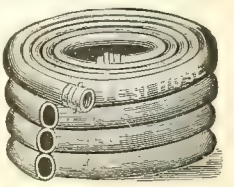
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 163 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 16-20 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

PLATINUM.

JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. **136 Liberty St.,** NEW YORK.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 10 So. 18th St., Philadelphia, Pa.

See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

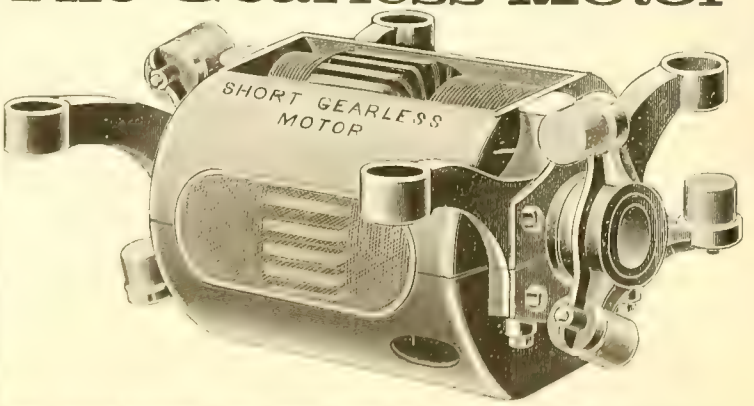
SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

The Gearless Motor



In view a recent convention of hundreds of street railway officials who visited Pittsburgh during the Street Railway Convention it is pronounced by all "**A Brilliant Success.**" Buy no equipment until you have examined Short Motors, and obtained prices from

THE SHORT ELECTRIC RAILWAY CO., CLEVELAND, OHIO.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, NOVEMBER 28, 1891. No. 22

Central Stations at Mulhausen and Darmstadt.

Central station managers in this country will be interested in the installations illustrated in the accompanying pictures, as they may be considered fair examples of the best method of construction in the old country. The system described utilizes a storage battery plant in connection with the regular generating station, and is employed in the central stations at Mulhausen and Darmstadt.

Fig. 1 gives an excellent view of the dynamo room at the Darmstadt plant, which is under the management of the municipal authorities, and Fig. 2 shows the accumulator installation in the Mulhausen station. Both of these plants were installed by Siemens & Halske of Berlin. The first to be completed was the Mulhausen station, which has been in operation three years. The steam plant comprises two boilers, having an aggregate capacity of 526 horse power, and two Armington & Sims engines of 300 horse power capacity. These engines are coupled directly to two Siemens & Halske continuous current dynamos of a capacity of 150,000 watts. The distribution in the city is by three-conductor cables, and the three-wire system is used in connection with the large storage battery plant shown in Fig. 2. The Tudor batteries are used, and the capacity of the accumulator plant is 146 horse power. The total length of cable laid is 15,000 meters, and the greatest distance at which current is supplied to consumers is 1250 meters.

The installation at Darmstadt is under the management of the city and was constructed by Siemens & Halske of Berlin in the spring of 1888. The system of distribution is by single and double underground cables. Here, also, the three-wire system is used in connection with a large storage battery plant of the Tudor type. The total capacity of the station is 615 horse power, and an accumulator plant capable of furnishing 35 horse power is connected in parallel with the dynamos. The total length of cable laid is 42,000 meters and the greatest distance at which current is delivered to consumers is 1,000 meters. In this plant there are three boilers, all of which were furnished by Goehring & Leuchs of Darmstadt. Two of the boilers are Cornwall steam boilers, and the third is a water tubular boiler. The total capacity of these boilers is 615 horse power. There are five compound non-condensing engines of the vertical type directly coupled to seven continuous current dynamos of the Siemens & Halske type. The engines were built by G. Kuhn of Stuttgart, having a capacity of 580 horse power. Five of the dynamos have a capacity of 425 amperes at 125 volts, and the remaining two have a capacity of 200 amperes at 125 volts. This station has been giving entire satisfaction since its installation.

The connections of the storage battery plant and dynamos for the three-wire system as here used may be seen in Fig. 3.

This same plan is used at Stockholm and Lundswall, but at Darmstadt, Vienna, Haag, Breslau and Stettin the connections are somewhat different, as seen in Fig. 4.

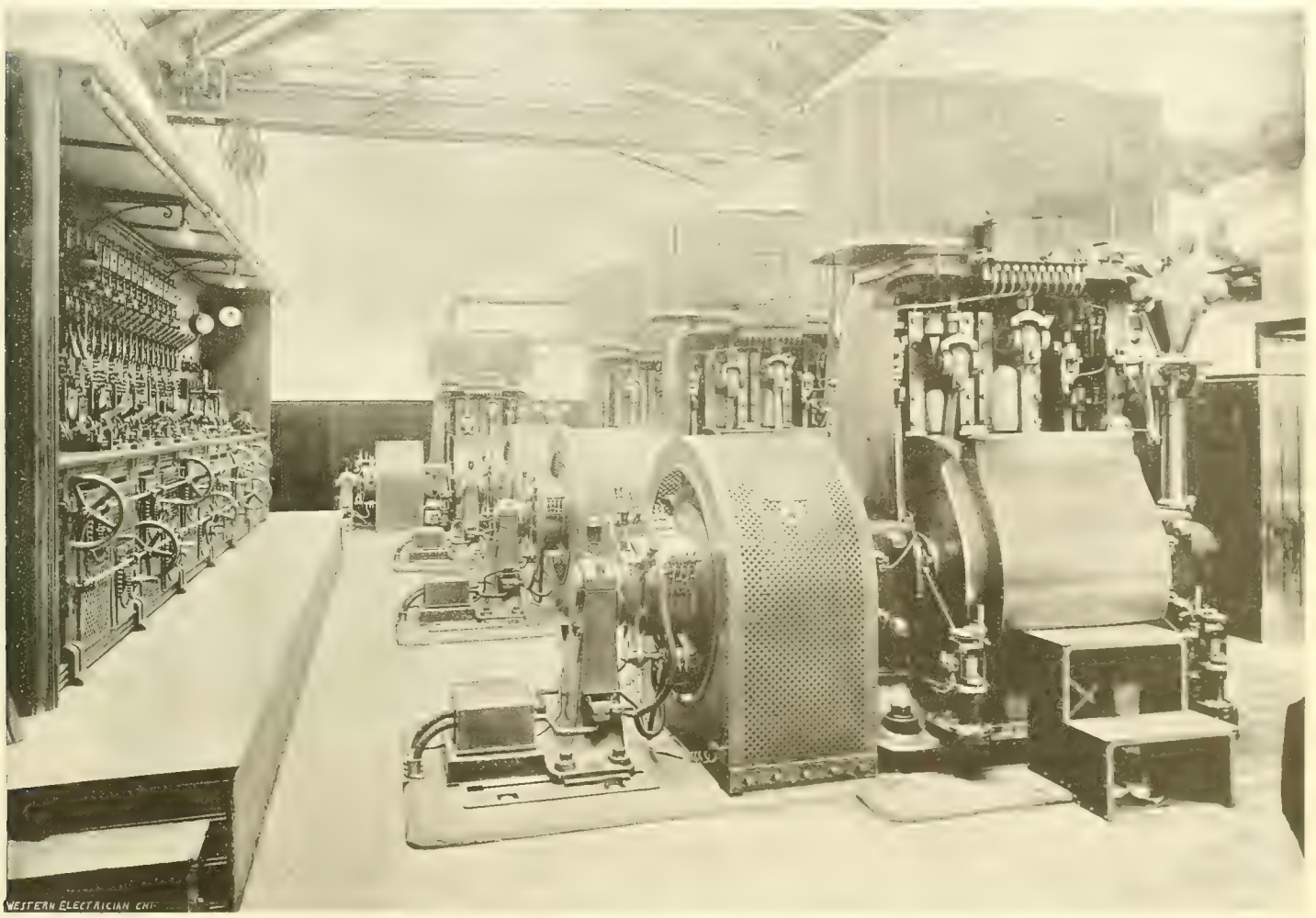


FIG. 1. CENTRAL STATIONS AT MULHAUSEN AND DARMSTADT.

In Rochester, N. Y., the other day the firemen were ordered out to cut down a newly erected electric light pole at the corner of North avenue and Franklin street. The pole was put up by the Edison Electric Illuminating company, and adjacent property owners objected.

Electricity at the World's Fair.

Considerable business was transacted at last week's meeting of the committee on electricity. The questions propounded to Mr. Hornsby by foreign manufacturers were taken up. The petition for a special building, presented by Siemens & Halske of Berlin, was referred to the committee on grounds and buildings, with the recommendation that the request be not granted.

The Germans also asked whether the employes who came over with them could find hotel accommodation at the exposition grounds, and at a later meeting of the grounds and buildings committee Chairman Clowry was instructed to reply that while the Exposition company would not conduct boarding houses on the grounds, it would certainly provide proper accommodations for that class of employes. Solicitor-general Butterworth replied to an inquiry about the protection of German patents by saying that foreign patents would be carefully protected. "The fact is," he said, "that our laws are more rigid in that respect than those of any other country on the globe. Foreign exhibitors will receive all the protection they could ask, and more, in fact, than they are accorded at home. In this country a man can use a new invention two years before having it patented, if he desires, and the same rule would apply to foreign exhibits."

In reply to the inquiry as to stage lighting and ventilation Chief Barrett was desired to reply that there will probably be two music halls, one seating about 2,000 and one about [illegible] persons. There will also probably be a large auditorium seating about 10,000 or more, with room beside for chorus and orches-

tral work. There may possibly be a small theater, though this project has been but little agitated. It is not improbable that each of these may be used by the electric companies, if found best, to exhibit lights and ventilating appliances, etc. The electric equipment of these buildings, it is thought, will be determined by competition among the several companies.

Prof. Barrett was also requested to advise the foreign firms that specifications are now being made out for the general supply of light, which will be soon sent to all the prominent electrical firms, both in Europe and this country.

There was considerable talk in relation to the old question of the duties of the electrical and construction departments with respect to the supply of electric light and power. No definite conclusion was reached, however. An en-

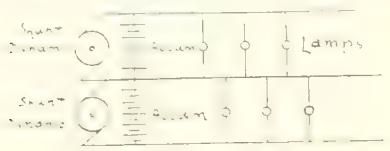


FIG. 3. CENTRAL STATIONS AT MULHAUSEN AND DARMSTADT.

deavor will be made to arrive at some settlement of the matter in order that a statement may be made in the prospectus of the department of elecricity, which is shortly to be issued. This pamphlet is also to include a description of the electrical work done in connection with the construction operations.

Electrical Engineer Sargent's plan for dividing the work of furnishing electric light and power is as follows:

I would suggest that plans and specifications be sent to all responsible companies in the United States and Europe, for the equipment and service required for the exposition grounds, and that separate proposals be asked for, for the following contracts, viz.:

Nine contracts for arc lighting, divided as follows:

1. Horticultural Building.
2. Transportation Building with Annex and Service Building.
3. Mines Building.
4. Electricity Building.
5. Manufactures and Liberal Arts Building.
6. Government Buildings and Fisheries Buildings.
7. Machinery Hall and Annex.
8. Agriculture Annex, Stock, Forestry, and Dairy.
9. Illumination Circle.

Contracts to provide for such arc lights as may be required for the interior, exterior, and directly adjacent grounds, as may be indicated by plans and specifications in each particular instance.

Twelve contracts for incandescent lighting, divided as follows:

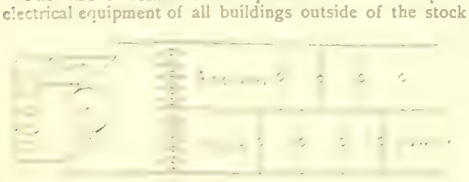
1. Territory intervening between Fifty-sixth and Fifty-seventh streets.
2. Territory intervening between Fifty-seventh street and Fifty-
3. Horticultural Building and Horticultural Building, with Pack Building.
4. Transportation Building and Annex.
5. Mines Building.
6. Electricity Building.
7. Agriculture Building.
8. Machinery Hall, Annex, and Boiler-house.
9. Administration Annex.
10. Manufactures and Liberal Arts Building.
11. Illumination Circle.
12. All United States Government Exhibits and Fisheries.

Proposals to provide for such incandescent lighting as may be required in interior and exterior of buildings, and directly adjacent grounds, in each instance as indicated by plans and specifications.

Five contracts for power service, divided as follows:

1. Machinery Annex.
2. Mines Building.
3. Electricity Building and Annex.
4. Agriculture Annex.
5. Machinery Hall.

The above contracts will provide for the complete electrical equipment of all buildings outside of the stock



ranged that if the service rendered is inefficient, and is jeopardizing the interests of the exposition, the Exposition company shall have authority to operate said plant with its own forces, charging cost of operating expenses to the contractor.

It is said that this plan will result in the showing of at least twenty types of dynamos in the great central station, and that several of these will be of foreign manufacture. It is computed that if the World's Columbian Exposition were to buy outright all the electrical machinery and equipment needed, the cost would be not far from $2,000,000.

Mechanical Engineer Slocum, of the bureau of construction, announces that E. P. Allis & Co. of Milwaukee, Wis., have donated the use of a mammoth engine to the exposition authorities. This engine will be of 2,500 horse power capacity, and will develop almost double the amount of power produced by the big Corliss engine at the Centennial, now in use at Pullman. The great World's Fair engine will be of the vertical triple-expansion type, and will, it is said, be the largest single engine ever built in this country. Mr. Slocum has received assurances that engines aggregating 16,000 horse power will be put at the disposal of the exposition authorities during the World's Fair by the various engine companies free of charge. No proposition for the donation of electrical machinery has been received, however.

William B. Thomson of Chicago, late of Scotland, has written Mr. Keller to state that he thinks he can put the

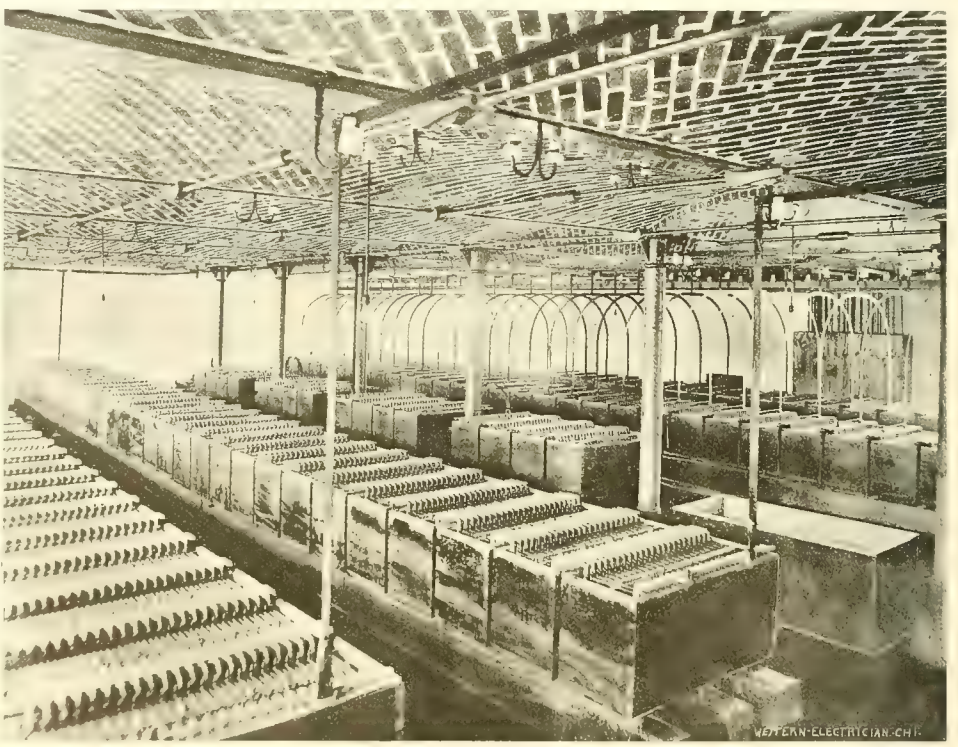


FIG. 2. CENTRAL STATIONS AT MULHAUSEN AND DARMSTADT.

department on the track of an electric clock made by the late Alexander Bain when quite a lad while living at his home in Spittle, in the County of Caithness. This clock was made about sixty years ago. Mr. Thomson says that "it took its supply of current from metallic plates sunk in the earth, and kept very good time." This interesting relic will be a decided acquisition to the collection of historical apparatus.

R. H. Pierce, lately president of the Electrical Engineering company of Chicago and formerly connected with the Edison company, has been appointed assistant in the electrical engineering department of the bureau of construction. Mr. Pierce will rank next in authority to Mr. Sargent, and will have charge of the electrical work in the absence of that gentleman.

Electric and Steam Cranes.

An interesting comparison of the cost of operating steam and electric cranes on a London wharf has been made public. Formerly there were on the wharf a ten ton steam crane, a two ton steam crane, and two hand cranes. The cost of coal for driving the two steam cranes was $1,250 per year, [illegible] to be kept up night and day. All four of these cranes were fitted with electric gear, and a [illegible] necessary wiring, switches, and safety [illegible] being $1,250. A gas [illegible] the dynamo, and the [illegible] of the work cranes, chaff cutter and corn crusher, besides an ordinary friction hoist—is given as $280 for the year, while the amount of the work done has been considerably in excess of any previous year. The engine is a 12 horse power Otto gas engine. The cost of repairs and renewals for the year has been a little more than $25.

Electric Mining Machinery Abroad.

America is not the only country in which the peculiar advantages of electricity as a motive power in mining operations are receiving recognition. At the Mechernich lead mine in Brussels, Belgium, not only are electric lights employed throughout the mine, but electricity is used in several other directions with marked success. It is stated that over 3,000 tons of ore are raised daily, and so perfect are the automatic arrangements that only twenty-five hands are required for the output. One clever electrical appliance attracts particular attention, and will doubtless soon be generally adopted in English mines. When a wagon of ore is deposited at the shaft's mouth an electric contact is made in the tipping, and a small needle in the office makes a red mark on a band of paper revolving by clockwork. The object of this is not so much to give automatically the number of wagons tipped as to show at a glance that the hauling is proceeding regularly. The paper band is divided into half-hours for a week, and at the end of a week's work it needs but a glance to see the number of wagons that have been tipped on any day and at any time. This is said to be a sure way of preventing the disputes that arise as to quantities raised.

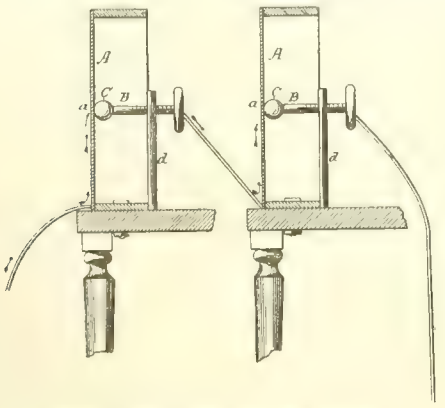
The Australians, also, are quick to adopt new machines and systems in their mining work, and were among the first to utilize electricity for power in this connection. Several years before there were any quartz mills run by electricity in this country, a mill of this description was operated at Skipper's Creek, N. Z. The Australian miners bought the water wheels and dynamos in this country and set them at work in 1885. The Australians are about undertaking one of the largest general plans for using electricity in mining that has yet been proposed. A company is establishing a central plant to generate electricity which will be sold for power purposes to all the mines requiring it in two mining districts. Both power and light will be furnished. The two mining districts of Dundas and Zeehan, some miles apart, have each many mines and reduction works. At a point on the river between these districts, where water is abundant, the Zeehan and Dundas Electric Power and Lighting company will establish a power plant which will have an output of 5,000 horse power. By means of electricity this power will be distributed to the mines and mills in the two districts. This will do away with the necessity of separate power plants for the several mines, and the company expects to sell the electric power for much less than the mine owners could produce it themselves. A railroad runs down from upper Dundas to the harbor on the coast, and it is possible that this also may be operated by electricity.

The Berliner Patent.

One of the most important documents issued from the United States Patent Office in many years was granted last week to Emile Berliner on a "combined telegraph and telephone." The application was filed June 4, 1877, and was issued November 17, 1891. The specifications are reproduced, together with the drawings as they were issued from the patent office:

My invention consists in a new and useful improvement in transmitters for electrically transmitting sound of any kind, of which the following is a specification:

It is a fact that if at a point of contact between two conductors forming part of an electric circuit and carrying



FIGS. 1 AND 2. THE BERLINER PATENT.

an electric current the pressure between both sides of the contact becomes weakened the current passing becomes less intense—as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness the sounder at the receiving instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric current in the following manner:

In Figs. 1 and 2 of the drawings, *A* is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball *C*, terminating the screw-threaded rod *B*, which is supported by the bar or stand *d*. The pressure of the ball *C* against the plate *A* can be regulated by turning the rod *B*. The said ball and plate are included in circuit with an electric battery, so that they form electrodes, the current passing from one of them to the other. By making the plate vibrate the pressure at the point of contact *a* becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly, as already described. By placing now, as is shown in the drawings, one such instrument in the station, Fig. 1, and another instrument capable of acting as a telephonic receiver in the station, Fig. 2, both situated on the same electric circuit, in which a current is passing (as shown by the wire connections following the arrows), sound uttered against the plate of the instrument, Fig. 1, will be reproduced by the plate of the instrument, Fig. 2, for as the vibrations of the transmitter, Fig. 1 caused by the sound will alternately weaken and strengthen the current as many times as vibrations occur, the diaphragm of the receiver will be caused by these electrical variations to vibrate at the same rate and measure. The latter vibrations being communicated to the surrounding air, the same kind of sound as uttered against the transmitter, Fig. 1 will be reproduced at the receiver, Fig 2, or in as many other receiving instruments as are situated within the same electric circuit.

It is not essential that the plate should be of metal. It can be of any material able to vibrate, if only at the point of contact suitable arrangement is made so that the current passes through that point. The plate may be of any shape or size, or other suitable vibratory media may be used—a wire, for example. Any other metallic point, surface, wire, etc., may be substituted for the ball. There may be more than one point of contact to be affected by the same vibrations. Both of the electrodes may vibrate, although it is preferable that only one should. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point of contact in the transmitter, then the result at the receiving instrument will be a tone much louder, but not as distinct in regard to articulation.

I have also embodied my invention in, and used it in connection with, some other forms of apparatus.

In the drawings, Fig. 4 represents a detached view of the vibratory diaphragm, showing its relative situation to the poles of the galvanic current. Fig. 3 represents a view of a complete apparatus, Fig. 5, a view of the diaphragms arranged to receive and transmit the sound waves; and Figs. 6, 7 and 8 modifications of the vibratory diaphragm.

In the drawings, the letter *A* represents a diaphragm or plate of thin metal, of limited conductive capacity, such as iron, steel, German silver, platinum, secured in the frame *m m* in the box *F* in any convenient manner.

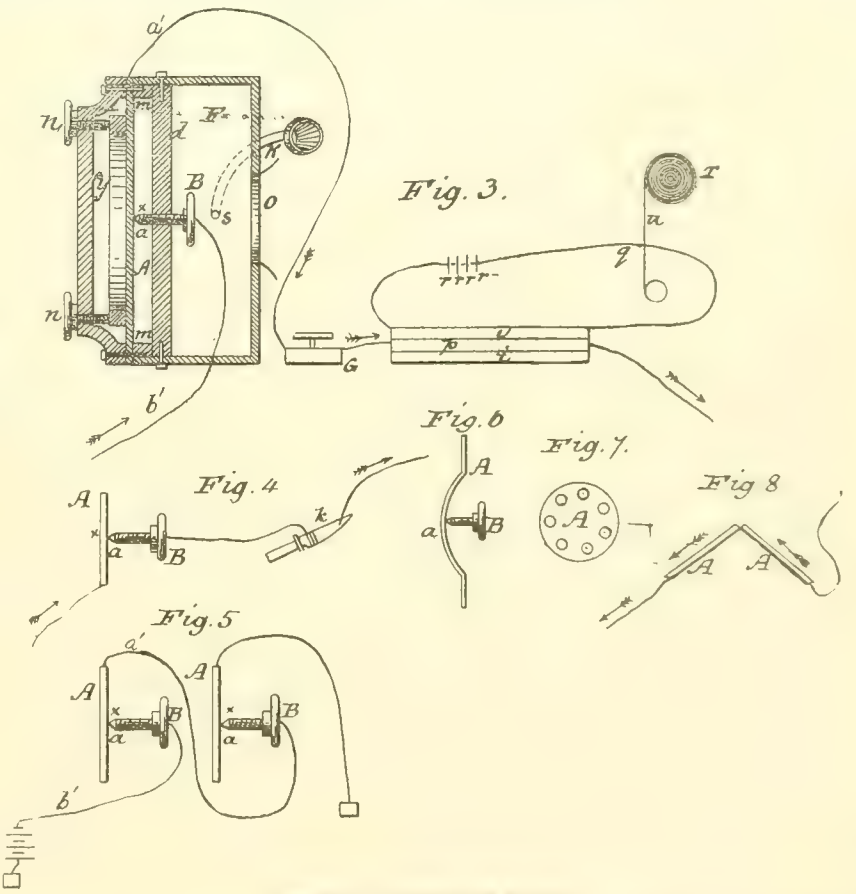
The letter *y* represents a ring resting against one side of said diaphragm and capable of being made to bear upon the same with more or less force by means of set screws *n*, in order that the tension of the diaphragm may be regulated.

The letter *B* represents a screw or pin of metal, pointed at one end and mounted in a cross-piece *d* in such position that the point will be in contact with the diaphragm *A*. The diaphragm *A* is connected with one pole of a battery by means of a wire *a'*, and the pin *B* with the other pole by means of a wire *b'*.

The box *F* of Fig. 3 is provided with a tube *k*, to which the ear of the operator may be applied, in order to hear the sounds produced by the vibratory diaphragm when the instrument is employed as a receiver, and a tube *O*, through which he can speak when employing the instrument as a transmitter, so that the operator is not in need of moving the instrument or moving his head while carrying on a conversation.

Instead of employing a single vibratory plate, as shown in Figs. 1, 2, 3, 4 and 5, in each instrument, two such plates may be employed, as illustrated in Fig. 8, said diaphragms being connected to the respective poles and in contact with each other at their edges, as shown in Fig. 8.

The diaphragm of my improved receiver or the diaphragm of any magneto-receiver (such as those described by Alexander Graham Bell in his patent No. 174,465 of March 7, 1876, and in his patent No. 186,787 of January 30, 1877) will receive a particularly strong shock at the setting in and sudden cessation of the current when a ticking sound will be heard from the plate; but a weakening of the current alone can also be observed most distinctly and accurately by making, for example, a connection with in the same circuit by a wire and the blade of a knife *k*, Fig. 4. When scraping the wire end over the blade of the knife, this scraping is distinctly audible on the plate. Here the current is never entirely interrupted, yet the minute elevations and cavities on the blade, caused by the structure of the steel and which again cause minute alterations in the intensity of the current, are sufficient to shake or vibrate the plate with varying intensity, thus rendering again the same peculiar scraping noise. If, now, the plate of one instrument, as in Figs. 1 and 5, is vibrated by sound waves (which happens whenever any kind of sound is uttered or is produced by musical instruments in its neighborhood) every wave or vibration that strikes the plate produces between the two sides of the contact a variation of pressure, which causes a variation of resistance at that point, and therefore a variation in the strength of the passing current, and if the sound is sufficiently strong it will break the circuit at said point of contact, the variations in the current thus produced causing similar vibrations in the plate of the receiving instrument. The essential part of



FIGS. 3 TO 8. THE BERLINER PATENT.

the apparatus is the point of contact, which must offer a resistance to the current.

It is not necessary in the transmitting apparatus that the plate should be of conducting material, for any substance capable of vibration will answer, if only at the point of contact provision is made for the current to pass. It is sometimes convenient to use a vibrating plate in the form of a reflector, as shown in Fig. 6, for concentrating the sound, or the diaphragm may be provided with a number of apertures to disperse the sound, as shown in Fig. 7. These apertures prove advantageous with strong sounds, particularly the hissing sounds, as while the sound waves are rushing toward the diaphragm, those touching the plate are repelled and partially destroy the following waves, just as sea-waves when forced against a cliff will be thrown back, destroying those directly behind. The holes permit

[illegible] *p* and suddenly is broken, a spark will rush over between [illegible] companied by a peculiar sound due to the electric discharge, and [illegible] and connecting points *r, r, r, r*, a spark will occur between each of them, provided they are near enough to each other, and the peculiar sound will be heard between each of them [illegible] or [illegible] the [illegible] prepared in such a way that each spark will produce a mark upon it. If, therefore, the plate *A* vibrates by sound, each vibration causing a break of contact will produce a spark at *q*, and the strip being drawn through, a succession of marks will be produced upon the strip according to the number of vibrations caused by the sound; but at the same time the sound which was uttered at the plate *A* will be heard from the sparks rushing over the points *r, r, r, r* and *q*, because every spark produces one wave in the atmosphere in which it occurs, and a certain number of waves will therefore produce certain tones. Therefore the same sound which is uttered against the plate *A* will be heard from the sparks. The scraping of the wire end on the knife-blade *k*, as in Fig. 4, in the primary current will also be heard between the wire ends of the secondary current at *r, r, r, r* and *q*. This permits a number of designs for a receiving apparatus within the secondary current. For instance, initials, ornaments, etc., consisting of a number of metal pins can be constructed in such a way that whenever a tone is produced against the plate *A* a spark will rush over said metal pins, and at the same time their sound is produced will render the design visible in illuminated characters.

By making the person of the operator a part of the secondary circuit and discharging the sparks in the body in the neighborhood of the ear the sound will be more particularly apparent.

It will be observed [illegible] modes presents a [illegible] knob. This possesses some advantages, among which are ease of construction and [illegible] wear away the opposing [illegible] would, and when the [illegible] made of such a form the freedom of the vibration is less interfered with.

I do not claim that [illegible] transmitting vocal and other sounds telegraphically by causing [illegible] waves accompanying [illegible] that I am the first who [illegible] by varying the [illegible] current was passing.

I do not herein claim the [illegible]

receiver which I have described, because that is a subject of claim in another application. I claim.

1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking-telephone transmitter operated by sound-waves, and consisting of a plate sensitive to said sound-waves electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

3. The combination, with the diaphragm and vibratory electrode, of a rigidly held opposing electrode in constant contact with the vibratory electrode, substantially as described.

4. In a telephonic transmitter, a vibrational plate made concave for condensing the sound, substantially as set forth.

5. In a telephonic transmitter, a vibrational plate provided with one or more apertures, as and for the purpose set forth.

6. A speaking-telephone transmitter comprising a diaphragm or disk sensitive to sound-waves, combined with a rigidly held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm.

The specifications were drawn by A. Pollok and the patent was assigned to the American Bell Telephone company of Boston. It is claimed that the Bell company hopes to retain exclusive control of the telephone business for another seventeen years by the granting of this patent. Of course there is a diversity of opinion on this point, but telephone experts generally seem inclined to believe that the Bell company has secured another lease of life. One of these after a careful examination of the patent just granted, said:

"If I had that patent I wouldn't take $50,000 in cash for it."

J. J. O'Connell, the telephone expert of the Chicago exchange, after examining the specifications and drawings in the Berliner patent, pronounced it one of the most valuable telephone patents ever granted. He said:

"This patent covers the fundamental principle of a transmitter and while the drawing represents a very crude instrument—one that would not be used to-day and would, in fact, be considered impracticable—it is unquestionably a fundamental patent and a valuable one too.

"You will notice that the first claim granted is on 'the method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between the electrodes in constant contact so as to strengthen and weaken the contact, and thereby increase and diminish the resistance of the circuit.'

"This covers the principle upon which is based the transmitters now in use throughout the country, and will since the announcement of the granting of the patent, to the effect that this would not prolong the life of the Bell company's monopoly, Mr. O'Connell said: "In a practical telephone system a transmitter is an important part, and if, as I believe this patent covers the fundamental principle of the present transmitters, the public will have to wait until the patent expires before it can use this telephone without infringing Berliner's patent. Heretofore the Bell company has relied exclusively upon its receiver patent, and has kept the transmitter in the background. Who ever heard of the Bell company closing an exchange for infringing on the transmitter? The fact of the matter is, the company has fortified itself thoroughly and is to-day in a better position than ever before."

C. H. Wilson, superintendent of the Chicago Telephone company, was asked to state his opinion as to the effect of the new patent. "As I understand the matter," he replied, "the patent covers the principle of the carbon transmitter The claim for this patent has been in interference for many years with applications for a similar patent from Edison and Blake. It appears that the commissioner of patents has now decided to issue the patent to Berliner, the Drawbaugh litigation being now out of the way. The carbon transmitter is a valuable improvement in the telephone, but it is not absolutely essential to the use of the instrument. Of course, all other carbon transmitters will now be infringements on this patent."

When Mr. Wilson was asked his opinion of the result of the expiration of the fundamental Bell patent in 1893 he said: "Well, we expect to keep right on doing business at the old stand. For my part, I will be glad to see some of these men who are howling about telephone monopoly and extravagant charges form companies of their own. I venture to say that they will learn a few facts about the cost of conducting a telephone exchange that will open their eyes and temper their extravagance of assertion The expense of building up a rival system that could equal the Bell company's appalling My own idea is that the telephone business of the country will show a repetition of [illegible] of telegraph companies."

The superintendent was asked concerning the reported [illegible] Bell company would go into the business of sending messages by telegraph. He replied that the Long [illegible] company was putting [illegible] system of copper [illegible] for the local [illegible] construction in the country. Any one could see, he said, that telegraph instruments might be attached to these circuits at any time. Whether they would be or not, he could not say. He knew of no contract, however, with the Western Union company that would prevent such action. As a matter of fact, the Bell company already leased its wires for telegraphic purposes, although it did not itself transmit messages of this character.

Multiple No-break Contact System.

BY J. J. O'CONNELL.

There are many disadvantages in the operation o break contact switch-board in telephone work which might be obviated by transforming the device into a no-break system. I have always contended that the present system was not all that was wanted and I have designed a no-break system which will be readily understood by reference to the accompanying drawings. The system is designed so that the present boards may be changed into no break boards.

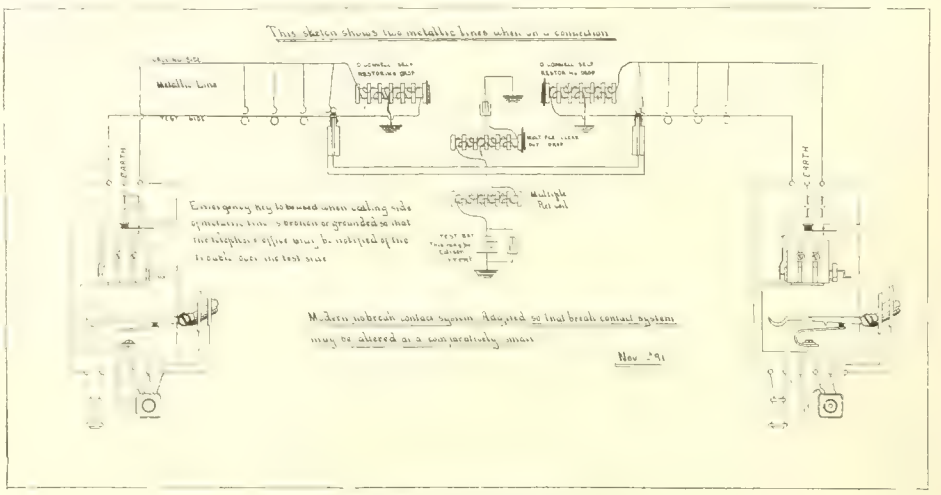


FIG. 1. MULTIPLE NO BREAK CONTACT SYSTEM.

In the early days of the telephone business I designed a board of this kind and having satisfied myself that later improvements in this system might be of some value in the operation of metallic circuits, I filed an application on June 6, 1887, and secured a patent, No. 420,091, January 28, 1890.

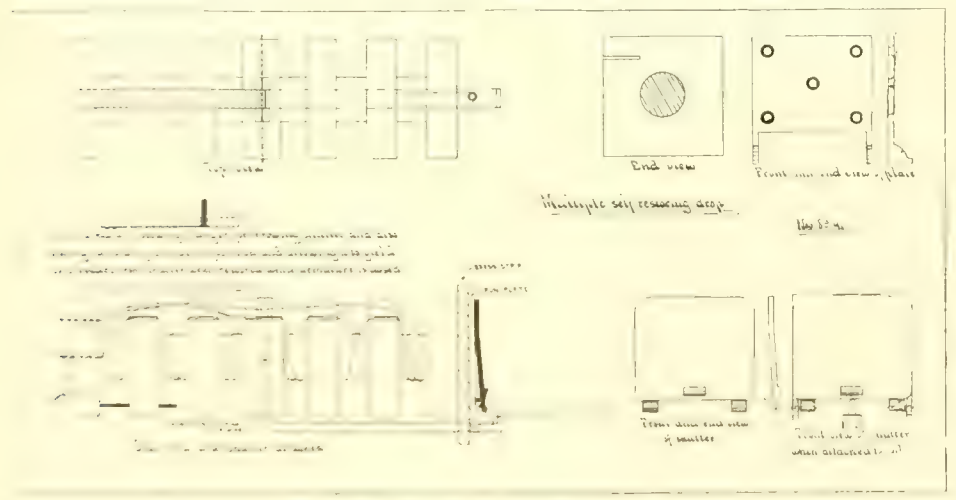
In this system, the busy test was put on by the closing of a battery to lines when the connecting cord was attached to them. This test system was afterward generally adopted by the telephone companies, and is now used extensively throughout the United States.

The no-break contact system, however, did not seem to meet with approval, and break contact switch-boards have been put in most of the large cities of the world. The result of this is that lines keep opening up in the contacts, and it is impossible to keep a balance. Consequently, electrical disturbances of all kinds are heard in the telephones.

The new system will do away with this trouble, for the resistance of both sides of the metallic lines on the switch-board is the same, and all attachments which may be made on one side of the circuit have a corresponding number placed on the other, thus keeping up a perfect balance. The new feature of this system, illustrated in the drawings, is the adoption of a multiple coil drop, of great retardation. This drop is an improvement on the one shown in patent No. 420,091, and its action is as follows: When a call is sent into it, the armature kicks the iron shutter down, by striking it near the hinge joint. This action is produced by current flowing through only one-half of the coil. The operator then attaches the answering plug to the line. The current from the battery of this plug flows through the other winding of the drop coil and magnetizes the end from which the shutter was kicked, and the armature at that end coming back, suddenly and automatically kicks it back into its former position, where it will stick, and cannot be thrown down while the two lines are connected, so that one subscriber may call the other without either of the calling drops being thrown, and the office may also call the subscriber.

On the calling side of the connecting cords is attached a 100 ohm retardation drop. This is used as a ring-off drop, when the subscribers wish to be disconnected.

Fig. 1 shows two metallic lines in connection and Fig. 2 gives a detailed sketch of the self-restoring drop and the winding of the armature.

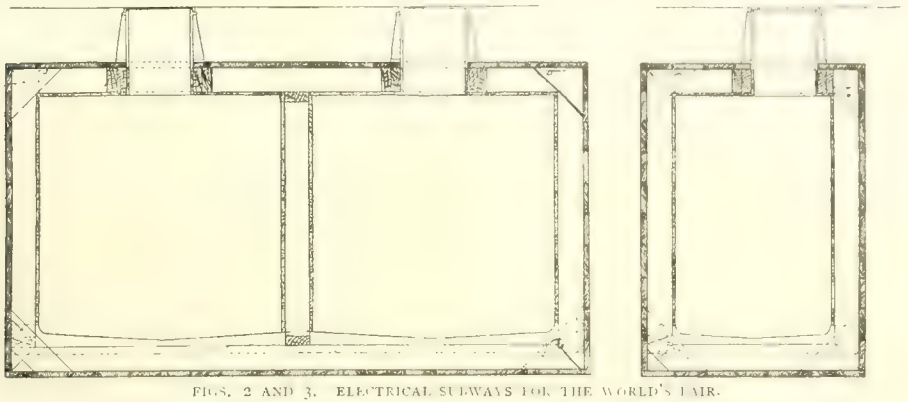


[illegible]

An electric light plant has been established at Dublin, Ga.

Electric Subways for the World's Fair.

Attentive readers of the WESTERN ELECTRICIAN must have been before this impressed with the fact that an immense amount of electricity is to be transmitted from the great service plant at the World's Fair to various parts of the grounds for light and power. Overhead wires are, of course, out of the question, and subways were long ago decided upon as the only feasible means of meeting the conditions. For several months Electrical Engineer Sargent has been at work on the plans for the subway system, with a large force of draughtsmen to put his ideas on paper, and at last week's meeting of the committee on electricity his designs were formally adopted. It has been no easy task to devise a plan adequate to meet the requirements as to size and efficiency without involving a construction too complex and expensive for temporary use. Several designs were considered, but were, one after the other, found open to objection, until the present plan was evolved.



FIGS. 2 AND 3. ELECTRICAL SUBWAYS FOR THE WORLD'S FAIR.

A general idea of the system may be had by a reference to the accompanying map and drawings. The generating plant, as indicated, will be located in a portion of machinery hall set aside for its use. This space will be 850 feet long by 150 feet wide, and in it it is expected that 25,000 horse power will be generated. The engines will be located near the wall, and the dynamos toward the center of the building. The conductors, after leaving the dynamos, will be arranged in a suitable fire-proof rack located under the main floor about 150 feet from the south wall, and running lengthwise of the building. From the rack five distinct groups of feeding wires will start as follows: The first group will supply all the territory contained in the space bounded by Fifty ninth street on the north, the center of the basin on the south, Lake Michigan on the east, and the lagoon on the west; also the electric fountain located at the west extremity of the basin, and the following buildings, etc.: The fisheries building, the

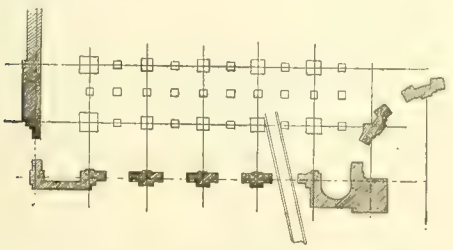


FIG. 4. ELECTRICAL SUBWAYS FOR THE WORLD'S FAIR.

government building, the naval exhibit, the manufactures and liberal arts building, and all the grounds within the territory. It is proposed to provide a main conduit for this group in the following manner: Starting from the rack in machinery hall, already referred to, a conduit is to be provided; this conduit is to be of sufficient capacity to accommodate 150 insulated cables of various sizes up to 600,000 circular mils area. The conduit will run north from the rack under the floor of the machinery hall to the electricity building, with a branch for the electric fountain; east from the electricity building to the bridge, and from the bridge to the manufactures building. The system will terminate at the fisheries building. The tunnel itself, or any of the buildings through which it passes, may be tapped by draw-in systems buried in the ground wherever it is necessary to supply light or power to the grounds or any other buildings that may be erected in this territory.

Group No. 2 will be provided for in a conduit of the same capacity as that for the first group, and will run direct from machinery hall to the electricity and mines buildings, with a branch for the administration building. This will also provide for all grounds adjacent to these buildings, and will probably include the wooded island.

Group No. 3 will run direct from the machinery hall to the elevated railroad structure, and supply all territory north of the basin and the administration building not reached by groups No. 1 and No. 2, including the transportation building and annex, the service building, the horticultural building, the woman's building, the state and foreign building, the art gallery, the Midway Plaisance, and all grounds and smaller buildings in the territory mentioned. Draw-in systems or buried conductors are to be used wherever the elevated structure is not available.

Group No. 4 will provide for the machinery hall, the machinery annex, the boiler house, the western portion of the stock exhibit, and the western portion of grounds. The wires will be distributed under the basement of buildings and on elevated railway, beneath the track, and thence to the grounds and stock exhibit by draw-in or buried systems.

Group No. 5 will provide for the agricultural building and annex, the sawmill, the forestry building, the dairy building, the eastern portion of stock exhibit, and the pier and casino.

The wires are to be distributed on the elevated structure, in the basement of the agricultural building, and on piles under the roadway over the pier so far as practicable, and then by draw-in or buried systems. The tunnel system cannot be well continued farther north than the fisheries building, because the ground is not of sufficient height above water-line. Groups No. 1 and 2 will be laid in the conduits, which are indicated on the map, Fig. 1, while the others are provided for in the manner described.

The three smaller drawings show details of the construction of the conduits. In Fig. 2 is shown a section of the double conduit extending from the generating station to a point north of the administration building. This is inclosed in one wooden structure, and comprises two full sized conduits. Those parts of the conduit north of the center of the manufactures building and leading into the electricity and mines buildings are of a smaller size, shown in cross-section in Fig. 3. A ground plan of a corner of the electricity building is presented in Fig. 4, showing the manner of laying the conduit among the foundation timbers.

The greater portion of the conduit will be exactly eight feet and four inches square. The outer material will be two-inch tarred plank laid on stringers one foot apart. These stringers will be eight inches wide and they will support the inner skin of the conduit, which will be an inch thickness of cement plaster laid on metal lathing. The larger tunnels will be six feet six inches wide inside, and the smaller size four feet three inches. All will be six feet six inches high in the clear, so that a man may walk through without difficulty. In the larger conduits there will be a passageway in the center, with a row of cross-

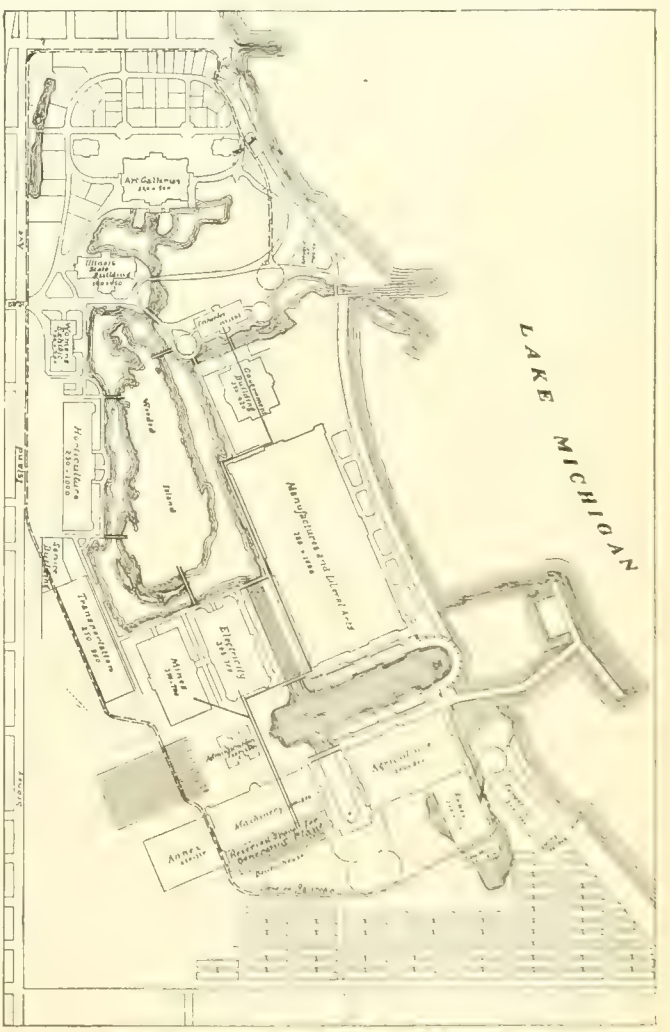


FIG. 1. ELECTRICAL SUBWAYS FOR THE WORLD'S FAIR.

[illegible] cables will be used on the cross-arms. All wires must be covered with water-proof insulation. The conduits will be laid, on an average, eighteen inches below the surface of the [illegible] lake. The interior will have the appearance of a concrete tunnel, and there will be ample room for all the wires necessary. The World's [illegible] nish the conduits, cross-arms and insulators, but contractors for lighting or power service will be required to furnish wires and place them in position. It is expected that the contract for the wooden work of the conduits will be awarded in about two weeks.

Safety Device for Mine Shafts.

A mining contemporary gives an account of an electrical apparatus designed for the prevention of accidents to miners while riding on the cages in the shaft, and which will also, it is said, tend to lessen the number of accidents occasioned by cages coming in contact with the chairs. The invention has been in successful operation during the past two years at the Drum Lummon mine of Montana, and it was devised by an ingenious employe of that company. The arrangement consists of an electrical connection between the cage and the chairs on the different levels of the mine, and also between the cage and the engine room. An ordinary battery is placed in the bottom of the cage and wires attached to it run through a contact piece to the side of the shaft, something on the same principle as the trolley on an electric street car. An ordinary push-button is placed in such a position on the cage that the station tender can readily reach it. Wires running down the shaft connect with the trolley on the cage, and at the other end are attached to a dial in the engine room. Another wire connects with the chair in the mine, and as the dial is in full view of the engineer it can tell at a glance whether the chairs or set of [illegible]. Should an accident happen to any one on the cage between two levels by pressing the push-button the cage can be brought to a stop in a moment. In the ordinary way with a bell-rope attachment, if the cage is going at even a [illegible] speed it is dangerous to attempt to grasp the bell line on account of the liability of getting an arm caught between the sets.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - Editor and Publisher

J. B. O'HARA, }
F. L. PERRY, } Associate Editors.
W. E. KEILY, }

J. I. BAKER - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT — Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers. In clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING — THE WESTERN ELECTRICIAN — ***the only general electrical paper published in the West*** — thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.

[illegible] at [illegible] and Darmstadt. Illustrated. ... 313, 314

[illegible] Cranes ... 314

Electric Mining Machines Abroad ... 314

The Berliner Patent. Illustrated ... 315, 316

[illegible] Contact System, by J. L. O'Connell. Illustrated ... 316

Electric Railway at the World's Fair. Illustrated ... 317

[illegible] ... 317

[illegible] ... 318

[illegible] Machines. Illustrated. ... 319

New [illegible] Carbon [illegible] ... 319

[illegible] Illustrated ... 319

[illegible] ... [illegible]

[illegible] Illustrated ... 319, 320

[illegible] E[illegible] ... 3[illegible]

[illegible] ... 320

[illegible] ... 320

A Motor Operating Automatically at any Desired Speed or Torque, and with Maximum Efficiency under all Conditions, [illegible] ... 320, 321, 322

DEPARTMENTS.

[illegible] ... [illegible], 324

[illegible] ... [illegible]

[illegible] ... 324

[illegible] ... 324, 325

[illegible]

[illegible] of the [illegible] scheme of electric wires for [illegible] decided upon, are presented in this issue. They possess both interest [illegible] top for the [illegible] was abandoned on account of the expense; the square form is cheaper and simpler. It is thought that a plan has been devised that [illegible]

[illegible] reason to believe that it will, it is likely that the United [illegible]

Our San Francisco correspondent called attention, last [illegible] some weight on the Pacific coast where the benefits of the electric railway have not yet been fully demonstrated, but on this side of the Rockies they are simply laughed at. Mr. De Young should have one of his reporters accompany him the next time he comes to Chicago to attend the meetings of the World's Fair officials. He would gain some valuable experience by riding on the North Side cable company's lines in Chicago, and if he were still a believer in the superiority of the cable he might interview Thomas Lowry of Minneapolis who discarded the cable equipment in the St. Paul–Minneapolis system for the electric. The St. Louis & Suburban company's lines would also furnish interesting data on the relative merits of the two systems. Mr. De Young's paper bids fair to secure the booby prize if it continues to exhibit its ignorance of matters outside its narrow range.

As a result of the discussion over the issuance of the Berliner patent attention is attracted to the great advancement that has been made in telephony. It is surprising how little is known by the general public of the details of the system which they rely upon so much and abuse so roundly. Electrical engineers, too, whose attention has been devoted to the handling of heavy currents look upon telephone work with a feeling akin to contempt, yet in this much abused system about which so little is generally known, the most exact work is required, and many serious problems are encountered. The general public does not take into consideration the fact that an expensive corps of experts is required to conduct the experiments and devise new methods and appliances to obviate the ever-arising obstacles which confront the superintendents of exchanges, both large and small. The advancement which the electric motor has made and especially its application to street railway work, together with the development of electric lighting, has turned the attention of the people from the work of the telephone companies. These corporations during the last few years have been expending vast sums of money in perfecting their systems. In large cities especially is this true. For instance, in Chicago the underground work completed in the last few years represents the investment of a large fortune. Moreover, the entire system has been practically rebuilt with a view of adopting complete metallic circuits. It may be argued that the telephone company was merely fortifying its position for selfish purposes, but the fact that it is improving the service and spending money freely in this direction should be considered commendable. It is evident that the company is bent upon removing all cause for complaint of poor service on the part of the public, and this is no doubt the very best method it could adopt of fortifying itself against competition.

THERE seems to be some doubt in the minds of many persons interested in the proposed electrical congress as to the provisions made for holding this meeting. The managers of the congresses have adopted a general plan for the organization of these bodies, by which the work is divided into two parts. This plan will be followed in the case of the Electrical Congress. The task of providing accommodation and entertainment for the visiting electricians will be assumed mainly by the local committee, and the work of the congress itself, including the arrangement of the programme and all details connected with the meetings, will be made by an advisory committee in conjunction with Prof. Gray. This committee, it should be remembered, will be composed of the most eminent electricians in this country and abroad, and its work will be distinct from that of the local committee. The names of the members of this advisory committee have not yet been given to the public, but assurance has been had that these gentlemen will comprise the leading authorities on electrical matters of the day. If these facts were generally understood, it is hardly probable that the eastern electricians would look upon the project as they now seem to do. They appear to be under the impression that the local committee is to have control of the congress, and that the gathering is to be conducted on the basis of a Chicago meeting. There is absolutely no ground for such an opinion. Prof. Gray, who is at the head of the affair, is peculiarly well fitted for the work, and he will give it his [illegible]. In the selection of associates as members of the advisory committee he may be depended on to [illegible] in the profession.

In this connection it will not be amiss to once more call the attention of the members of the American Institute of Electrical Engineers to the fact that there will be plenty of work for them to do at the congress. Many of the American members of the advisory committee will no [illegible] members of the Institute, and that body will be called upon to act in conjunction with [illegible] promoting the interest of the congress. In order to be in a position to give the congress their earnest support and assist in promoting its interests, it will be necessary for the Institute and its members to check those who are now posing as the representatives of the Institute and are really placing that organization in a false position.

We believe that the Institute and its members, as soon as they fully understand the comprehensive and nonsectional plan on which the Electrical Congress is organized, will be among its most enthusiastic supporters, as, indeed, they should be.

GENERAL interest is manifested in the Berliner telephone patent, the specifications for which, together with photographic reproductions of the original drawings filed in the Patent office, are presented elsewhere in this issue. This patent is claimed by many telephone experts to be equaled in value only by the original patent on the Bell receiver. It is contended that the present method of operating telephones is dependent almost entirely upon the principle involved in this patent. The claim of Berliner on "the method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit," is certainly very broad. It is generally claimed by telephone experts that while the original Berliner transmitter has been greatly improved, yet the fundamental principle upon which the patent is based remains, and that under the present system a transmitter cannot be constructed without infringing upon this patent.

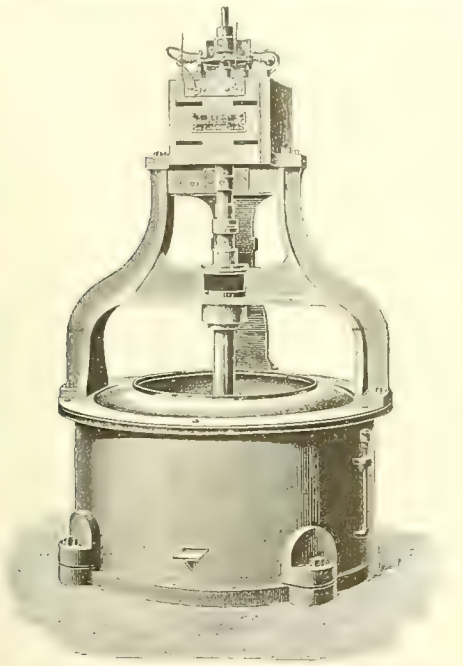
Heretofore the Bell company has relied upon the receiver patent for its exclusive control of the telephone, but now it will undoubtedly devote its efforts to maintaining the validity of the Berliner patent. When the news came from Washington that the Berliner patent, controlled by the Bell interests, had issued, there was considerable excitement among many who were interested in companies organized for the purpose of competing with the Bell interests for telephone patronage. Those who were confident that with the expiration of the Bell patent on the receiver there would be an open field refused to believe that another obstacle in the way of a transmitter patent had to be surmounted before the telephone would become "public property." Yet such seems to be the prevailing opinion among the men most competent to judge of the merits of the case—the experts who have made telephony a study, and who would no doubt be greatly benefited if the telephone business passed from the exclusive control of one great corporation.

IT now appears probable that a plan of dividing the contracts for the electric lighting and power service at the World's Fair will be adopted, by which about fifty separate groups, for either indoor or outdoor work, will be provided. Bids will be solicited for each of these, and the contract will undoubtedly be let to the lowest responsible bidder in each case, unless, indeed, the directors make a reservation by which a certain percentage of the electric lighting and power service shall go to the foreign exhibitors. In that case it is probable that the lowest foreign bidder will get the contract on the work thus reserved—say the buildings of foreign countries at the north end of the park—provided his bid is not above a certain amount conceived as a reasonable and just compensation. This discrimination has been proposed to compensate the foreigners for the great expense they will be under in showing their machinery at Chicago. It is not expected, however, that the amount they shall receive will equal the amount expended in making the exhibits. In fact, neither they nor the American exhibitors need expect to secure the great advertising benefits the exposition will afford and still make a profit out of the fair. Undoubtedly, the advertising value of each building will be taken into consideration by the competing companies, with a corresponding effect on the size of the bids. It will be considered a great distinction to furnish the light for the electricity building, for instance, and this contract will undoubtedly be eagerly sought, and so on, from the great manufactures building, down. Mr. Sargent, the head of the electrical engineering department of the bureau of construction, is confident that this plan will enable all the prominent companies of the world to take part in the lighting and power service, and he thinks that there will be at least twenty types of dynamos in the great central station. It is entirely possible that he is right, and that no better plan can be devised; but, as we have before pointed out, this is an important and delicate matter, and the management should take no steps until all possible objections have been thoroughly canvassed.

Application of Electricity to Centrifugal Machines.

One of the latest applications of electricity is shown in the centrifugal machine of Johann Kleinwerfers Sons, of Crefeld, Germany, a cut of which is herewith given.

The *Electrotechnische Anzeiger* says: "A glance at the compact structure of the motor will show at once many of its advantages in the present application. The arrangement, by reason of the absence of reciprocating parts, permits of a perfectly uniform revolution. Further, where steam motors are employed, any leak in the pipes or



APPLICATION OF ELECTRICITY TO CENTRIFUGAL MACHINES.

valves, is likely to cause drippings of dirty steam or water on the delicate fabrics in the 'wringing-out' process in the centrifugal machine, and this, it is needless to say, is avoided by the employment of an electric motor. As in the case of all centrifugal machines, a high speed of revolution is a desideratum; the motor most admirably fulfills this requirement."

New Double Carbon Suit.

On November 17th the Brush Electric company commenced a new suit in the United States Circuit Court, Chicago, against the Western Electric company, alleging infringement of the Brush double carbon lamp patent by reason of the manufacture and sale of the "Twin" lamp, which has been made and sold largely by the defendant company during the last year. It is claimed on the part of the defense that this twin lamp contains two complete regulating mechanisms, being, it is said, two single lamps inclosed in one cover, so arranged that after the carbons of one are consumed the other can be started up and burned. The question as to whether the Brush patent is broad enough to cover the device came up in a proceeding against the defendant company for alleged contempt of court, in disregarding a restraining injunction, which was brought up on ex parte affidavits. The court having intimated that it did not wish to decide the novel question presented in such a proceeding, the complainant has commenced this suit, as before stated, in order that the question of infringement may be presented in the usual way.

It is claimed on the part of the plaintiff that the defendant has continued to make and sell double carbon arc lamps since the injunction issued by Judge Gresham, September 1, 1890, restraining it from so doing, and that these lamps are substantially the same as those involved in the old suits. An injunction is asked.

Affidavits bearing on the case, taken on behalf of the plaintiff, have been made by Prof. Morton of Hoboken, N. J., Prof. J. P. Barrett, Alexander Kempt and Henry S Manning of Chicago. Prof. Morton deposes that the double carbon lamps complained of were made in substantial accordance with the patent granted C. E. Scribner January 7, 1890. He then gives an elaborate description of this lamp and a minute comparison with the lamp described in the Brush patent of September 2, 1879, and states his opinion that the former is the substantial equivalent of the latter, both in its construction and in its mode of operation. Prof. Morton concludes as follows: "I had occasion to compare the Jenney double carbon lamp with the lamp of the Brush patent 219,208, in the suit brought by the Brush Electric company in the district of Indiana against the Fort Wayne Electric Light company. Also the Wood double carbon lamp in another suit between the same parties. Also the old Sperry lamp, in a suit brought in the Northern district of Illinois by the Brush Electric company against the Belvidere Electric Lighting company. Also the new Sperry double carbon lamp and the modified Sperry double carbon lamp in the suit against the Sperry Electric company of Chicago, Ill. Also the Scribner double carbon lamp in the suits brought in Ohio and Illinois. While each one of these several lamps differed quite radically in appearance from the lamp of the Brush patent in question, still each had copied the latter electrically, and each employed mechanism which was the substantial equivalent of that disclosed in the Brush patent. As I view the Western double lamp of December, 1890, it is a closer copy, both electrically and mechanically, of the lamp of the Brush patent 219,208, than either the Scribner double carbon lamp or some of the others above referred to."

Prof. Barrett deposed that the Western Electric company had sold the city of Chicago 180 double carbon lamps in December, 1890, at $30 per lamp, giving a bond indemnifying the city from any infringement suit. Mr. Kempt, western manager for the Brush company, deposed that the Western Electric company took the contract at "such a price as the complainant could not afford, in view of their great outlay and expenditure for patents and inventions, to compete with or meet." Mr. Manning gave details of the construction of the Western Electric lamp.

H. A. Seymour of Washington and Offield, Towle & Linthicum of Chicago are the counsel for the plaintiff, while Barton & Brown of Chicago will appear for the defendant. It is stated that the case will be pushed to a conclusion as speedily as possible.

O'Connell's Telephone Relay.

The accompanying cut illustrates a receiver and transmitter combined. It is designed for use with an alternate current transmitter on long lines to relay the telephonic current from a point where, owing to resistance and capacity of line, the current begins to fail; to farther point that it would be impossible to reach by direct connection. The device is in reality intended to bridge across the line. The cut will give an excellent idea of this device and its application. The invention was designed by J. J. O'Connell, electrical engineer of the Chicago Telephone company.

Chicago Electric Club.

The first social session of the season was held by the Chicago Electric club last Monday evening and proved a most enjoyable novelty. President Sunny called the members to order shortly after 8 o'clock, and introduced C. C. Haskins, who read a humorous paper. This was followed by a mock trial of Prof. F. B. Badt, who was charged with 'stealing four watts from Terry's field." Alex. Kempt presided at the trial, and while his rulings were not entirely in accordance with the views of the attorneys, they were received with favor by the club. W. J. Buckley appeared for the complainant, and F. E. Degenhardt for the defendant. It is unnecessary to say that these gentlemen did not disappoint the expectations of their friends. Charles E. Gregory created a sensation as clerk of the court. At the conclusion of the proceedings Prof. Barrett announced that the jury found the defendant "not guilty, but advised him not to try it again."

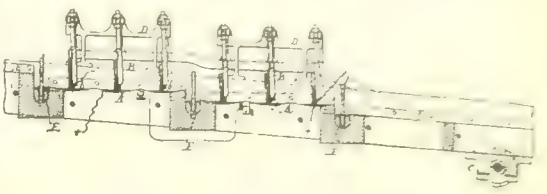
proceeds being contributed to the entertainment fund.

lunch was served, and the remainder of the evening

pected to make these meetings a feature of the winter's programme.

The managers of the club are preparing for active work during the approaching winter, and the necessity of con-

approaching season that will surpass all former efforts in this line. The record of the club is the best assurance that this will be done. Since its organization the Chicago Electric club has presented many valuable scientific papers and discussions which have attracted attention among electricians throughout the world. It is now proposed to excel this record. In social features the club presents many

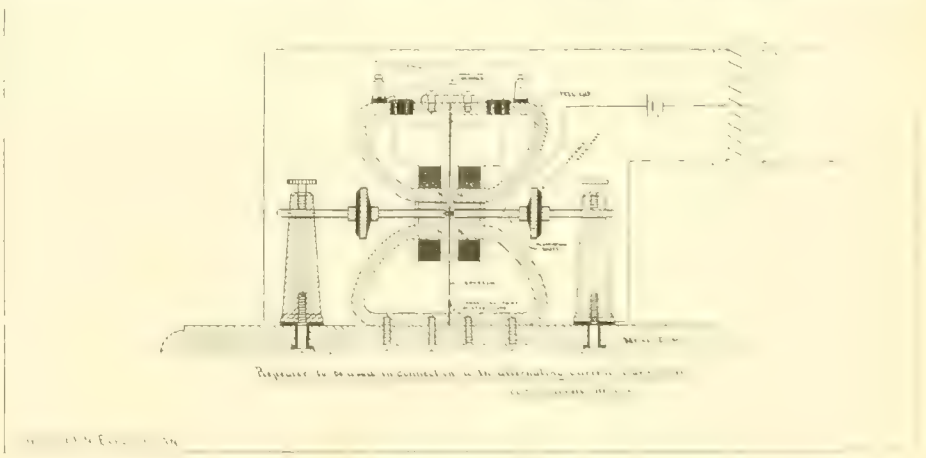


ELECTRICAL AMALGAMATING APPARATUS.

attractions. Its reading room is supplied with all the leading publications, and its library is one of the most valuable collections of electrical books in this country. There is always plenty of amusement, too, as the club is provided with fine billiard, pool and card rooms. The cafe service has greatly improved since the management adopted the policy of running its own kitchen. This important department was established at an expense of $2,500, and to-day the service is far superior to anything the club has heretofore enjoyed. It is the aim of the management to not only maintain the present standard, but rather to improve it. In view of the approaching electrical congress the club will make special efforts to improve its present standing and place it in a position to entertain the visiting electricians attracted by the World's Fair and the electrical congress.

Electrical Amalgating Apparatus.

What appears to be a practical device for the treatment of gold and silver ore, shown in the accompanying illustration, has been patented by George Button and William E. Wyeth of Griqualand West, South Africa. The table or base of the apparatus is constructed with transverse shallow channels, *A A*, in each of which there is a quantity of mercury. The finely crushed ore to be treated is mixed with water and made to flow along this table, passing over the channels just mentioned. Above each channel is mounted a brush [illegible] brushes are composed of ordinary bristles and extend the whole width of the table, the bristles being of such length as to dip into the semi-liquid ore and nearly touch the surface of the mercury. Against one side of each brush is fixed a conducting [illegible] The brushes are revolved [illegible] having a reciprocating motion [illegible] over the surface of the mercury. The table is formed of corrugated copper plates [illegible] a dynamo or other source of electricity, while the conducting bars, bearing against [illegible] other pole. Thus as the ore flows along the table from



O'CONNELL'S TELEPHONE RELAY.

one channel to another a current of electricity is constantly passing through it, and the mercury from the bars to the brushes, and thence to the table. The electrolytic action thus created, combined with the agitation of the brushes, causes the gold or silver to be effectually taken up by the mercury and amalgamated with it.

Electricity at the Augusta Exposition.

The South is attracting much attention at the present time among manufacturers of electrical apparatus, and many of these have taken advantage of the Industrial Exposition at Augusta, Ga., to present their specialties to the people of that section. There is undoubtedly a wide field for operation in that part of the country, and the people seem to take kindly to electrical apparatus of every description. Many of the leading manufacturers of electrical apparatus have extensive displays, and many applications of electricity are shown at Augusta for the first time in that state. One of the most interesting features of the display is the electric elevator. At the top of the elevator shaft is a fine promenade, and those who made the trip at night were lost in admiration of the grand view from this point of observation. The immense exposition buildings covering many acres of ground and thronged with spectators presented a "dazzling appearance" according to the local scribes.

Commenting on the electrical display the Augusta *Chronicle* says editorially:

The electric exhibits and display will be a revelation to our people. Nothing of the kind has ever before been witnessed in the South.

The prominent electricians visiting in the city say that it is the largest exhibit of electrical appliances ever brought together in the United States.

One of the novel devices will be the manufacture of ice by electricity. This begins to-day. The elevator will also be in operation. The hoisting, drilling and pumping machines will also be in operation.

The electric exhibits will be in full blast from now on. Fourteen companies contribute to make the finest and most valuable display ever witnessed in the United States. This is glory enough for the Augusta Exposition. Electricity is the marvel of the age.

Among the things run by electricity in the electric department are dental instruments, ice makers, automatic tank fillers, pumps, fans, drills, clocks, bells and an elevator 100 feet high.

Electrical Exaggerations.

The "electrical experts" of the daily press have a way of telling a story in which electricity plays a part, that is truly unique. It may be assumed that none of its wonderful features are belittled in the telling of the story. Several unusually graphic accounts of accidents attributed to electricity have of late appeared, and from these the following are selected as fair examples. The first appeared in the form of a press dispatch from Salem, Mass.:

Electricity played some queer pranks at Porter's meat market yesterday afternoon. On the roof of the market building is a clothes line. During the rainstorm a towel blew from this line on an electric light wire below. Being wet, it wound around the wire, and electricity passed through it and shot down into the ground, where it came in contact with water pipes leading into the building. Along the pipes it scampered, and the first thing it met in the basement of the building was a pot of lard, which was boiling on the stove. It illuminated the lard and the young man in charge thought it must be burning. He started to remove the pot from the stove and received a shock that landed him against the basement walls. He rushed up stairs, where a fellow workman, noting his blanched appearance, reached for the faucet to get him a glass of water and was tossed into a far corner of the room. For a few moments everything seemed turned into an electric battery. The nails in the wall became red, elec- [illegible] around the iron [illegible]. At last the cause of the trouble [illegible] removed.

According to another paper electricity created quite [illegible] the other day. All the business portion of the city was suddenly thrown into [illegible] ... slightly shocked by stepping on the gratings at the [illegible]

junction of North St. Paul and Scrantom streets. As soon as he inserted the key he felt a peculiar sensation in his body which caused him to let go the key and step backward. He was unable to account for the queer feeling and supposing that his nerves must be a trifle out of order he approached the box again, grasped the lock firmly in one hand and with the other took hold of the box. The shock he received almost knocked him off his feet and with some difficulty he relinquished his hold and stood aside. By this time he realized that the electric current which was supplying the light at the top of the pole had in some manner leaked down and charged the box. He therefore procured a stick and pulled the letters and papers out into his leather sack. At this stage of the proceedings a stranger approached and was requested by Mr. Connaughy to close the box. The stranger made the attempt, but he, too, dropped the key like a hot potato and stood aside to wonder on the cause of the phenomenon. The letter carrier, not caring to manifest any surprise, wickedly said that all of the letter-boxes in the city had been charged with electricity to prevent robbery.

Grouping Batteries.

By Frank K. Irving.

In talking to the majority of amateur electricians on this subject, I find that there is generally much difficulty experienced in obtaining the best results, because of the lack of a simple formula to aid in the necessary calculations. There are exact methods whereby the result may be determined with a certainty in most all cases. Some of these I shall endeavor to explain.

In determining the best method of coupling up, three measurements must be considered, and these must be expressed in electrical units—volts and ohms—before they can be used in formulæ. These measurements are: 1st. The internal resistance of the element (r) expressed in ohms. 2d. The electromotive force of the element (E) expressed in volts. These two quantities, called the constants of the battery, are generally supplied by the maker. They always vary with the nature and dimensions of each element. 3d. The external resistance (R) expressed in ohms. This resistance comprises not only the resistance of the conductors, but also that of the instruments to be placed in circuit. In the simplest case, where a single cell is placed in circuit, the current (C), expressed in amperes, is:

$$C=\frac{E}{r+R}.$$

When we have several cells, they may be coupled up in various ways, as follows:

1st. All cells may be connected up in quantity, or parallel, that is, all zincs together and all carbons together. In this way we get the electromotive force of one cell. But the internal resistance is always proportional to the number of cells, always growing less as each cell is added in multiple or parallel.

2d. All the cells may be connected up in series; that is, zinc to carbon. In this case, both the electromotive force and the internal resistance are multiplied by the number of elements in series. Between these two extremes we have the following combinations, governed, of course, by the number of cells used. Let us say we have 40 cells. These enable us to make first, 40 in force, 1 in quantity; second 20 in force, 2 in quantity; third, 10 in force, 4 in quantity; fourth, 5 in force, 8 in quantity; fifth, 1 in force and 40 in quantity, and so on, as the case may require, according to the external resistance to be overcome. The following are the formulæ by which it is possible to determine the arrangement which gives the maximum external work and the value of the corresponding currrent:

Let F represent the number of elements in force.

Let K represent the number of elements in quantity.

Let I represent the total number in elements.

Then $I=FK$.

The current in an external circuit of a resistance R, if E is the electromotive force of one element, and r its internal resistance, will be:

$$C=\frac{FE}{\frac{I}{K^2}r+R} \qquad \text{(A)}$$

By varying I and K in such a way that the product IK remains constant, there is a maximum for external work, when:

$$\frac{I}{K^2}=\frac{R}{r} \qquad \text{(B)}$$

The external work is a maximum when the number of elements in force (F) is to the number of elements in quantity (K) as the external resistance (R) is to the resistance of one element (r).

Example: What is the best arrangement for a battery of [illegible] (E=1.07; [illegible] 6 ohms) to work a bell, whose resistance is 10 ohms, on a line of 4 ohms.

According to the given formulæ, $R=10+4=14$ ohms. The formula (B) gives

$$\frac{I}{K^2}=\frac{14}{6}=2.33$$

In practice it is necessary to take for F and K the numbers approaching nearest this ratio. In this particular case it is by taking $F=4$, $K=2$ that this equation is best satisfied. Under these conditions, the current calculated by the formula (A) will be

$$C=\frac{4\times1.07}{\frac{4}{2}\times6+14}=\frac{4\times1.07}{12+14}=0.16 \text{ ampere}$$

By coupling up 8 cells in force, $(F)=8$, $(K)=1$, the formula (A) gives

$$C=\frac{8\times1.07}{8\times6+14}=0.14 \text{ ampere nearly.}$$

By coupling up 8 cells in quantity, $(F)=1$, $(K)=8$, the formula (A) gives

$$C=\frac{1.07}{\frac{6}{8}+14}=0.07 \text{ ampere.}$$

When the constants of the batteries, the number of elements and the resistance of the external circuit are known, formulæ (A) and (B) enable us to determine the ratio between F and K, which gives C at a maximum, and also to calculate exactly the value of the current corresponding to each particular coupling up of the cells.

A Motor Operating Automatically at any Desired Speed or Torque and with Maximum Efficiency under All Conditions.

By H. Ward Leonard.

In the operation of electric motors there are three principal factors to be considered—the speed, the torque and the efficiency. Under any variations in power the efficiency should remain as nearly constant as possible. For one class of work it is desirable to keep the speed constant when the torque varies. For a second class of work it is desirable to keep the torque constant at one particular amount when the speed varies. For a third class it is desirable to operate at many different speeds, and yet automatically at any particular speed desired, regardless of the torque. For a fourth class it is desirable to operate at many different torques, and yet automatically at any desired torque regardless of the speed; and for a fifth kind it is desirable to keep the amount of power supplied constant, regardless of a change in torque, that is, so that if the torque changes by the requirements of practice, the speed would automatically change so that the power consumed would remain constant.

The shunt-wound motor, operating on a constant potential circuit, is well adapted to the first class of work mentioned, where but one fixed speed is desired, practically regardless of the torque, and with a practical constant efficiency.

The second class of work mentioned, having one particular constant torque and a speed variable at will, cannot be performed by existing electric motors without great sacrifice of efficiency. In this class of work we find hoists lifting constant weight, certain printing presses, swing bridges, stamp mills, pumps, etc.; that is, such work as requires that we should start up from dead rest with full torque and run at any desired speed with the same torque and with perfect efficiency.

The third and fourth classes of work are more common than would at first appear evident, but since neither the steam engine nor the water-wheel can be operated under conditions where both speed and torque will vary, and where the speed or torque can be held automatically fixed at any point desired, regardless of variation of the other, we do not find work of this kind existing in such shape as to be operated by an electric motor instead of some other power. Nor has the electric motor been availabe for such duty heretofore. A familiar instance of the third kind of work is met with in the printing of fabrics, where the presses have a large number of rolls upon which the torque depends, and the speed of the presses must be varied as desired, and yet at any given speed must hold that speed constantly, regardless of the number of the rolls set down, that is, regardless of the torque. Similarly, lathes, drill presses, wood-working machinery, etc., belong to this class. Certain variations in the speed are possible by existing methods by the use of cone pulleys and equivalent devices, but no motor of any kind has heretofore existed which, directly applied, would conform to the requirements of this kind of work.

The fourth kind of work has, as a familiar example, the passenger elevator, where the weight, and consequently, the torque is variable, and where at any torque the speed should be controllable at will, with constant efficiency. Another example is the pumping of water against a variable pressure with the speed controllable at will, and independent of the pressure. This result is not obtained directly by any motor to-day.

The fifth class of work, where the speed is automatically varied to keep the power consumed constant, no matter how the torque varies, is not met with in practice as far as I know, yet oftentimes we may have a constant source of power from which we wish to get a torque variable to the requirements of a variable load and do not care particularly

about the speed. An electric street railway operated by water power is a familiar example of this class of work.

It will be seen from the above that of the five principal classes of work there is only one, namely, constant speed and variable torque, which we can take care of with reasonable efficiency and from our existing supply circuits.

It is well known that when a street car is first started and is scarcely in motion the actual power represented by such motion is almost nothing, for, although the pounds pull is large, the feet per minute is extremely small; consequently the power required must be extremely small. What do we find in practice? We find that in order to develop a power of but a fraction of a horse power we must on account of the slow speed demanded, develop about 30 horse power, and then waste about 98 per cent. of this horse power in order to utilize the remaining 2 per cent. in the way it is desired. The efficiency of the modern electric street car is not probably more than 2 per cent. when just starting from dead rest and moving at the rate of one-half foot per second.

When we come to investigate this, we find that the explanation is that in order to get the necessary large torque with freedom from excessive sparking we must have a very large current in a nearly constant field; and since our electromotive force is constant we must use an amount of power which will vary directly with the torque, and will be regardless of the speed. Or, in other words, the efficiency of the motor will vary directly as the speed with an efficiency of perhaps 80 per cent. at full speed.

As a result of my investigation of this subject I have concluded that the operation of electric motors should conform to what apparently is a new law, which may be stated as follows:

Vary the voltage as the speed desired.

Vary the amperes as the torque required.

In other words, make the speed dependent upon the voltage only and independent of the current, and make the torque dependent upon the current only, and independent of the voltage. Since the product of the speed and torque represents the work being done, and the product of the volts and amperes represents the power supplied, it is evident that if we can operate in conformity to this law, we shall have a constant efficiency under all conditions, disregarding, of course, the small fixed losses in the field and armature.

One way in which this law can be followed is to supply the field of the motor from one source of electric energy and supply the armature from another source, the electromotive force of which can be varied. It will be noticed that when the speed is fixed a fixed voltage will be necessary in order to conform to the law, and the shunt motor is found to conform perfectly to the law; but it is the only motor I know of which does conform to the law which seems to be generally applicable.

A simple case will be the operation of a printing press for printing fabrics. Suppose the press has 10 rolls, that is, the torque will vary from 1 to 10 in amount. Suppose also that it must be run at any speed from that represented by 1 to that represented by 20, and at any speed it must hold its speed constantly, whether 1 or 10, or any intermediate number of rolls be brought into use. Also that the efficiency must be independent of the speed or torque. In order to conform to the law in a simple way, we will install a generator and motor of the same size and connect their armatures by two conductors. We will supply their fields from a small separate exciter in the shape of a shunt-wound dynamo. In the circuit leading to the field of the generator we will place a rheostat. If now we drive our generator at a constant speed, the electromotive force it will produce will depend upon its field, which in turn will depend upon the amount of resistance in the rheostat in its field circuits. The strength of the motor field is constant, being supplied by the constant electromotive force exciter. Now, evidently the speed of the motor will depend solely upon the electromotive force supplied to its brushes, and this can be varied from 0 to the maximum limit by varying the rheostat, which will preferably be placed beside the motor itself. The current will automatically vary in proportion to the torque; the speed will vary directly, as the voltage and the efficiency will be constant and independent of the speed or torque.

If we wish to operate an elevator from central station conductors of constant electromotive force we supply a shunt-wound motor mechanically connected directly with a generator, whose armature is connected to the armature of the elevator motor. The field of the generator is supplied from the central station conductors, but a loop goes up to the elevator car, where a rheostat and reversing switch is placed so that electromotive force of the generator can be varied and reversed at will. The field of the elevator motor is excited from the line constantly.

It will be evident that we can control the elevator perfectly from the car and run in either direction, at any desired speed, and with perfect efficiency. It is worthy of notice that the non-sparking point is entirely independent of the speed, and that for any particular weight the non-sparking point is absolutely fixed and independent of the power used. Also that, since the maximum weight alone determines the maximum amperes, it will be impossible to send more than the normal full load in amperes through the armature; consequently the liability of burning out of armature is reduced to a minimum. The elevator in coming down generates current to assist the central station, and since the efficiency is practically constant under all conditions, and since as many foot pounds of work are done by the elevator in descending as it requires in ascending, the consumer will in reality pay only for the energy wasted in changing the fields, in heating the armatures; and that represented by the friction of the gearing, will be the least possible. The starting up of the elevator requires a minimum of power, and hence does not subject the central station to large, sudden fluctuations of load.

Suppose we want to operate a swing bridge by an electric motor. We connect as in the case of a printing press, but instead of a hand field rheostat we use an automatic field rheostat, such as is used by the Edison company. We place an ampere meter in the armaturecircuit of our motor, and when the ampere meter needle indicates full load, it touches a contact leading to the relay magnets of the automatic rheostat, which causes it to throw in resistance in the field circuit of the generator and reduces its electromotive force. Similarly, just below full load, the amperemeter needle makes contact, closing a circuit in the automatic rheostat so as to throw out resistance and raise the electromotive force of the generator.

To start up the bridge we insert all of our resistance in the field of the generator, and have, let us say, no volts. Now we close the main line switch to the motor; we will have no current; hence the amperemeter needle will be on the lower contact, which will gradually throw out resistance and cause the generator to generate an electromotive force. The current will increase and will finally cause the needle to leave the lower contact. The full torque is now being developed, and the bridge, if the motor be of proper size, will start to move. As it does so, the counter electromotive force of the motor will tend to reduce the current, but this will cause the needle to again make the lower contact and raise the electromotive force and speed and hold the current and torque constant.

Thus, the bridge will start from rest with a minimum of power but full torque, and will gradually accelerate in speed until the full electromotive force and speed of the motor is reached. To vary the speed by hand, we merely move the ampere meter needle to make either contact desired. In case the bridge should meet an obstruction which would slow it down, the amperes would not increase, but would remain constant, as the volts would be immediately and automatically reduced to just that amount necessary to keep the amperes constant. With this arrangement it will be practically impossible to overload the motor armature.

Another good application of this method of keeping the torque constant will be in any case where a tool is cutting certain material which may vary in hardness, or when the feed may vary. If the torque be kept constant it will be impossible to break the cutting tool, or injure the apparatus. An electric coal-cutter is a case in point. The cutter may be advancing through slate, fire clay or coal, and occasionally it will meet a layer of hard iron pyrites, known in the mines as "sulphur." This may stop the cutter-bar entirely, and with an ordinary or series or shunt motor the result would probably be a burnt-out armature. With the system I have described, the current would be constant in any event, and the cutter would automatically go faster in soft material and slower in hard material.

In pumping by an electric motor operated on this system, the head alone determines the torque, and hence the current. Consequently, for any lift the non-sparking point will be fixed and the number of strokes per minute can be controlled at will from 0 up to the maximum by varying the volts

For operating an electric railway we will place a shunt-wound motor on the car, and directly driven by this motor will be a special generator, which will be connected to the electric motor below the car. It is evident that the generator and working motor armatures may be wound for any voltage desired, say 20 volts, which will make the problem of insulating the street-car motor an extremely simple one. If desirable, we can supply several cars of a common train from one special generator on the forward car. With this outfit, we will be able to take any car up any practicable grade or around any curve with no more power than is required to move the car on a level, and always consume the same power, regardless of weight, grades or curves. That is, the automatic increase of current, to take care of any increased torque, will be compensated for by a corresponding decrease in the volts and speed. We may start a car up on any grade or curve with but a small fraction of the power required for normal speed on a level.

I wish to call attention to a very important development leading out from this, namely, that we will be able to use alternating currents for operating our street cars, for it is well known that the ordinary alternating current generators will operate perfectly as motors, if the speed and torque be kept constant. Since by this system we can, from a constant torque and speed, get any other torque, and, automatically, a corresponding speed, we shall be able to run street cars perfectly by alternating currents. This again will enable us to dispense with trolleys, conduits, storage batteries, etc. We will place between our tracks, in manholes, converters whose primary pressure can be anything required for proper economy, and whose secondary will be, say 15 volts. This secondary circuit will connect directly with the rails. The road will be divided in sections, each a few hundred feet long, and each section will be supplied by its own converter.

This system also lends itself very readily to the transmission of power. We may transmit by alternating currents, and the alternating current motor running at a constant speed and at a nearly constant torque will drive special generators to operate hoists, pumps, locomotives, etc., at the varying torques and speeds demanded by practice, and yet without subjecting the alternating current motor to a sudden or wide fluctuation in its torque, and without any necessity of varying its speed. With this system of operating electric motors there seems to be no work met with in practice which cannot be perfectly performed.

On first consideration, the additional apparatus necessary would seem to make the system prohibitory in practice; but the capacity of the present single motor is greater than the combined capacity of the apparatus this system would require, and the capacity of the prime motor is very much reduced.

In order to reduce the first cost to a minimum and yet secure the advantages of different automatic speeds and high efficiency, I have devised two modifications of the arrangement described above. The first is adapted to power in which a smooth, efficient acceleration of a load from rest is required, as in the case of passenger locomotives and elevators. The second case is where various

[illegible] case in machinery in general.

[illegible] find that for full speed upon a level we require about [illegible] find that we get a speed upon the heavy grade which is about one-quarter of the speed upon a level. In order to [illegible] generator, the motor part of which is wound for 500 volts [illegible] wound for 125 volts and 50 amperes. The fields of the [illegible] 500 volts, as are the fields of the two propelling motors, under the car. All these fields are supplied from the 500 volt trolley circuit. In the field of the auxiliary generator is placed a rheostat.

Now, suppose the car at rest upon a grade. The motor generator is running [illegible] field. Its armature is connected by a controlling switch to the propelling motors. We now gradually cut out resistance from the generator field circuit and finally get about 20 volts at the brushes of the generator. With this electromotive force we get sufficient current to produce 50 amperes through the armatures of the propelling motors in a saturated field. This gives us the full torque and the car starts at a speed of perhaps half a foot a second. This speed can be maintained constantly and indefinitely and the consumption of energy will be less than two horse power. This is less than three amperes from the trolley line. In practice, however, the speed will be rapidly but gradually accelerated until we have 125 volts upon the terminals of the propelling motors. We will now be running at one-quarter speed and will be consuming 125 volts and 50 amperes, that is, 6¼ kilowatts instead of 25 kilowatts, to get the same result with existing motors. To put it another way, we will not be using as much energy as is represented by the 500 volts and 15 amperes necessary for a full speed on a level.

The next step on the controlling switch will disconnect the armatures of the propelling motors from the auxiliary generator and put the two armatures in series across the trolley line direct. We will now go at a speed represented by 250 volts, that is, one half full speed. The next step of our switch will place the two armatures in multiple across the 500 volts, and the next and last step will place the 120 volt auxiliary generator in series with the main central station generators and give us 625 volts on our armatures and a correspondingly increased speed. We will be able to go up a grade of six to eight per cent. at full speed, with 50 amperes and 500 volts, which, with the present motors, gives us only about one-quarter of that speed

Under this arrangement it will be noticed that the only apparatus which could be called additional is the small motor of 500 volts for the generator part of our motor-generator, which is useful not only for starting but for full speed also. In stopping the car we have an electric brake action delivering back energy to the line at full efficiency and not through a rheostat, as at present.

If we have a train of, say, three cars, so that we have six motors, we can start from rest with sufficient smoothness by placing all six armatures in series, which will give us something less than one-sixth speed as the first step. Then we can place three in series with two multiples, which gives us one-third speed. Next, two in series with three multiples, which gives us one-half speed, and finally all in multiple, which gives us full speed. Under such conditions we can dispense with the small converting plant altogether.

For an elevator requiring, say, 15 horse power we will put in a motor-generator of 3 horse power, with which we will control the starting and stopping and the operation up to one-fifth of full speed. Then for full speed we will connect direct to the line and operate without any conversion of energy.

For power in which smoothness of motion in starting and stopping is not essential I have devised a new system of distribution as follows: Three dynamos, all having the same current capacity and having voltages of 62½, 125 and 250 respectively, are placed in series and from conductors led off in multiple, one from each terminal of the machines. These conductors will have potentials which can be represented by 0, 62½, 187½ and 437½. Let us now take a shunt wound motor, and disconnecting the field from the armature circuit excite the field from the outside two of the four conductors, that is, by an electromotive force of 437½ volts. By connecting the armature terminals to the four conductors in various ways we shall be able to operate in either direction at six different automatic speeds represented by the following voltages: 62½, 125, 187½, 250, 375, 437½. By varying the field strength of the motor we can, if required, get any intermediate speed.

In many cases two dynamos will answer, one of, say, 110 volts already in use for incandescent lighting, and a second of, say, 30 volts. With this arrangement we could run in either direction and with automatic speeds represented by 30, 110 and 140.

With the four-wire six voltage system of distribution in a shop we can take out all countershafting, belting, pulleys and gears, if desired, and place a motor upon every tool, which we can operate in either direction at any automatic speed desired. Lathes, planers, [illegible] can be perfectly operated, and by getting rid of all countershafts and belts we can introduce the greatest of modern tools, the traveling crane, which we will also operate from our general system. We can also readily operate ventilating fans, hoists, elevators and factory tramways from the system.

The addition of one dynamo and one new conductor to

[illegible] three wire system will probably give all the [illegible] required to meet practical conditions of varying speeds. For the alternating system a synchronous motor driving our three continuous-current generators will give us the four-wire system in any distant factory or town. For 500-volt street railway circuits a small motor generator plant for the slow speeds and a direct connection for full speeds will give us perfect results. For storage battery work we have the most perfect condition, as we can get any electromotive force desired, with a corresponding speed while keeping the field separately excited.

Now, that we have the rotary field at command, I think I may safely assert that the time is not far distant when we shall have transformers which will, without motion, convert an alternating current in the primary into a continuous in the secondary; and this seems to me to be the ideal system of the future, that is, one in which energy will be transmitted by alternating currents of constant electromotive force transformed without motion into continuous currents for use at the translating devices and used where motors are concerned, in conformity with the law of efficiency for motors. Vary the voltage as the speed desired; vary the amperes as the torque required.

CORRESPONDENCE.

New York Notes.

NEW YORK, November 21.—It is every man's privilege to make the best of a bad bargain, and that is one reason for giving the usual paragraph on the New York correspondent's last resort, namely, that well-worn subject, "rapid transit." The fact that some day the tunnel will be [illegible] and the trains in it will be run by electricity is my apology for informing the readers of the WESTERN ELECTRICIAN that the park commissioners, on November 20th, approved the plans of the rapid transit commission. It is stated that the work of securing the necessary consents of the property owners along the proposed route is being carried on most successfully. Already a large number of favorable replies have been received, and it is said that up to Friday morning not a single dissenting reply had come in. While speaking of rapid transit in New York mention must be made of the fact that Mayor Grant has been making a personal inspection of the London tunnel. The mayor was taken over the line by Mr. Greathead. His honor thinks, though, that there is too much noise and too much friction in the management of trains, and too much expense involved to apply this system, as now developed, in New York. Mayor Grant admitted, however, that this system had decided merits.

A man named Paul Miller, of Newark, was killed by an electric car on the Springfield avenue line on Wednesday last.

There was a rumor rife this week that the young lady operators of the Metropolitan Telephone & Telegraph company were going to strike for higher wages and shorter hours. The rumor was denied, however, by the company, and also by a number of the alleged would-be strikers.

The commission appointed to consider the proposal to allow the Coney Island & Brooklyn Railroad company to extend its trolley system into the city limits and through Fifteenth street to Ninth avenue, has reported in favor of the trolley system. The commission is in favor of an overhead system through Fifteenth street, with poles at the curbstones, and also that the circles at Fifteenth street and Coney Island avenue, and at Fifteenth street and Ninth avenue should be spanned in some suitable manner, and that no poles should be placed in the roadway. Current is to be carried across the circle by an underground wire. Some of the property owners are up in arms already and have filed a notice of appeal from the report on the ground that two of the commissioners are interested [illegible]

On Thursday evening a number of the members of the [illegible] headquarters and passed [illegible] fire alarm telegraph [illegible] the [illegible] meeting [illegible]

[illegible]

nent to Buenos Ayres for $50,000, and would increase its capital stock by an equal amount. The Central and South American Cable company, it may be stated, has a line down the west coast of South America to Chili. At the office of this company it was not denied that such a purchase might be made, but it was said that negotiations had not been completed.

There was a man asphyxiated this week on Third avenue by illuminating gas. Such accidents as these are, of course, not unusual occurreuces, but the fact is mentioned merely to prove that it is electricity and not gas that is dangerous, and also that the Westerners who imagine New York is uncivilized may be brought to a realization that this is not the place where lamp cords are knotted or attempts made to blow out filaments inclosed in hermetically sealed glass globes.

The *New York Times* is a great paper, and its "Progress in Science" column contains many interesting and some surprising facts. Last Sunday this journal gravely informed us that "electric motors have been so greatly improved of late that they will now pull nearly 30,000 pounds."

That much maligned company known to the world as the Western Union seems always to be having trouble of some sort with somebody. But no sooner does it get through with the Frosts and their incandescent lamp-in-the-hat scheme, by which several days' news was secured and sold at a handsome profit, than two inconsiderate wretches tap its local pool room wires and again the detectives are put at work. This time it was two enterprising gentlemen, Harry Summerfield and Edward Fitzgerald, who did the work. These worthies, it seems, tapped one of the wires leading into J. A. Steinmetz's turf commission rooms at No. 48 Cedar street. The detectives found that the wires had been tapped on the roof of a building at the southeast corner of Nassau and Cedar streets, and the circuit turned into No. 36 Pine street, where it ran down the chimney into a small office room on the third floor of the building, Steinmetz claims to have lost at least $3,500 during the time the scheme has been in operation.

One reason why the great Astor library in New York has never been open evenings can be obviated by the introduction of the electric light. Several years ago the question of opening the library at night was discussed by the trustees. At that time gas was used almost exclusively, and it was urged that the fumes from gas jets would spoil the bindings of the books. The conditions have now changed, however, and there is nothing to be apprehended from the use of electric lights. It is likely that the modern light will soon be introduced. F. L. P.

San Francisco, Cal.

SAN FRANCISCO, Cal., November 16.—Appearances indicate that before very long the Electric Improvement company and the San Francisco fire department will be entertaining each other and the public generally, in a wire cutting bee. Readers of the WESTERN ELECTRICIAN may remember that about eight months ago mention was made of the futile effort of George L. Henzel to secure an electric light franchise, and of his determination to follow the example of the Electric Improvement company and string his wires on housetops without a franchise. This he commenced to do, and in fact finished his first circuit when Chief Scannell of the fire department commenced to cut down the wires, citing as his authority for so doing an ordinance empowering him to remove all electric light or power wires run on the roofs of buildings in San Francisco. Henzel at once secured an injunction against Scannell, and three or four months ago the matter came up for hearing before Judge Hoge of the Superior Court. The case was taken under consideration, but Judge Hoge died before rendering a decision. It was then assigned on briefs to Judge Hebbard, who dismissed the injunction suit a few days ago, and affirmed the legality of the ordinance. Thereupon the city and county attorney instructed Chief Scannell that the decision empowered him to act. As a result Scannell has ordered the electric lighting companies to remove all housetop electric light and power wires within ten days, and that if no attention is paid to this order a force of firemen will immediately begin to cut down the wires, and will not stop until the work of removal is finished.

As intimated this order affects only the Electric Improvement company, as the Edison Light & Power company [illegible] Electric Light company) has a franchise and easement, and maintains its circuits on pole [illegible] given up the idea of starting a [illegible] when he [illegible] the plant one day on a [illegible] one night

but "there was no pressure, and the engine wouldn't take half enough gas," so in view of his fight with Scannell and of his disgust for gas engines when operated in the residence portions of San Francisco during the evening, he resolved to quit. The Electrical Improvement company, however, was not discouraged by such an apparently little thing as being refused a franchise. The company went ahead, built the station, and carried out the contract with the state harbor commissioners for lighting the sea wall. Then the first thing the public and the fire department knew the company had its wires run on housetops into the retail portion of the city, where it is now supplying about 4,000 incandescent lights of the Slattery induction system, and nearly 400 American (Wood) arc lights, all from housetop circuits. These are the circuits which the fire department threaten to annihilate, and if war is waged on the Electric Improvement company, public opinion will certainly be pitted against the aggressors. The company has applied for a franchise on two or three occasions, but it has each time been rejected, and now the public hardly blames it for the course pursued, even if it is illegal. The Improvement company has not as yet contested the ordinance in the courts, but it is now probable that it will do so, and will carry the matter to higher tribunals than Henzel did. Meanwhile, the Palace Hotel people and those of the public who are supplied by the Electric Improvement company with light, are evincing not a little interest in the controversy.

Charles S. Wieland, an enthusiastic member of the Pacific Yacht club, and who, by the way, is one of San Francisco's young millionaires, is the happy possessor of the world-famed electric launch, Magnet, which now darts swiftly about the bay to the complete mystification of almost all who see her. On Saturday afternoon last a party of sixteen, including representatives of the local press and the correspondent of the WESTERN ELECTRICIAN assembled at Sansalito in response to the invitation of Mr. Wieland to attend the trial trip of the Magnet. From the very first sight of the craft, the idea impresses itself more and more firmly that the Magnet is the ideal pleasure yacht; nothing could be neater or cleaner. Along the center are two long richly upholstered plush seats, placed back to back, and each having a seating capacity of ten persons, or twenty in all. The floors are finely carpeted, and overhead is a colored canvas awning supported by a few carved oak stanchions. Save the little 14-inch nickel plated pilot wheel and two small electric switches near by, no machinery of any sort is visible and the uninitiated, at first sight of the launch would surely wonder that any one should build such a boat, apparently without any sort of motive power and only nice to sit in.

At the appointed hour Electrician R. B. Elder, under whose supervision the electrical equipment was placed, touched a button, and the peculiar tooting of the electric fog horn announced the time of starting. That electric fog horn has an individuality all its own, and to hear it is to laugh—it is so out of the ordinary, yet so effective. A simple turn of a switch and the boat glided away from her mooring place almost without a jar, tremor or sound, and for an hour or so she ran along from Sansalito over to Tiburon and Angel Island at the comfortable speed of eight miles an hour. Then the second switch was thrown over and the little boat jumped ahead at the rate of twelve miles an hour, a speed considerably greater than is attained by any launch of equal size on the bay. The novel experience of the ride was most enjoyable, and the sensation of rushing along almost silently through the water in an elegantly fitted boat, free from the noise of working machinery or the heat, smoke and dirt attendant on steam or gasoline launches, again added to the conviction that the electric launch is the ideal pleasure boat. The return trip was purposely made after dark in order that the lighting effects of the launch might be more fully appreciated. Six 16-candle power incandescent lamps light the Magnet within, while at the bow is placed a 100-candle power search light, and the customary red and green lights are placed on the starboard and port sides respectively. From the shore at night the Magnet appears almost as a blaze of light, as it scoots along with its lights reflecting on the water. The lamps burn perfectly steady, and the search light is remarkably powerful.

The Magnet was designed by Frederick Reckenzaun and her hull, which is carvel built, was made by Messrs. G. H. & G. S. Seybolt of Newark, N. J. The length over all is twenty eight feet, six foot beam, and her depth amidships is three feet. The draught at stern is thirty inches. Fifty-six storage battery cells of the Accumulator company's "23 M" type are placed in a pitch lined box upon which the seats are placed, and these cells furnish the current operating a Reckenzaun series wound motor. The motor has gun metal bearings, and is connected directly to an 18-inch two bladed screw, which turns at 540 revolu

tions when the boat travels eight miles per hour, and at about 900 revolutions when making twelve miles per hour. At the slower speed the cells are coupled into a multiple series of twenty-eight cells each, delivering to the motor 28 amperes at 56 volts. When running at twelve miles per hour all the cells are thrown in series, and the motor takes about 70 amperes. The electrical horse power in the first instance, therefore, approximates 2½ horse power, while in the second it is about 10 horse power. To discharge the battery at 70 amperes continuousiy would depreciate it materially, so it is worked at that rate only in "spurting." The motor weighs 420 pounds, and the cells weigh about 2,400 pounds, making the total weight of the propelling power less than 3,000 pounds, which is about equal to that of a steam engine. In the Magnet, however, this weight serves as ballast. The Magnet runs eight miles an hour for ten hours on a single charge, or if run at the rate of twelve miles an hour the duration of the charge will be decreased about one-quarter, and the distance about one-half. Mr. Wieland has erected a neat charging station on the grounds of the Pacific Yacht club at Sansalito, which also furnishes light to the club house. The plant consists of one 30 horse power marine boiler, one 18 horse power automatic vertical Payne engine, and two 3 kilowatt Edison 125 volt dynamos. Both the station and the electric launch were installed by the Pacific Electrical Storage company, San Francisco, the coast agent of the Accumulator company. Among those present on the trial trip were James Armstrong, R. B. Elder, J. H. Harbour, John Richards, George P. Low, Professor A. Harding, W. W. Stater, A. J. Caire, Captain Kelly, B. F. Hughes, Thomas Hittrick and H. D. Peet.

There is at least one newspaper that appreciates electric railroads. The San Francisco *Daily Report* in a recent editorial stated as follows:

Electric street and suburban railroads are being rapidly built all over the United States. Wherever they exist they are strongly popular, and the people who have them in use would no more think of exchanging them for cable roads than San Franciscans whould exchange their cables for horses. Naturally, as San Francisco was the first to introduce the cable and has a very handsome system of cable roads, in which a large amount of capital is invested, the introduction of the electric road proceeds here with difficulty. The difficulty is increased by the strong provincialism of this city, born of isolation from other great cities, and general ignorance of their progress. But it will not be long before the superior utility of electric roads will be recognized even here, and then their construction will be very rapid.

A contract was let a few days ago by the Consolidated Electric Street Railway company, which operates the Berkeley road, for filling in the marsh on Seventeenth street, between Peralta and Sixteenth street station. It is expected to have the branch completed in three months. The Mountain View Cemetery branch will be running within thirty days, and the East Oakland cross town branch will soon be commenced.

The Postal Telegraph company has been constructing a line between Los Angeles and San Diego, but owing to trouble with the Western Union Telegraph company work has been suspended. The Western Union Telegraph company claims exclusive right to run wires on the railroad's right of way, which it says is 200 feet wide. The Postal Telegraph company has planted poles and run its wires on the 100-foot supposition, and the matter will probably go to the courts.

Contracts have been signed for the erection of a new first-class family hotel to be call the "Edison." It is to be five stories high, situated on north side of Sutter street between Taylor and Mason streets, San Francisco. The building will have over 100 rooms, to cost about $50,000. It will be lighted throughout by electricity, and the elevator will be run by an electric motor.

The San Francisco and San Mateo Railway company has been having trouble with property owners on Guerrero street. The road was not built on the official grade, and an objection was made. The company re-laid the track on another grade, supposing it to be the right one; but complaint has been made again, and the track is being changed to still another grade. All this is very expensive and unpleasant for the company, but the property owners are satisfied.

At one time there was but one lady acting as station agent and telegraph operator on the Southern Pacific—Miss Mattie Lake at Banning, Cal. The road decided to uniform all its operators, the contract for making the clothing was let, and to hurry matters the following telegram was sent to all operators on the road: "Be on platform when No. 19 passes, with nothing but your pants and shirt on." This was in order to measure the men quickly. When No. 19 pulled into Banning the clothier was accosted by Miss Lake's brother who wanted to know if he sent that telegram. Receiving an affirmative answer he proceeded to punish the clothier, and it took half an hour to explain matters to Mr. Lake. Every one laughed so over the story that the company gave up its uniform plan.

Dr. Addison of the Thomson-Houston company has closed the contract for motors, wires and all electrical work on the Haywards electric road. The ties and poles are purchased and a contract has been awarded for the construction of the power house. Engines, boilers, brackets and other machinery are to be placed by the Risdon Iron Works.

On October 12th the Hawaiian Electric company, limited, of Honolulu was organized as an incorporated joint stock company.

On October 3d the Main Electric Light & Power company limited was also organized as an incorporated joint stock company. This company will light Kahulai by electricity.

Dr. Addison of the Thomson-Houston company has secured the contract from A. B. Spreckles for the equipment of the Fifth and H street lines of the San Diego street car system, which are now operated by horses. For the original equipment two 80 kilowatt dynamos will be placed in the generating station and nine single truck cars will be used. These will be of the combination type, seating eight passengers on the open end. The line was formerly one of the companies controlled by the Coronado Beach company, but was recently purchased by A. B. Spreckles, son of Claus Spreckles, the sugar magnate.

The board of supervisors has refused to exempt the North Beach & Mission Railway company from the provisions of order 2369, prohibiting the construction of overhead electric wires within prescribed limits in San Francisco. The company now operates an extensive horse car system, and desires to change the equipment to an electric road. S.

Denver, Colo.

DENVER, Colo., November 21.—The city council of Galveston, Tex., has granted a franchise to the South Galveston & Gulf Shore Electrical Railway company. The proposed new line will pass through a part of the city hitherto without railway facilities. It will extend down the beach to South Galveston, about thirteen miles west of the city.

Aspen will probably have an electric street railway line next year. J. R. Pemberton of Detroit, Mich., desires to build a road, and the citizens favor the project. It is expected that work will be begun next spring.

"If the rumors that are circulating around are true," says the Colorado *Sun* in its issue of November 15th, "Denver may soon enjoy the luxury of having all its lighting companies owned and controlled by one rich and powerful corporation."

Negotiations are reported to be progress between the Denver Consolidated Gas company, the Denver Gas company and the Denver Consolidated Electric company, which, if completed, and a franchise secured from the city, will result in a gigantic local monopoly. According to the *Sun's* story the negotiations have been in progress some time, and the project would not now be made public had it not been necessary to organize a new company and apply to the city council for a franchise. The hurried manner in which the franchise was put through the council led to inquiries which tend to show the existence of such a deal, which will be consummated should the Denver Consolidated Gas company secure the passage of the franchise over the mayor's veto. Negotiations were started last fall in New York, when the Denver Consolidated Gas company was then organized, but the fact of the organization was not made public until the evening of the application for the franchise, when incorporation papers were filed in the secretary of state's office. The ordinance for the franchise passed through the board of supervisors and also through the board of aldermen at a special meeting held two days after it was introduced in that body. The ordinance was vetoed by the mayor, who, it appears, discovered an important omission in the ordinance, namely, the clause to prevent the consolidation of the company with any other company engaged in the lighting business. By some means the company secured the passage of the franchise through the board of supervisors over the mayor's veto, and will endeavor to have the board of aldermen pass it over his veto.

In the articles of incorporation of the Denver Consolidated Gas company the following are named as directors: Isaac Siegleman and George Coppell of New York, and E. O. Wolcott, J. F. Vaile, J. B. Grant, William J. Fay, F. P. McManns, J. A. Thatcher and Dennis Sullivan of Denver. The capital stock is placed at $1,500,000. Mr. Sullivan of the old gas company and E. W. Rollins, president of the Consolidated Electric company, have both

[illegible] according to the *Sun*, which published the article pur-

Minneapolis, Minn.

[illegible] ing [illegible] the St. Paul Heat, Light & Power company's ordinance. The vote against it was almost unanimous, only two of the alderman voting for the ordinance. A motion to reconsider [illegible] lost. The sentiment of the board was evidently in favor of putting all the wires under ground, but in a general conduit, under the [illegible] the city attorney and city engineer.

Prof. Geo. D. Shepardson, professor of electrical engineering at the University of Minnesota, gave a lecture on "Electricity and Engineering" before the Minneapolis Association of Stationary Engineers, Friday evening, November 20th. Prof. Shepardson is comparatively a new man in Minneapolis, having only recently received his appointment. He has had a large [illegible] son-Houston shops at Lynn, Mass., and with the Boston West End Railway company. He is a graduate of Cornell University. This is the first of a series of lectures given by the National Association of Street Engineers to all the engineers and electricians of Minneapolis.

The courts at Stillwater have enjoined the electric street railway company from doing certain paving between its tracks on the ground that the work is not done substantially. The street car company will be obliged to proceed with the work, doing it in a substantial manner, or the city will do it and the cost will be charged up to the company.

The first snowstorm of the season did not interfere in the least with the operations of the Twin City electric railway lines. The company has a full equipment of snow plows in readiness and believes that no matter how severe the winter may be it can take care of all travel without interruption.

Toledo, O.

TOLEDO, November 21.—The Consolidated Street Railway company has gained a decided victory in the dissolution of the two injunctions restraining it from putting up trolley wires over their tracks where the Toledo Electric Street Railway company already has wires, on Monroe and Summit streets.

The Robisons (the latter company) have fought for every inch of ground, and the use of the tracks where the Consolidated has horse cars already in operation, and won in nearly every instance. Now they are trying to compel the Consolidated to use their wires, and pay them for the same. The Consolidated company claims it would be sheer foolishness, when it ha all the power it wants of its own. The ordinance refusing two sets of wires over one track has been amended, and the injunction dissolved so that the Consolidated company has commenced putting up a wire of its own, and although it is claimed by some to be a dangerous experiment, it is working very well so far. Although this city is up to the times in electricity and rapid transit, it still has some of those detestable "bob-tail" cars, which the company claims do not pay revenue enough to pay for a conductor. An ordinance was put through the council a few days since, compelling street car companies to put conductors on all cars after July 1st. A. E. Lang, general manager of the Consolidated company, is reported as becoming so disgusted at seeing the bill go through with such a rush that said they had better pass an ordinance to have the company put a brass band on every car to dispense music to its patrons.

The Toledo Electric Street Railway company has received a dozen new motors, which will be used in putting double motors on each car, thus obviating the slipping of wheels on smooth track. The new cars ordered are expected every day. F. C. H.

A dispatch from [illegible] F. W. Matheisen has been [illegible] Electric Smelting & Aluminum [illegible] Mr. Matheisen is the [illegible] try, his home being at [illegible] Cowles company [illegible] the Pittsburg Reduction [illegible] constructed. It is designed [illegible] pure aluminum per day [illegible] quire it is said [illegible] Mr. Mathesen has made [illegible] in zinc and proposes to double it in aluminum. The other officers elected were [illegible] president, Horace W. [illegible] T. Osborne of Cleveland, treasurer.

PERSONAL.

W. D. Packard, president of the New York & Ohio company, Warren, O., was in Chicago, Monday.

C. A. Haigh of the Electrical Engineering & Supply company, left for the East on Wednesday evening last, to be absent two weeks.

H. G. Issertel, traveling salesman for Alexander, Barney & Chapin of New York, was in Chicago last week. Mr. Issertel will make an extended trip through the West and South.

C. A. Benton, manager of the railway department, Detroit Electric Works, passed through Chicago on Saturday last on his way home from a trip to St. Paul and Minneapolis.

A. D. Lundy of Sargent & Lundy, Chicago, left on Friday night of last week for Atlanta, Ga., where his firm has just completed the Grant Park electric road. Mr. Lundy will be absent ten days.

Prof. Elihu Thomson delivered a lecture on "The Convertability of Energy," before the Thomson Scientific Club of Lynn, on November 11th. This organization was named after Prof. Thomson, and he delivered the first lecture in its course.

James I. Gulick, who will be pleasantly remembered in connection with the Montreal convention, where he had charge of the exhibits, was in Chicago last Saturday. Mr. Gulick was on his way to St. Paul, where he will take charge of the Columbia Electric company.

Charles R. Barnes, city electrician, Alderman S. D. W. Cleveland, John U. Schroth, member of the executive board, and Pierre Purcell, of the *Union and Advertiser*, Rochester, N. Y., were in Chicago Monday and Tuesday investigating the underground conduit system for electric wires. They will visit Minneapolis, Washington, Pittsburg and other cities before making their report.

E. Rosewater of the *Omaha Bee* passed through Chicago last week with a party of Omaha business men en route for Washington, where they met the national Republican committee, to secure, if possible, the location of the coming national convention at Omaha. Mr. Rosewater started out in life as a telegraph operator, getting his ideas of the newspaper business from the handling of press dispatches. He started many years ago in a small way in Omaha, and after much opposition and hard work he has built up one of the most influential and best paying newspaper properties in the West. Mr. Rosewater has always been strongly in favor of a government telegraph. Before his return from the East he will read a paper before the Electric club of New York, giving the results of a recent trip abroad for the purpose of investigating the degree of success met with in the operation of the different governmental systems in Europe at the present time. Mr. Rosewater is of Bohemian descent, and speaks nearly all the continenal languages, giving him unusual facilities for gathering much information, and his address in New York will be undoubtedly of great interest.

NEW INCORPORATIONS.

Farmers' Protective Union, Bradley, Cal.; capital stock, $50,000; to construct and operate gas and electric works, etc.; W. M. R. Parker, Salinas, Cal.

Ypsilanti Electric company, Ypsilanti, Mich.; capital stock $25,000; to supply electric light and power in Ypsilanti: Tracy L. Downer, Ypsilanti, Mich.

Washburn Electric Light & Power company, Washburn, Wis.; capital stock, $20,000; electric light & power business; A. C. Prohert, Washburn, Wis.

Bronx Electric Light company, New York, N. Y., and Wetchester, N. Y.; capital stock, $15,000; to manufacture and use electricity, for light heat and power.

Ronceverte Electric company, Ronceverte, W. Va.; capital stock, $100,000; supplying light, heat and power [illegible] of Ronceverte, W. Va.; John W. Harris, [illegible]

[illegible] Storage Battery company, Sioux City, Ia., capital stock, $1,000,000; to manufacture, buy, sell, etc., storage batteries, dynamos and electrical appliances; Haines & [illegible] City, Ia.

[illegible] Electric Light & Power company, Point Pleasant, W. Va.; capital stock, $50,000; erecting an elec- [illegible] Point Pleasant, W. Va., Wm. N. Miller, Parkersburg, W. Va.

[illegible] company, Fairmont, [illegible] acquiring real estate and erecting buildings thereon; erecting and operating [illegible] T. Martin, Fairmont, W. Va.

[illegible] Incorporated [illegible] manufacturing, selling and [illegible] York, N. Y.

[illegible] maintenance therewith of an electric power plant; L. W. [illegible]

[illegible]

capital stock, $30,000; constructing, equipping, selling or leasing suitable buildings for business, manufacturing or residence purposes and with or without steam or electric power, or for buying or selling real estate or building material of any kind; C. W. Scarff, Burlington, Vt.

Southern Montana Telegraph & Electric company, Virginia City, Mont.; capital stock, $25,000; dealing in water power for the purpose of generating electricity for propelling machinery for furnishing light and heat, and to lease and deal in telegraph, telephone and motor lines in Montana from Virginia City to Dillon, to Norris, to National Park.

ELECTRIC LIGHT.

Iowa Falls, Ia., proposes to take to itself the benefits of electric lights.

The city council of Franklin, Va., has decided to erect an electric light plant

The city of Carrollton, Ga., has purchased for $6,400 the electric light plant of Henry Lanier.

Two dynamos—one arc and one incandescent—are to be added to the plant of the Alton, Ill., Gas & Electric company, increasing its capacity by 50 arc and 650 incandescent lamps.

At Wheeling, W. Va., the Edison Electric Light, Heat & Power company has petitioned the city council for authority to lay its wires underground. It proposes, if the privilege is granted, to construct a system to cost about $500,000.

The new electric light station at Ennis, Tex., is now running nicely. The Slattery alternating system is used, and the plant was installed under the supervision of Frank Moffett, late of Dallas, who has accepted the position of superintendent.

The electric light for traveling menageries is the latest novelty in England, and it is reported that the experiment has been highly successful. Portable plants are used. Here is a feature in which American showmen may well imitate their enterprising British brethren.

The Fitchburg, Mass., Gas & Electric company has added two fifty light arc dynamos and completed fifteen miles of new construction work, which was necessitated by a new contract for three years with the city for 56 additional lights, making a total of 156 lights, 1,200 nominal candle power, running from half an hour after sunset until one o'clock every night. The price received is $85 a year per lamp.

It is stated that a new deal has been made by the Dubuque Electric Street Railway, Light & Power company, known as the Allen & Swiney line. The floating indebtedness of the company was funded, and a mortgage of $50,000 given to cover other loss. President Allen will retire in a day or two. A new president will be elected. The eastern bondholders are represented by Foster & Curtis of Boston. The mortgage runs to Thos. Lane of Davenport, as trustee.

A novel utilization of the electric light was made by one of the leading New York athletic clubs. Some important foot ball matches were close at hand, and the time for getting the men into condition was short. It was therefore decided to have night practices, and a number of arc lights were placed around the practice grounds, every part of which was thus illuminated sufficiently for the playing of the game. The practice was continued nightly, and many of the players who play being occupied during the day with business were thus enabled to fit themselves for the contests.

As the result of recent interesting experiments, very handsome and inexpensive incandescent lamps are now produced in colors—red, green, amber and blue. The bulbs instead of being made of colored glass, which is costly, are made of common white glass and then dipped in colored varnish. This varnish has been proved to be as durable as the lamp itself and is perfectly transparent, which could not always be said of the regular colored glass, which is sometimes muddy. A very pretty rose-colored effect is secured by first frosting the glass by sand-blasting, and then dipping it in the red varnish. Another form in which it can be used is to dip the plain glass, paste paper letters on the bulb, and then frost it, the result being a white frosted bulb with colored lettering.

In a recent paper on lighting of railroad trains read before the Institute of Civil Engineers it was stated that on some lines in Germany candles and oil lamps are still in use, but during the last 12 years Pintsch's oil gas has been largely introduced on main line trains. Although this method of illumination is a distinct advance over the older illuminants, it is not quite satisfactory. The light is unsteady, especially in stormy weather; there is frequently an unpleasant smell due to leakage, and there is also a serious element of danger, as is shown by the terrible accident at Wannsee in 1880, at which several persons were burned to death by the escaping gas. In all these respects electric lighting is better, though it may be more costly. In the Khotinsky system of electric lighting each coach is provided with two distinct storage batteries, and the lamps are on two distinct circuits, so that in case of accident to one circuit, or during the changing of the batteries, no compartment shall be left entirely without light. The storage cells, which have been [illegible] constructed to stand rough handling and [illegible], have a capacity of 200 ampere hours [illegible] 7 amperes. Each battery supplies current to four 8 candle power lamps for the compartments and [illegible] candle power lamp for the [illegible]. The weight of [illegible]. The batteries are placed in boxes, one at each end of a coach under the floor, and special arrangements are made for rapidly replacing the exhausted batteries by others newly charged. The wiring is on the outside of the coach, and one lamp in each compartment is provided with a switch and the other with a resistance by which its light may be reduced to 2-candle power at the pleasure of the passengers. This light is in use on the line Fulda Frankfort, and is being fitted on one of the express trains running between Berlin and Frankfort.

ELECTRIC RAILWAYS.

It is stated that the Chattanooga Belt railroad is to be changed from a dummy line to an electric road.

A Boston syndicate has purchased the Rome, Ga., street railway and intends to introduce electric power.

The Chattanooga, Tenn., Water & Electric company will build an electric railway from North and Broad streets to Cameron Hill.

M. M. Bright & Co. contemplate building a three-mile street railway at Decherd, Tex., and will probably operate it by electricity.

C. W. Gallagher of Baltimore is organizing a company to build an electric railroad from Shelby, N. C., to the Cleveland Springs.

The Atlanta, Hapeville & Manchester Railroad company of Atlanta, Ga., has obtained permission to build an electric railroad from Atlanta to Manchester and Hapeville.

The Thomson Houston Electric company has secured a franchise to build an electric street railway in Hopkinsville, Ky. It is stated that a $75,000 plant is to be erected.

The Seven Pines Railway company of Richmond, Va., is considering the substitution of electricity for steam as a motive power on its narrow gauge railroad. The line is about seven miles long.

The Detroit Electrical Works have secured a contract for one 80,000 watt generator and five 30 horse power equipments for the Kokomo City Electric Railway company, Kokomo, Ind. These machines will be shipped by December 15th.

The Cumberland Manufacturing company of Westbrook, Me., is putting in a Thomson-Houston electric tramway service It will be for freighting, and will be fitted out with a six horse power electric locomotive, supplied with two three horse power motors.

D. C. McMartin of Des Moines, Ia.; Richard Snell of Kansas City, Mo, and William Metzgar of Illinois, have leased the street railroad at Austin, Tex., running to the dam. The lessees agree to equip the road with electricity within six mouths after notice of the city's readiness to furnish electric power.

The officers of the Rochester, N. Y., Railway company are endeavoring to establish a benefit association among the men employed on the lines. The employes have received the suggestion with favor, and the good feeling that has thus far existed between the new management and the employes of the company has been improved by this action.

The Oxford Lake line at Anniston, Ala., has been opened to the public. It is said to be the first electric railway in Alabama, except an experimental one at Montgomery. The road is nearly seven miles long, and the Thomson Houston system is used. The electric cars have superseded steam dummies, and a freight car to carry cotton is a part of the equipment.

The railway between the Hague, in Holland, and the neighboring watering place, Scheveningen, forms a portion of the general tramway system of each town. Its length is about two miles There are on this line six electric cars, on which accumulators are used. It is stated that the rapid speed and smooth running of these cars is making them exceedingly popular.

President Beckley of the Rochester, N. Y., Railway company is authority for the statement that the company will do away with all horse cars at an early date. Several lines of the company's system are not yet fully equipped with electric motors, but this work will begin early in the spring. President Beckley says: "We shall begin next spring to extend our electric system over every line, and as soon as the changes can be made we will run electric cars in place of horse cars. The work will occupy some time, but from the present outlook we think the public may depend on seeing nothing but electric cars operated on the streets of Rochester before the end of next summer."

Says the *Manufacturers' Record*: "Jarvis & Conklin of Kansas City, and their English associates, who, with one exception, own a greater mileage of electric railroad than any other company in this country, including about 40 miles at Salt Lake City, 20 or 30 miles in Ogden and 25 miles in Augusta, Ga., have just closed a deal by which they secure the controlling interest in the North Avenue Electric Railroad company of Baltimore. This company has built only a part of its line, but the entire work will now be vigorously pushed to completion, and in connection with it will also be built a double track electric road out to Lake Roland, about seven miles from the city."

News of two proposed street railway combinations comes from Pittsburg. One is a practical consolidation of the Widener Elkins cable line and C. L. Magee's Duquesne electric road. The two would have a combined stock of $[illegible],000,000, and $1,500,000 in bonds. It is calculated that the net receipts of the two would reach $320,000 a year, and the only matter to be adjusted is the division of profits. At present the cable people are carrying passengers for three cents and the electric people for five. The

roads are parallel for five miles, and both will charge five cents after the combination. The other consolidation to be effected is between the Pleasant Valley and the Pittsburg, Allegheny and Manchester, both electric lines, traversing Allegheny City and part of Pittsburg. The combined capital is $5,000,000, and it is calculated that the roads can be operated jointly at a net profit of over $300,000 above the interest on the bonded debt.

ELECTRIC MOTOR.

It is said that the largest electric motor ever constructed is that which is being used by the Lonsdale company at Lonsdale, R. I. The trucks have a 30 horse power motor and the locomotive is capable of hauling 60,000 pounds.

Chicago's new daily paper, the *Press*, which has an office at 77 Fifth avenue, will be printed on presses driven by electricity. A 20 horse power motor, furnished by the Detroit Motor company, will operate two Goss perfecting presses and the stereotyping machinery. Current will be furnished from the down town station of the Chicago Edison company.

An interesting instance of the effect of rapid transit on real estate valuations is shown by a deal just consummated in St. Cloud, Minn. An eastern syndicate, whichis represented by L. D. Petre of St. Paul, purchased land along the new electric line in the suburbs, paying $65,000 therefor, and is negotiating for more. This purchase is directly traceable to the construction of the electric line through the property.

The Westinghouse Electric & Manufacturing company has begun suit in the United States courts against the Pittsburg & Birmingham Traction company for the alleged infringement of its patent covering a device on electric motors rendering them both noiseless and durable. The invention was made and patented on December 9, 1890, by Albert Schmid, and was assigned by him to the Westinghouse company. It is alleged that the success of the motors made them so desirable that nearly all of the other companies engaged in the same business have taken the risk of infringing on the patent. The patent suit is brought with a view of making it a test case.

Dr. J. E Stanton, a progressive Boston dentist, writes to the *Scientific American* to tell of the advantages of electric power in dentists' offices. He says: "I have a battery (primary) charging two cells of storage battery, which has been in daily use for nearly a year without once failing. From the storage cells I run a motor, one-eighth horse power, giving me power enough for all dental operations, viz., my dental engine used in the mouth and the lathe for grinding and polishing, the electric mallet and mouth lamp. The power is fully equal to the demand at all times. As you well know, the secondary battery needs no attention whatever, and all that I have ever done to the primary battery is to pour out the water once in two months, and put in about four pounds of blue vitriol to each jar. There are ten jars of primary coupled to give five volts and about one ampere; as a matter of fact, it will give more than one ampere during the two months, but after that period the quantity lessens. The cost of maintaining this is about 75 cents per month, and it requires about one hour to renew, if all the cells are cleansed at the same time, which is not necessary. The capacity of the storage cells is four volts and thirty-five ampere hours. This summer, before I went on my vacation, I discharged the secondary battery, and in so doing ran the motor without load for six hours continuously before it stopped."

ELECTRIC MINING.

An electric drill, the first ever used in California in mining operations, arrived in Shasta from the East a few days ago, consigned to the Gladstone Mining company, whose property is situated on Kline Gulch, in the French Gulch mining district.

The generators and motors for the Belmont Amalgamation mills at Telluride, Colo., are now all on the ground, and are being put in place as rapidly as possible. The mills will be operated from a power house about 1,000 feet below them on an arm of the San Miguel river.

The Virginius Mining company of Colorado has added to its electric power and is now running the concentrator, saw mill, pumps, hoisting machinery and other appliances by electricity, in addition to lighting the mine. The Virginius mine is at an altitude of 12,500 feet, and electric power makes a great saving where fuel cuts such an important figure in the cost of mining.

An electric pump will be added to the equipment of the Colorado Mining company of Butte, Mont. This will be the first application of electricity to pumping engines in that vicinity, and should it prove as successful as its promotors anticipate, its use will be largely adopted by many mills, smelting plants and mines in Butte, which now depend wholly upon steam as a motive power.

TELEGRAPH.

A stock company has been formed to build a telegraph line from Knoxville, Tenn., to Sevierville, in the same state.

The council of the government of the Island of Mauritius has voted the sum required to lay down a telegraph cable from that island to Zanzibar. This will be an immense advantage to the shipping trade, as messages to and from the Mauritius at present occupy ten days to a fortnight in transmission.

On November 8th lightning struck the Board of Trade building at Third and Main streets, Louisville, Ky., and partially destroyed it. The fifth and sixth stories were totally burned, and the third and fourth deluged with water. The fourth and fifth floors were occupied by the Western Union Telegraph company for operating room, offices and batteries. Lightning struck the rack of wires on top of the building and at once flames broke out. The Western Union loss, 7,000 batteries and its whole outfit of instruments, valued at $10,000.

The executive board of Rochester, N. Y., has granted the application of the Western Union Telegraph company for permission to lay a conduit for its wires in Mill street from its office to Central avenue, under condition that all poles on that street be removed as soon as the conduit is in operation. This conduit will contain all wires, eighty in number, leading from the Western Union office, except one through the center of the city along the canal to South avenue. "There is no question," said City Electrician Barnes, "that wires of light current, like telegraph and telephone wires, can be operated successfully underground. The controversy is over wires of higher tension, like light and power wires."

The annual meeting of the Edison Mutual Telegraph company was held in the office of the company in Van Wert, O., November 19th. Two vacancies in the directory had occurred in the past year by the deaths of Col. I. N. Alexander and Dr. H. C. McGavren. These vacancies were filled by the election of Edward Gilmartin, of Fort Wayne, and Dr. G. W. McGavren, of Van Wert. The officers and directors of the company are as follows: President, Hon. Titus Sheard, New York; vice-president, George R. Sheldon, New York; secretary and treasurer, George W. Beers, Van Wert; directors, Edward Gilmartin, Fort Wayne, Ind.; Gen A. V. Rice, Ottawa; Dr. G. W. McGavren, Van Wert; G. L Marble, Van Wert.

The attorney-general of the United States has brought suit against the Union Pacific Railway company and the Western Union Telegraph company. The government seeks to have declared void the contract entered into on the 1st of July, 1881, between the two defendants on the ground that the act of the entering into the contract was beyond the corporate competency of the railway company. The government counsel contends that the contract grants to the telegraph company exclusive right to the occupancy of and connection with the railway company's depots or station houses for commercial or public telegraph purposes as against any other telegraph company. This effectually destroys all competition. The personal privilege granted to the Union Pacific Railway to construct, maintain and operate a line of railroad and telegraph for the use of the government and the public, the counsel for the government says, is a personal power, and can not be alienated or abandoned by it.

TELEPHONE.

Telephonic communication between Velasco and Houston, Tex., by way of Alvin, is proposed.

The Cumberland Telephone company will, it is reported, construct a telephone line from Cookeville to Lebanon, Tenn.

A new telephone company has been incorporated to construct a telephone line from Dobbin to Gormania, W. Va., and Oakland, Md.

The directors of the Belgian and Netherland telephone companies are considering a scheme for connecting the systems of the two countries.

Workmen are busy moving the telephone wires in Rochester, N. Y., from the poles on the east side of the Genesee river. Underground wires are ultimately to be used throughout the entire city.

On a recent Sunday, says a London paper, a number of ladies and gentlemen attended at the telephone exchange, Loughborough, to hear the service at Christ Church, Birmingham, 60 miles away. Every word was distinctly heard —the sonorous tones of Canon Wilcox reading the lessons, the solo by Master Hulme, and the sermon by the vicar being all audible.

Julius Andres, of Milwaukee, has just placed in the Industrial Exposition, for the Chicago agency of the Mather Electric company, two 6 horse power motors to be used in running the display machinery. These motors are of a recent pattern, perfected by the Mather company, and a very high efficiency is claimed.

A queer story comes from London to the effect that the French minister of public instruction—noting that in learning English it is the pronunciation that is the most difficult part—has decreed, in accordance with arrangements made with the minister of posts and telegraphs, that after October 15th the Paris-London telephone line is to be placed at the disposal of students of languages. Other international lines, it is said, as erected, are to be used in the same way.

Recently published statistics show that the telephone is in more general use in Sweden than in any other country in Europe, the proportion being 400 subscribers to each 100,000 inhabitants. Switzerland comes next with 316. Germany is first among the great powers, with 105, while Great Britain is put down at 58 and France at 41. Russia, with seven, is at the bottom of the list. Of the chief cities, Berlin has 15,000 subscribers, Paris 10,000, and London 7,000.

TRADE NEWS.

The Ries Electric Specialty company of Baltimore, Md., explains the now well-known features of the Ries socket in a neat little catalogue just issued.

The Empire China Works, Greenpoint, Brooklyn, N.Y., report a brisk business. They have a large number of orders on hand for non-conductive blocks, rosettes, bases for [illegible] never so large as at present.

[illegible] Turner Engineering comp[illegible] from the city for the [illegible] pany's contracts, which are nearing completion.

The Central Electric company, Chicago, is bringing out a new catalogue covering its lines of Bryant sockets, cutouts, branch blocks, etc. This catalogue, it is promised, will be both attractive and instructive. The Central Electric company is receiving many orders for Okonite lamp cord.

General Manager C. E. Bibber of the Consolidated Electric Manufacturing company, Boston, Mass., reports that his company has opened a new store and salesroom at No. 154 Franklin street. J. H. Cramphorn, well known to the trade, and formerly with the Holtzer-Cabot Electric company, has assumed charge of the store. The new salesrooms are centrally located.

William Courtnay of the Valcanized Fibre company, New York, announces that his company last month worked more hours than during any preceeding October since starting in business. This concern recently erected a fireproof storage house so as to be able to produce seasoned stock. An order has been received from London for 1,660 sheets of fibre, each 42x66 inches. This is the third order of this kind received from London.

The Hine Eliminator company of New York reports a large number of orders booked for its steam separator. Most of the orders last week were from the South. The following companies have been furnished with separators: Huntington Industrial Works, Hampton, Va.; F. Schenk & Sons, Wheeling, W.Va.; Standard Oil Works, Green Point, L. I.; three for Lane Bros., Detroit; Grace Hospital, Detroit.

The La Roche Electric Works, Philadelphia, have received from James W. Queen & Co., an order to build a large direct current dynamo and an alternating dynamo to be used for calibration purposes; also a special motor to run them. These machines will be made of the very best material in the market. The La Roche people feel highly complimented by this order. Among the orders recently received by the La Roche Works are the following: W. P. Troth, Jr., & Co., Frankford, Pa., 500 incandescent lights; Thomas J. Oliver, Philadelphia, 50 lights; C. W. Kennedy, Philadelphia, 50 lights; John W. Grantland, Philadelphia, 50 lights; Peter Reinhalter, Niantic, R. I., one 300-light dynamo (increase); A. P. Hill, Philadelphia, 100 lights; Quaker City Watch Case company, Philadelphia, one 7½ horse power motor; Col. H. A. Du Pont, Wilmington, Del., 150 arc lights.

A recent issue of the *Daily Beacon*, Ashtabula, O., contains the following: "The special session of the council to settle the electric light contract was one of the shortest on record, as it was only twenty-two minutes from the time Mayor Moore called to order until an adjournment was made. All members were present, and as the consideration of the contract between the city and the Westinghouse Electric & Manufacturing company was the only business that could be legally transacted at the meeting, it was at once taken up. The contract provides for the furnishing and erecting of the wires, poles, fifty-one arc lamps, two sixty light arc dynamos and one five hundred light incandescent dynamo. Nine bids were submitted by as many companies for the contract, but only five were considered: Thomson-Houston, Western Electric, Fort Wayne, Edison and Westinghouse. After a careful investigation and examination of all these systems, the committee reported in favor of the Westinghouse company's bid, as it thinks the system better and more economical than any of the others. The system is the alternating one, and the lamp instead of throwing a light down at an angle of about forty-five degrees, as does the direct current, gives a light that penetrates farther into the darkness horizontally than the other. Councilman Raser offered a resolution that the Mayor and clerk be authorized to sign the contract on behalf of the city. After a little discussion, this resolution was unanimously carried."

BUSINESS.

The Lahman-Kirkwood fuel-saving shaking and dumping grate bar for boilers and furnaces is illustrated in a new catalogue issued by W. H. Lahman, room 27, [illegible] street, Chicago.

Very business-like is the recently issued catalogue of the Manhattan Electrical Supply company, 36 Cortlandt street, New York. A very complete line of electrical specialties is shown, and the pamphlet is copiously illustrated.

General Manager C. B. Mackie of the Electric Secret Service company, New York, has returned from an extended business trip through the West. He secured a number of good contracts, one of which comes from one of the largest railroad systems in the country.

The Germania Electric company of Boston has [illegible] installed a Germania dynamo for the Lab[illegible] W[illegible] ase company, Sag Harbor, L. I. This dynamo is [illegible] the special purpose of running motors throughout the factory, and is giving entire satisfaction, and the demand for them is on the increase.

A new company to be known as the [illegible] ing & Manufacturing company has [illegible] and rooms for office and manufacturing purposes secured at 31 and 33 South Canal street, Chicago. H. L. Godden, formerly with the Pumpelly Storage Battery company, is president of the new corporation; Wm. Rauguth, treasurer, and Wm. Scott, manager. As the name of the company im-

plies, it is the purpose of the gentlemen interested to carry on a general engineering and manufacturing business and exploit several specialties.

General Manager E. W. Little of the Interior Conduit & Insulation company, New York, made his first appearance at the office last week, after having been confined at home for several weeks with an attack of typhoid fever. G. H. Sexsis, the assistant general manager, performed Mr. Little's duties during his sickness.

The "supplementary catalogue" of the W. S. Hill Electric company of 54 Devonshire street, Boston, is a dainty production. Motors, dynamos, switches of all sorts, fuse blocks, lamps, rheostats and other electrical appliances are illustrated and described. The company announces that it fully guarantees all its productions.

There have been many rumors afloat regarding the placing of a large order for electric cable. It seems that the order was for 700,000 feet of conductor, and that J. H. Bunnell & Co. were the successful competitors. This firm stated that this large order would be filled with Day's kerite wire, which had been selected on account of its excellent quality.

The New York Safety Steam Power company, New York, reports that it is in receipt of a full share of orders for its high speed engines for electrical work, especially from its Chicago branch office, where the volume of business has been much larger than it was this time last year. At the shops a number of orders are awaiting completion, two of which are for export.

One after another of the basements in the neighborhood of the offices of the Electric Merchandise company, Chicago, have been taken for storage purposes, and the company has just engaged the upper part of the building for additional office room. This extension of quarters will greatly aid in maintaining the standing which the company has gained as dealing in "electric railway supplies only."

The Joseph Dixon Crucible company of Jersey City, N. J., reports orders rapidly increasing for its graphite paint, which has become so popular for use on poles and iron work. This company recently erected a three story building at the corner of Wayne and Monmouth streets, just north of the present factory, to be used exclusively for offices. The building is 40x150 feet, built of Philadelphia pressed brick, with brown-stone trimmings. It is to be occupied about December 15th.

A new voltmeter, the invention of Frank Wagner, is being put on the market by Queen & Co., of Philadelphia. It is of the "hot wire" type, depending on the expansion of a wire which is heated by the passage of a current. The instrument is dead-beat. Two ranges, with maximum registrations of 55 and 125 volts, are offered. This voltmeter is intended for general testing work, and not for use as a station instrument. It is made almost entirely of aluminum and weighs but twenty-two ounces, with dimensions of eight by four by two inches.

The Chicago Electric Manufacturing company, 73 West Jackson street, is working more men than have heretofore been carried on its time rolls during any previous month. The company reports a very active business in prospect for the closing months of the year. It has a complete equipment, including a Wheatstone bridge, storage battery plant, Edison dynamo, etc., for the calibrating of new instruments and the recalibrating of such old instruments as may be sent it for repair. A large amount of instrument work is being received by this company.

Electric supply houses often receive orders for apparatus to be used for novel purposes. The Nassau Battery company, New York, recently received an order from Tahiti, Fla., for one of its electric thermometers, to be used in a large orange grove at that place, whereby the superintendent of the plantation is notified should the temperature fall to 40 degrees. At this point a bell is rung in the house, 800 feet from the place where the thermometer is located. By this arrangement he can notify his help at once to light the fires and thus ward off a frost which would destroy the orange buds upon the trees.

The merits of the Woodbury automatic self-contained [illegible] by the Stearns Manufacturing company of Erie, Pa., are attractively set forth in a new catalogue. Referring to the characteristics of the engine, the company makes this claim: "Nothing has been, or will be, sacrificed to mere cheapness, and it will be the [illegible] produced from the highest grades of materials and workmanship, believ- [illegible] of engineers [illegible] too good, and [illegible] always be to [illegible]

[illegible] for the entire [illegible] Packard lamp [illegible] Engineering [illegible] Packard [illegible]

make the outlook for the close of the year most promising.

The New York & Ohio company at Warren, O., reports a largely increased demand for the "Packard" lamp over any previous corresponding period. Several large sales have recently been made in New York and other eastern cities, and to supply the demand it has become necessary to run the factory 22 hours a day. The Packard lamp was among the first lamps perfected in this country, and is, with possibly one exception, the oldest lamp on the market, having stood the test for several years, meeting all the requirements of a demand that has been constantly changing. The name given to this lamp has become identified with the lamp industry of this country by reason of the general adoption of the Packard vacuum pump in incandescent lamp factories. The New York & Ohio company has largely increased its capacity in order to be able to take care of this season's business, until now the enterprise is one giving employment to a large number of men, and is pointed to with commendable local pride by the citizens of the beautiful little city of Warren.

The C. & C. company has recently installed lighting machinery for isolated plants as follows: One 75 light dynamo for the Snow Steam Pump company, Buffalo, N. Y.; one 175 light dynamo for the Cogdon Brake Shoe company, Fifty-ninth street, Chicago, Ill.; one 500 light dynamo in the Mitchell flats, Cincinnati, O.; two 250 light dynamos in the St. Nicholas hotel, Cincinnati, O.; one 125 light dynamo for Mock, Berman & Co., 119 West Third street, Cincinnati, O.; one 150 light dynamo for W. J. Morgan & Co., Cleveland, O.; one 100 light dynamo for the Bethel association, Cleveland, O.; one 60 light dynamo for the Northern Ohio Asylum for the Insane, Cleveland, O.; one 100 light dynamo for the steamer Royal, Evansville, Ind.; one 40 light dynamo for the Upton Glue company, Gardiner, Me.; one 40 light dynamo for the Boston Paper company, Hallowell, Mass; one 200 light dynamo for the iron foundry of T. Shriver & Co., 333 East Fifty-sixth street, New York; one 150 light dynamo for Weser Bros., piano manufacturers, 524 West Twenty-third street, New York; one 40 light dynamo for the Upton Glue company, Peabody, Mass.; one 150 light dynamo for Jordan & Goodrich Shoe company, Ravenna, O; one 500 light dynamo for lighting the offices of the Brush Electric Light company, Rochester, N. Y.; one 40 light dynamo for the Upton Felting mills, Salem, Mass. This company has also under way these installations: One 100 light dynamo for Mrs. Mary Jacobshagen, Union Sugar Plantation, La.; one 100 light dynamo for John T. Moore, Shriver, La.; two 600 light dynamos and one 300 light dynamo in the Erie County Savings Bank building, Buffalo, N. Y; one 200 light dynamo for John D. Muller, corner Fifth avenue and Union streets, Brooklyn N. Y.; one 100 light dynamo for the Crescent Farm Planting association, La., one 125 light dynamo for Shaffer Bros., Ardoyne Sugar Plantation, La.; one 125 light dynamo for Messrs. Walbridge & Co, Buffalo, N. Y; one 100 light dynamo for the Magnolia Plantation, La.

ELECTRICAL PATENTS.

Issued Nov. 17, 1891.

463,136. Device for Operating Railway Switches. Watson A. Brown, Rochester, N. Y.

463,154. Electric Arc Lamp. William Jandus, Cleveland, Ohio.

The object of this invention is to adapt to the present open air arc lamp a practical device designed to retard the waste of electrodes by oxidation.
The first of the eight claims reads as follows:
"1. In the arc lamp the combination, with a carbon holder, of an arc enclosing globe open at its lower end and hermetically closed at all points excepting at its lower end, substantly as set forth."

463,155. Electric Lock. Walter J. O. Johnson, Chicago, Ill.

463,164. Shoe Blacking Machine. Frederick G. Norton, Waukegan, Ill.

463,172. Insulator Support. Thomas C. Smith, Philadelphia, Pa.

463,174. Armature for Dynamos or Electric Motors. Barron D. Southard, Chicago, Ill.

463,188. Telephony. John W. Gibboney, Lynn, Mass.

This invention consists in making a suitable record of the sound waves or phonogram record, causing such record to produce corresponding electric waves or undulations of current at a reduced pitch or extended period, transmitting such waves or undulations of current over an electric circuit, and recording them at the receiving end of the circuit.

463,192. Electro Magnetic Switch. Charles H. Herrick, Winchester, and Willis M. Rand, Boston, Mass.

463,197. Electrical Conduit. John C. Love, Philadelphia, Pa.

463,19[illegible]. Electric Stop Mechanism. Lemuel Mellett, Somerville, Mass.

463,207. Telephonic Relay. Ephraim E. Weaver, Philadelphia, Pa.

463,213. Cut-out. Hermann Lemp, Hartford, Conn.

[illegible]

463,242. Dynamo-electric Machine. Martin C. Burt, Chicago, Ill.

463,247. Galvanic Battery. Walter A. Crowdus, Memphis, Tenn.

463,[illegible]. Galvanic Battery. Walter A. Crowdus, Memphis, Tenn.

463,257. Ice Breaker and Electric Current Transmitter. Chas. Smith, Wilkesbarre, Pa.

463,297. Electric Lock. Floyde H. Starrett, Clinton, Mich.

463,298. Thermo Circuit Closer for Electric Fire-Alarms. John Wrigley and George P. Chambers, Paterson, N. J.

463,305. Ore Separator. William D. Hoffman, Brewster, N. Y.

463,310. Crossing for Electric Railway Conductors. William J. Silver, Salt Lake City, Utah.

463,311. Electric Switch. Ernest J. Bagnall, St. Louis, Mo.

463,314. Alternating or Pulsating Current Motor. Ludwig Gutmann, Pittsburg, Pa.

The last claim reads as follows:
"11. An alternating current motor comprising primary and secondary field electromagnets, an armature provided with a closed winding subdivided into coils, and an electric conductor normally close-circuiting the terminals of contiguous armature-coils."

463,315. Power-storing Mechanism for Electric Locomotives. James A. Hockett, Stirling, Kan.

463,340. Fire Alarm Telegraph Repeater. George M. Stevens, Cambridge, Mass.

463,356. Electric Locomotive. Sidney H. Short, Cleveland, Ohio.

463,359. Motor Car for Electric Railways. Thomas E. Adams, Cleveland, Ohio.

The first of the twelve claims reads as follows:
"1. An electrically-propelled car provided with a trolley or trolleys for an overhead electric line and with glazed sight-openings in the roof of the car for observing the line."

463,384. Electric Cigar Lighting Apparatus. William W. Foster, Boston, Mass.

463,395. Electric Train Signal. Joseph B. Strauss, Cincinnati, Ohio.

463,396. Electric Switch. Alfred Swan, Orange, N. J.

463,420. Coupling for Electric Wires. Francis X. Gartland, Philadelphia, Pa.

463,428. Telegraph Sounder. James Maret, Mount Vernon, Ky.

463,486. Process of Welding Metals Electrically. Charles L. Coffin, Detroit, Mich.

This process consists in first separately subjecting the articles to be welded to the action of a heating current and the voltaic arc and then pressing the heated articles together to form the weld.

463,487. Electric Welding or Working of Metals. Charles L. Coffin, Detroit, Mich.

463,491. Baseball Indicator. James L. Cutler, Piketon, Ohio.

463,512. Electrical Conductor. Philip H. Holmes. Gardiner, Me.

The last claim reads as follows:
"5. The hardened electric conducting composition composed of plumbago, divided fiber and a drying oil, the plumbago being in excess"

463,544. Multiple Telephone Switch-board. Frank A. Pickernell, Newark, N. J.

463,545. Multiple Switch-board. Frank A. Pickernell, Newark, N. J.

Of the five claims the third is presented:
"3. The combination of two metallic or part metallic circuits, each permanently closed at a central station through the helices of a polarized call annunciator, a double conductor link connection uniting the direct and return conductors of one of the said circuits with those of the other, and a non-polarized disconnecting system annunciator located in a bridge-conductor between the two conductors of said link connection."

463,556. Speaking Tube Attachment for Telephones. Leondo H. Snyder, Sharon, Pa.

463,558. Apparatus for Measuring and Recording Electric Currents. William Thomson, Glasgow, Scotland.

463,562. Stop Motion Knitting Machines. Frank Wilcomb. Providence, R. I.

463,569. Combined Telegraph and Telephone. Emile Berliner, Washington, D. C. Filed June 4, 1877.

463,570. Fire Alarm. Alphonse Bichet and Robert W. Whitney, Florence, Kan.

463,585. Electric Blower or Fan. Walter B. Snow, Watertown, Mass.

463,586. Mast Arm for Electric Lights. Van A. Thomas, Providence, R. I.

463,587. Insulator Bracket. VanA. Thomas, Providence, R. I.

463,588. Insulator Bracket. VanA. Thomas, Providence, R. I.

463,595. Duplex Arc Lamp. Ernest P. Clark, New York, N. Y.

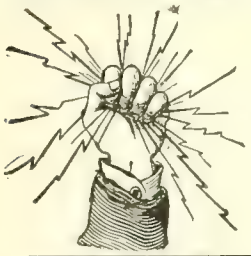
Of the six claims the third is given:
"3. In an electric arc lamp having a plurality of pairs of carbons and separate regulating mechanism therefor, an automatic switch for controlling the circuits, and an independent electromagnet located in the circuit of one pair of carbons and having its armature connected with the switch."

463,605. Circuit and Switch for Electric Motors. Wilhelm Lahmeyer, Frankfort-on-the-Main, Germany.

463,608. Automatic Fire Alarm System. Gilman W. Brown, West Newbury, Mass.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

THE ELECTRICAL ENGINEERING CO.,

322 DEARBORN ST., CHICAGO.

Contractors for all kinds of ELECTRICAL WORK.

GENERAL WESTERN AGENTS FOR

The Clark Wire.
The Interior Conduit and Insulation Co. of New York.
The Elektron Manufacturing Co.
Perret Motors.
The Standard Dynamo, Manufactured by the Fairbanks Scale Co.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are now prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible cables with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

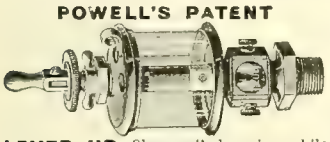
HENRY A. CLARK, Treasurer and Gen'l Manager.
HERBERT H. EUSTIS, President and Electrician.

CHICAGO AGENTS: The Electrical Engineering Co., 320 Dearborn St. TORONTO, ONT. AGENTS: The Toronto Electrical Works

CHICAGO. *The Electrical Construction Co.* 43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

POWELL'S PATENT



LEVER UP—Shows oil dropping while machinery runs.

SIGNAL OILERS

Still in the Van as the BEST for **HIGH-GRADE ENGINES and DYNAMOS.** The stop-feed features prevent waste of oil which item alone will more than save their cost in a short time. **HAS OTHER EXCEPTIONAL POINTS OF MERIT.** Send for full descriptive circular. Address THE WM. POWELL CO., CINCINNATI, OHIO.

Queen's "1891" Portable Testing Set,

For Illustration see THE WESTERN ELECTRICIAN, Sept. 19, page 183.

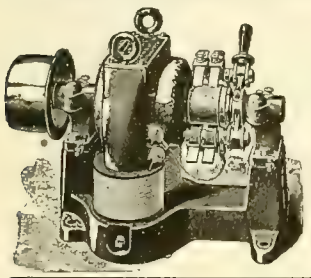
The galvanometer in this set is made of the D'Arsonval type, and is extremely sensitive, without being affected by *mechanical vibrations*, as on shipboard, or by intense *magnetic disturbances*, as in proximity to a dynamo. It is especially recommended for making tests where a galvanometer with fibre suspension cannot be used.

Send for Illustrated Descriptive Catalogue, 1-66

QUEEN & CO., PHILADELPHIA.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

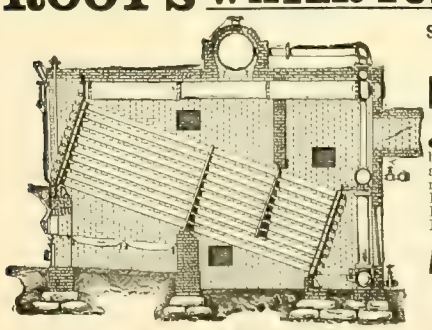
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK

ROOT'S WATER-TUBE BOILER.



Root's Sectional Safety Boiler.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Electric Light Companies** of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City and a great many others; also by the Arlington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass. and the Thomson-Houston Electric Co., Lynn, Mass.

Abendroth & Root Mfg. Co.,

28 Cliff St., New York.

BRANCHES: Chicago, Boston, Philadelphia, Dallas, Rochester.

The Winner of 1890 will win again in 1891. Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,

85 John St., NEW YORK.

Binders

FOR THE Western Electrician $1.00.

MICA

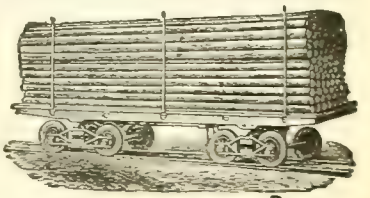
ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

ELECTRICAL WOOD.



Telegraph Telephone Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, Rods, Tubing, Washers, Discs and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.

BRASS FOUNDRY.

Brass, Bronze, White Metal, Aluminum-Bronze and Special Alloys. Castings for

ELECTRICAL SUPPLIES A SPECIALTY.

L. BLATZ, 103-107 West Monroe St., CHICAGO.

TO MAKE A STATION PAY

Buy only the best quality of goods. This you can do by sending your orders to us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers; Packard High Grade Lamps: Eddy Motors: "Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

931 Rookery, CHICAGO. 134 E. 6th St., opp Hotel Ryan, ST. PAUL. 409 W Michigan St., DULUTH.

SEND FOR CATALOGUE AND DISCOUNT SHEETS.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

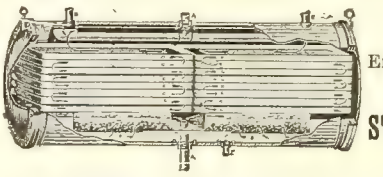
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

THE COWLES ELECTRIC SMELTING & ALUMINUM CO.,

LOCKPORT, N. Y.,

Offer Commercially Pure Aluminum

In Ingots, Slabs, Sheet Wire and Castings at lowest market rates.

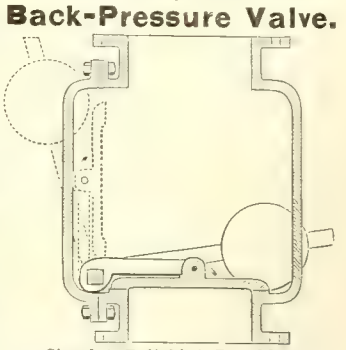
Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze in ingots and castings. Ferro Aluminum for steel and iron castings.

Correspondence Solicited.

THE EXCELSIOR

Straight-Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,

229 S. Franklin St., Chicago.

A GREAT RAILROAD.

By the absorption of the Chicago & Atlantic Railway between Marion and Chicago, the ERIE has at last effected its entrance into Chicago, and now occupies the proud position of being the only line between Chicago and New York entirely under one management.

One result of this is the arrangement whereby all the through trains of the Erie are now run solid between Chicago and New York without change. Passengers holding through tickets, whether first or second class, are able to go from Chicago to New York without changing cars.

Pullman's most modern Sleeping Cars are run on all through trains via this line, and on their Vestibule Limited, Pullman's Dining Cars. No extra fare charged on this train. In fact, the rates via the ERIE are lower than via any other route offering equal facilities.

SEALED PROPOSALS.

Notice is hereby given that sealed proposals will be received at the office of the Clerk of the City of Peru, Indiana, up to 7 o'clock P. M. of the 8th day of December, 1891,

For furnishing and maintaining of fifty or more arc lights as the Council may deem necessary; said lights to be of 2,000 candle power each and to burn all night, and be placed in such parts of the city as the Common Council shall designate, the Council having the right to add one or more lights to any contract they may make, at any time during the life of such contract at contract price of same, said contract to take effect on the 1st day of June, 1892.

The Council reserves the right to reject any or all bids.

By order of the Council October 13, 1891.

Address, JOHN TOLL,
City Clerk.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

BINDERS

FOR THE

Western Electrician,

ONE DOLLAR.

Manufacturers of

OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

ELECTRIC LIGHT AND BATTERY **CARBONS.**

THE NATIONAL CARBON CO.

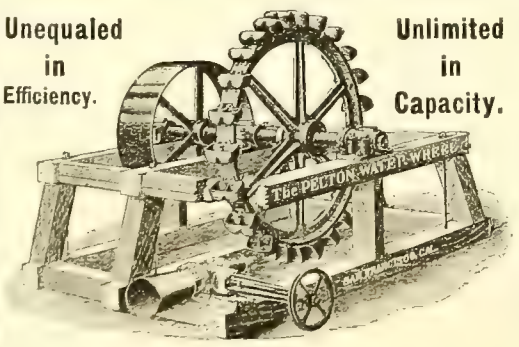
CLEVELAND, OHIO.

MOTOR BRUSHES.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 10 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,

121-123 Main St., San Francisco, Cal., U. S. A.

143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and are now tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

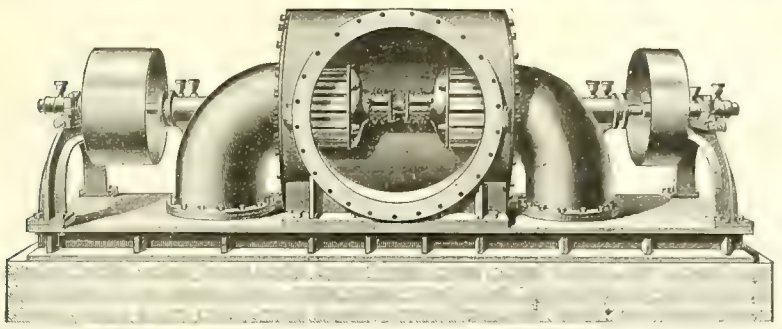
Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES [illegible] **CELEBRATED WATER WHEEL** [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** [illegible] **diameter,** being **double** the **Power** of most wheels of [illegible] by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, [illegible] of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended [illegible] required and it can be belted directly to dynamo.

The accompanying engraving represents a pair of [illegible] **VICTOR TURBINES** arranged on a horizontal shaft with Cast-Iron Flume, Draft Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shaft, [illegible] admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO., RAVENNA, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

TO DENVER VIA

BURLINGTON ROUTE.

Only One Night on the Road.

Leave Chicago at 1.00 P. M., or St. Louis at 8.25 A. M., and arrive Denver 6.15 P. M. the next day. Through Sleepers, Chair Cars and Dining Cars. All Railways from the East connect with these trains and with similar trains *via* Burlington Route to Denver, leaving Chicago at 6.10 P. M., St. Louis at 8.15 P. M., and Peoria at 3.20 P. M. and 8.00 P. M. All trains daily.

Additional express trains, making as quick time as those of any other road, from Chicago, St. Louis and Peoria to St. Paul, Minneapolis, Council Bluffs, Omaha, Cheyenne, Black Hills, Atchison, Kansas City, Houston and all points West, Northwest and Southwest.

SUBSCRIBE FOR THE WESTERN ELECTRICIAN.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),

DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

FOR HANDLING

GRAIN, COAL, TAN BARK, SEEDS, ETC.

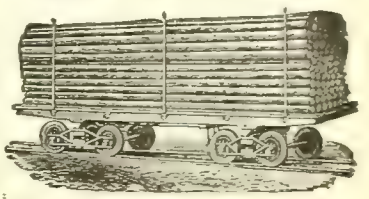
Will convey all kinds of grain without mixing.

Will carry two different kinds of material in opposite directions at the same time.

Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

VULCANIZED FIBRE CO.

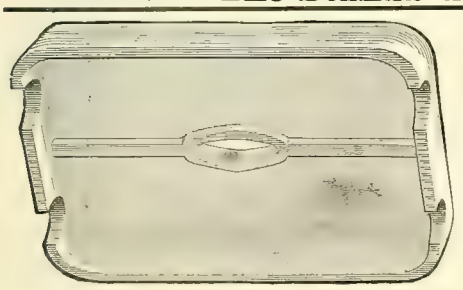
ESTABLISHED 1873.

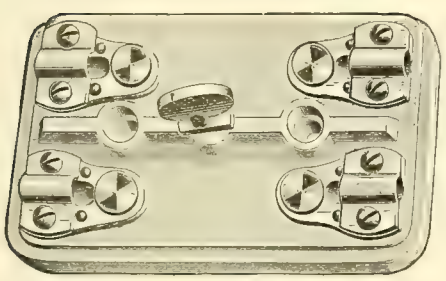
SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 114 DEY ST., N. Y.





CUT-OUTS,

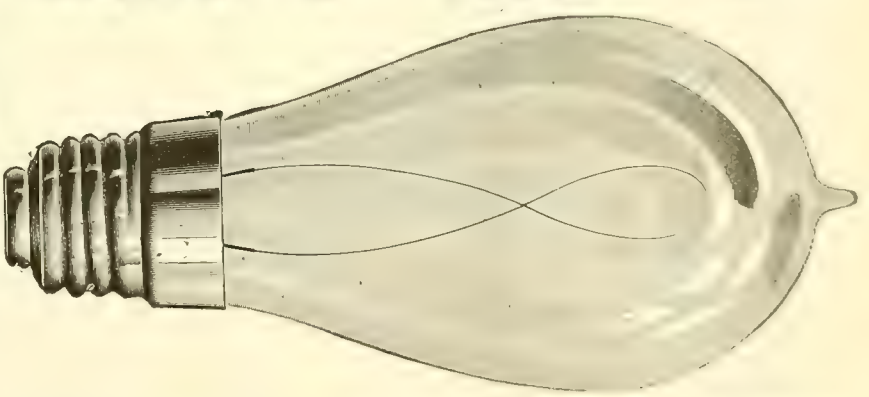
Single Light, Main and Branch,

OF SUPERIOR PORCELAIN,

With all Connections Under Cover.

SAWYER-MAN

LAMPS OF ANY C. P. VOLTAGE BASE.



HIGH QUALITY LAMPS FOR EDISON CIRCUITS.

WRITE FOR PRICES.

See Catalogue of Aug. 1, 1890.

SAWYER-MAN ELECTRIC CO.,

620 Atlantic Avenue, BOSTON, MASS.

510-534 W. 23d Street, NEW YORK.

217 LaSalle Street, CHICAGO, ILL.

C. & C. ELECTRIC MOTORS and DYNAMOS.

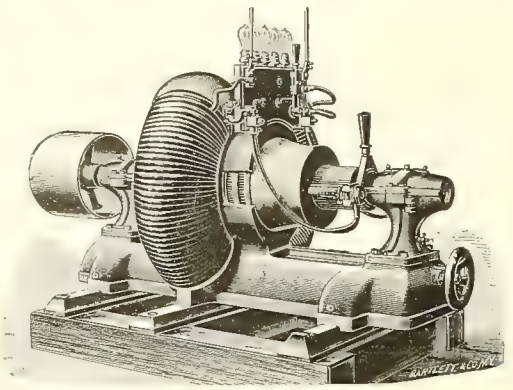
ELECTRIC MOTORS in all standard sizes, up to and including 100 H. P., for operating elevators, pumps, printing presses, and machinery for general manufacturing purposes.

POWER GENERATORS.

ELECTRIC MINING MACHINERY of all kinds, Hoists, Tram Cars, etc.

FAN OUTFITS, Electric Plants for pumping Church Organs.

We call the special attention of Station Superintendents to the fact that our machines are absolutely unsurpassed for economy of electric current.



DYNAMOS for isolated plants and the equipment of Mills, Banks and Office Buildings with Electric Lights.

ELECTRIC BLOWERS for ship ventilation. Have equipped 18 U. S. and foreign War Ships with ventilating apparatus.

NEW ENGLAND Office, 63 Oliver St., BOSTON.
PHILADELPHIA Office, 38 S. Fourth St.
CHICAGO Office, - Phenix Building.
SAN FRANCISCO Office, - 35 Market St.
ST. LOUIS Office, - - 421 Olive St.
NEW ORLEANS Office, 78 Customhouse St

THE C. & C. ELECTRIC MOTOR CO., 402-404 Greenwich Street, NEW YORK.

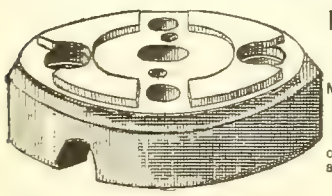
SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

Write for Prices and Samples. **S. TAUSSIG, Agent, 45 River St., CHICAGO.**

BINDERS FOR THE WESTERN ELECTRICIAN, ONE DOLLAR.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

BERNSTEIN ELECTRIC CO.

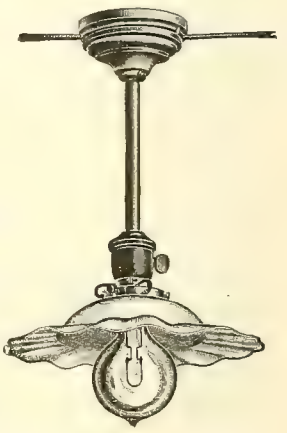
INCANDESCENT LAMPS

-FOR-

ARC LIGHT CIRCUITS.

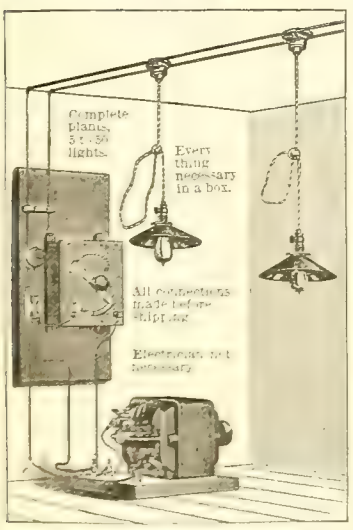
SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.



You can	Lights	Thoroughly		Send
Put	Are Standard	Reliable	Prices	For
It up	And	And	Reasonable.	Illustrated
Yourself.	Full size.	Practical.		Pamphlet.

BAIN ELECTRIC MANUFACTURING CO.,

47 So. JEFFERSON STREET,

CHICAGO.

"BE YE THE JUDGE."

HAVE YOU TRIED THE

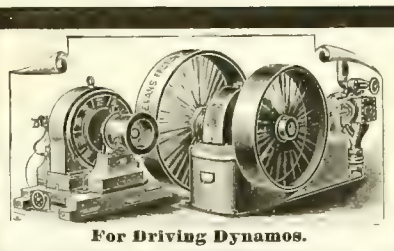
ECONOMIC INCANDESCENT LAMP?

If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again.* Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

GEO. L. KIRKHAM, Manager. **1017 Chamber of Commerce, CHICAGO.**

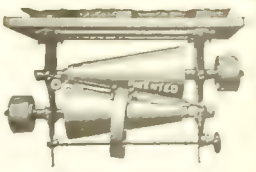


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

EVERYTHING IN
WIRE—FUSE— STRIPS.

WRITE

US.

MANUFACTURED BY
The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY
MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

ELECTRICAL INSTRUMENTS

RECALIBRATED.—REPAIRED.

CHICAGO ELECTRIC MFG. CO., 73 W. Jackson St.

ELECTRICAL BOOKS.

Send For Complete Catalogue.

Electrician Publishing Company,

6 Lakeside Building, - CHICAGO.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

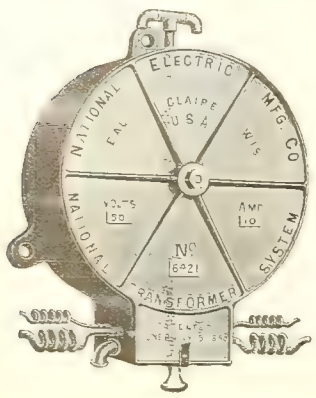
Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

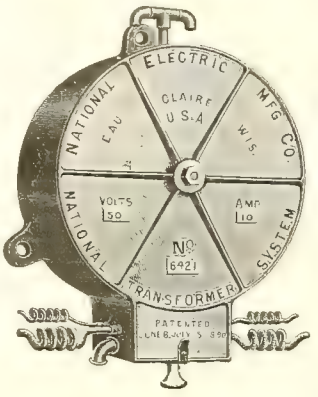
The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

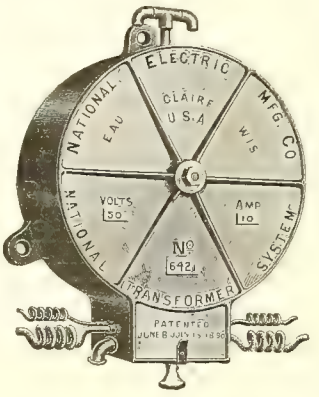
Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

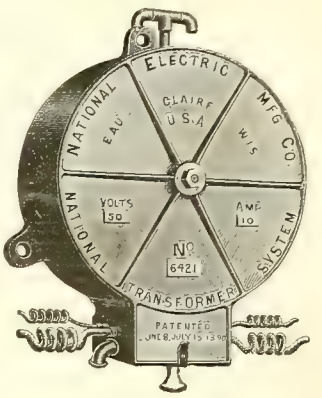
THE BRUSH ELECTRIC CO.,

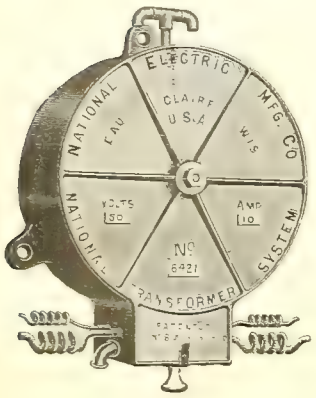
CLEVELAND, OHIO.











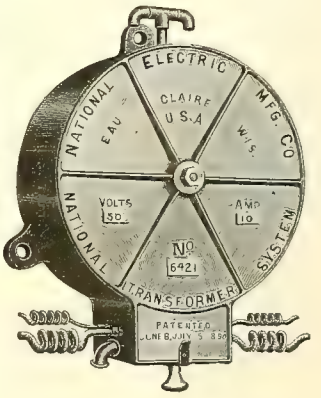
THE

National Transformer System

— OF —

INCANDESCENT LIGHTING.

TRANSFORMERS FOR ANY SYSTEM.

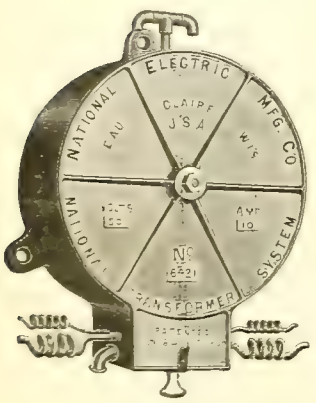


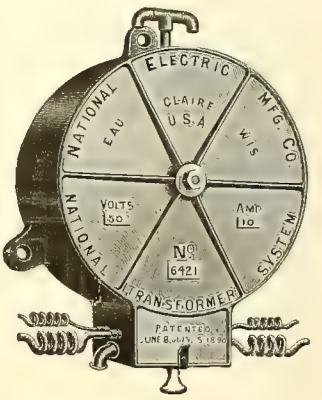
Alternating and Direct Current Dynamos.

MOTORS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

We are prepared to undertake the construction of Electrical Plants of whatever magnitude. Correspondence solicited.





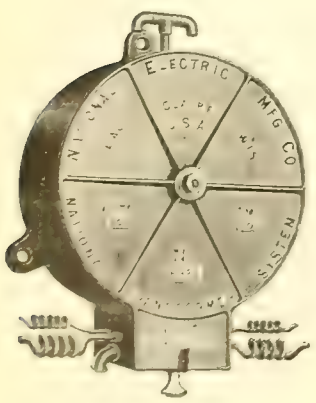
National Electric Mfg. Co.,

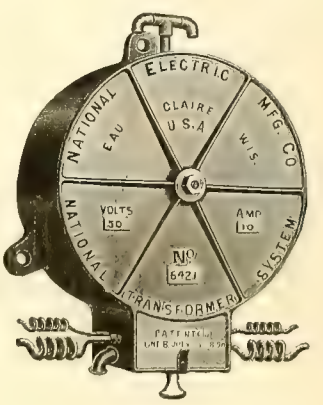
EAU CLAIRE, WIS.

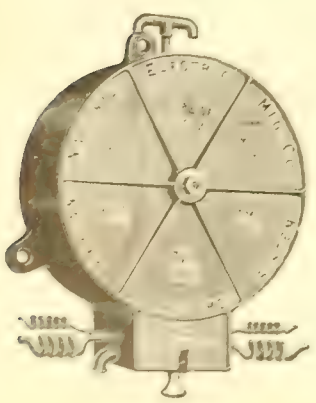
GEO. B. SHAW, Gen'l Manager.

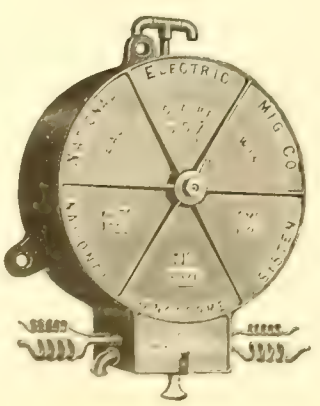
AGENTS:

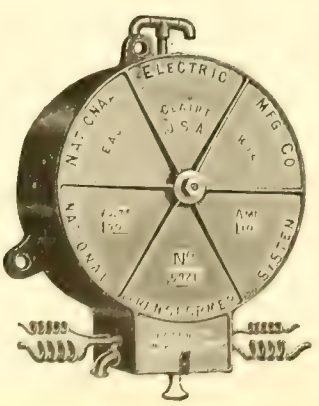
New York, N. Y.—NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Electrical Exchange Bldg.
Buffalo, N. Y.—F. P. LITTLE & CO., 141 East Seneca Street.
Cincinnati, O.—W. N. GRAY, 12 Chamber of Commerce.
Washington, D. C.—L. N. COX, 16 Fifth Street, S. E.
Philadelphia, Pa.—PENNSYLVANIA ELECTRIC ENGINEERING CO.
St. Paul, Minn.—THE ELECTRICAL ENGINEERING AND SUPPLY CO.
Detroit, Mich.—COMMERCIAL ELECTRIC CO.
Denver, Col.—THE MOUNTAIN ELECTRIC CO.
Winnipeg, Man.—SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO.
San Francisco, Cal.—NATIONAL ELECTRIC DEVELOPMENT CO.
Lincoln, Neb.—LINCOLN ELECTRICAL MFG. AND SUPPLY CO.
Duluth, Minn.—THE ELECTRICAL ENG. AND SUPPLY CO.
Kansas City, Mo.—THOMAS WOLFE, 515 Main Street.
Seattle, Wash.—CHAS. H. BAKER & CO.
New Orleans, La.—ENTERPRISE CONSTRUCTION AND SUPPLY CO.

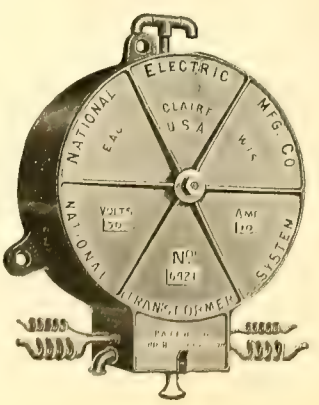




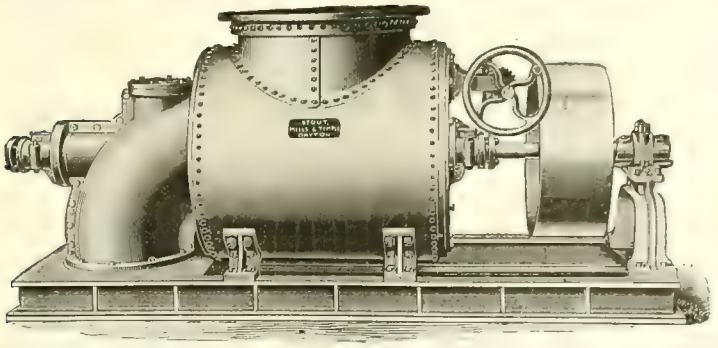








The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shafts.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

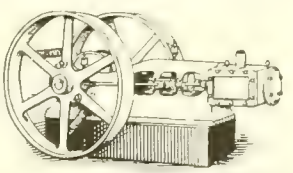
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

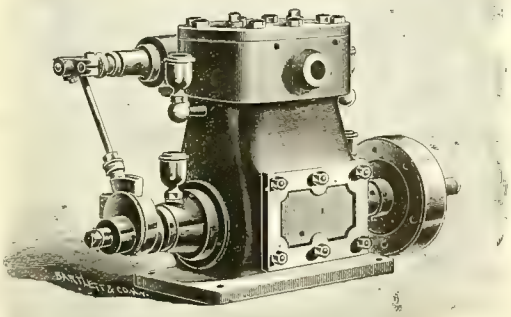


WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North Street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Fine Office Furniture and Folding Beds.
Brass and Wire Work. 215 Wabash Av.
A. H. Andrews & Co., Chicago.

WESTINGHOUSE ENGINES



THE ORIGINAL WESTINGHOUSE ENGINE,

BUILT A. D. 1880.

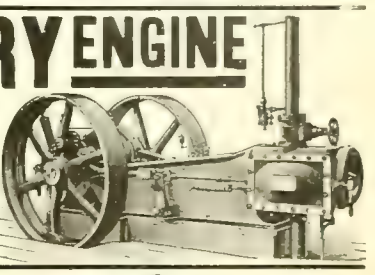
SIZE 3 x 3. 1,000 REVOLUTIONS.

Now preserved in the Offices of the Company, Pittsburgh, Pa.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE.
—Catalogue sent on application.
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST.
HALF TONE PLATE SPECIALTY
CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.

ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." PATENT "K.K." LINE WIRE TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

DID YOU SEE IT AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

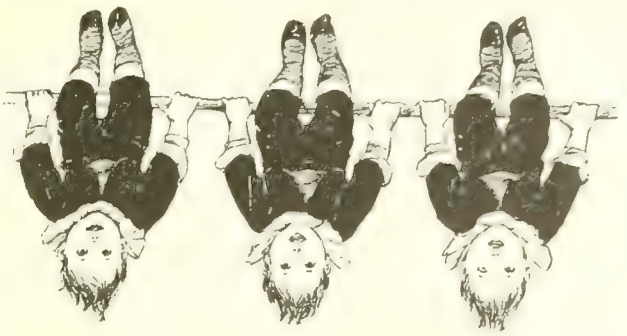
The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.,

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.



THE TURNING POINT

With all Electric Lighting Stations is the day the first dividend is declared. If you have reached that point, why not increase your next dividend? If you have not, there is no reason why you should not. You can do it by using

PERKINS' - INCANDESCENT - LAMPS.

BAIN'S

COMPENSATING

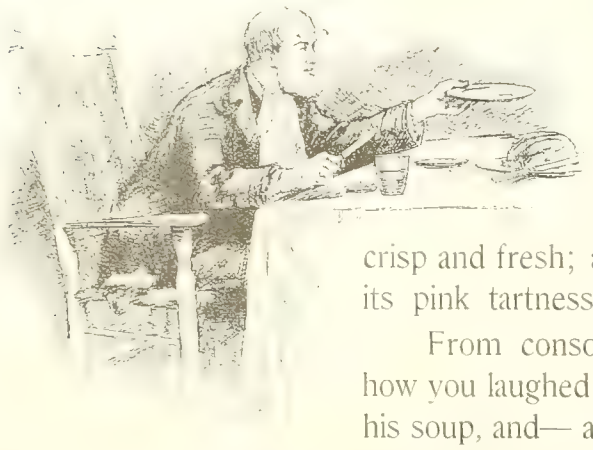
Voltmeters and Ammeters

Are Accurate, and do not get out of Calibration.

THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS AND DEALERS,

54 and 56 Franklin Street, CHICAGO, ILL.



You Will Want More.

Certainly you never enjoyed a better dinner. The "bird" was "done to a turn"—who but old auntie Chloe could ever get that shade of brown?—and the oysters! and the celery, crisp and fresh; and the cranberry sauce, adding zest to your jaded appetite with its pink tartness.

From consommé to coffee, it was a delightful affair—what good cheer! and how you laughed at the same old jokes and forgot to scold when Sammy upset his soup, and— and—you *did* pass up your plate for "more"? Sly Oliver Twist!

But what we most enjoy—after the clatter of the knives and forks, the tinkle of the goblets, the ripples of fun and frolic—is this post-prandial opportunity for a quiet chat. "You knew it was coming?" Suspicious, were you? Never mind, we must unburden our mind of that one thing—and, confidentially now—don't you know that "Shield Brand" is the best?

"Best what? Cognac?"

"No—*wire*—'moisture-proof'."

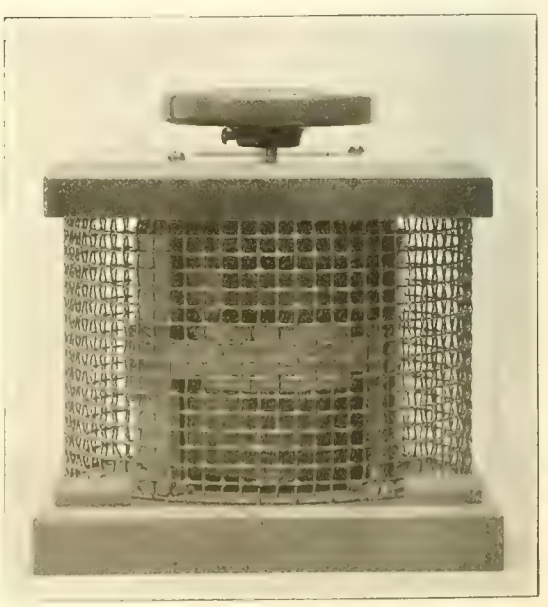
"Oh—'extra dry'?"

"Yes—'extra dry' if you will have your joke—but if you ever try it for a line wire, you will be sure to pass up your plate for more."

THE WIRT RHEOSTATS.

For many purposes the use of a rheostat or adjustable resistance is indispensable, and consequently the variety of forms in which these are made is very great. The chief difficulty has been to produce a sufficiently gradual increase of resistance and to insure good contact at the successive points, and at the same time have sufficient resistance and ample current capacity within reasonable space.

We are confident that these various points have been well combined in the Wirt Rheostats, two forms of which we illustrate here. We can make these in various sizes adapted to any special purpose for which they may be intended, such as photometric testing, dynamo and stage regulators, etc. They are finished either in hardwood polished, or mounted with marbleized slate. We will be pleased to answer any inquiries relating to these or special instruments.



The Electrical Supply Co.,

WESTERN OFFICE AND WAREHOUSES

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

Eastern Office and Factories

Ansonia, Conn.

C. R. Huntley,
General Manager.

Buffalo Electric Light & Power Co.

Office No. 5 & 6 Coal & Iron Exchange
257 Washington St.
Buffalo, N.Y. November 2, 1891

Mr W. D. Packard,
New York & Ohio Co.,
Warren, O.

Dear Sir:

We have yours of October 30th. We beg to state that we have used quite a number of your Packard Lamps, and have found them efficient and of remarkably long life. At the present time we are using your lamp with our meter customers to a large extent, finding that they, as well as ourselves, are better satisfied with these lamps than any others that we have used.

Yours very truly,
BUFFALO ELECTRIC LIGHT & POWER CO
C. R. Huntley
Gen'l Manager.

NEW YORK & OHIO CO., - Warren, Ohio.

AGENTS.

J. W. PEALE, 1 Broadway, New York.
THE E. E. & S. CO., 931 Rookery, Chicago; St. Paul and Duluth.
ELECTRICAL ENG. & SUPPLY CO., Syracuse, N. Y.
ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

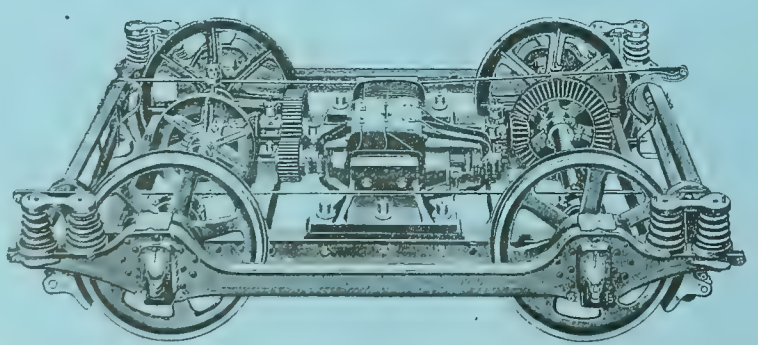
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

ONE MOTOR DRIVING BOTH AXLES

Of a street car, is the same principle as having all driving wheels of a locomotive connected, which is the AMERICAN SYSTEM.

Sizes: 15, 30 and 40 Mechanical Horse Power.



One Heat Proof Motor, Driving Both Axles.

This cut represents the latest construction of our Standard Apparatus equipped with our HEAT PROOF MOTOR. Attention is invited to the work being done by these equipments on the Merrimac Valley Street Railway, Lawrence, Mass.; Consolidated Street Railway Company, Grand Rapids, Mich.; and the People's Electric Street Railway, Springfield, Ill.; where, in each place, the two largest electric companies have put their latest equipments against them, with the result of proving our claims and strengthening the advantages derived from utilizing the full traction of the car, and driving all wheels simultaneously.

PATENTEES AND SOLE MANUFACTURERS:

DETROIT ELECTRICAL WORKS,

DETROIT, MICH., U. S. A.

Also Manufacturers of Electrical Power Machinery, Standard Line Appliances and General Electrical Supplies.

CORRESPONDENCE INVITED.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, DECEMBER 5, 1891. No. 23

"AJAX" The Best Circuit Breaker and Only Indestructible Switch.

C. S. VAN NUIS, 136 Liberty St., New York.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling. ALL SIZES *Lead Encased Wires.* Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

WILLIAM H. ECKERT, Gen'l Agent, 16 Dey St., NEW YORK.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,
5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

See Upper Half of Page ix, and Page xxv.

E. E. KELLER. F. E. DEGENHARDT.
Keller & Degenhardt, ELECTRICAL ENGINEERS,
542 Rookery Bldg., Chicago, Ill.
THE ONLY BUREAU OF ELECTRICAL INFORMATION IN THE WORLD'S FAIR CITY.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers. F. CAZENOVE JONES, Manager of Factories.
The International OKONITE COMPANY, LIMITED.
13 Park Row, New York.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

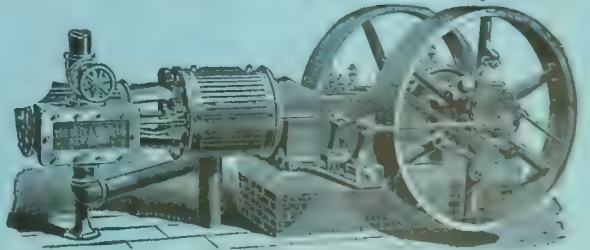
WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

THE 1891 ELECTRIC MOTOR AND BATTERY.

SIMPLE. DURABLE.
ECONOMICAL. EFFICIENT.
For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at
ONE-HALF PRICE.
Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IMPROVED BALL ENGINES,
BUILT BY THE BALL & WOOD CO., NEW YORK.



AGENTS.
W. B. Pearson & Co., Home Insurance Building, Chicago, Ill
Thos. G. Smith, Jr., 11 Hammond Building, Cincinnati, Ohio,
W. A. Day, 128 Oliver Street, Boston, Mass.
A. M. Morse & Co., St. Louis, Mo.
Cooley & Vater, Minneapolis, Minn.
Mead & Stringham, 321 Hammond Building, Detroit, Mich.

The Thomson-Houston ELECTRIC CO.,

MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000 Thomson-Houston Arc Lamps, | **750,000** Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co ...—
Alexander, Barney & Chapin.....I
American Desk & Seating Co..xvii
American Electrical Works xv
Andrews & Co., A. H..... ...—
Baggot, E xvi
Bain Electric Mfg. Co.....xviii
Ball Engine Co.....xxi
Ball & Wood Co., The I
Beckerleg, Jas. G..... xix
Beggs, J. E., Mfg. & Supply Co.xiv
Bernstein Electric Co.....—
Blatz, L.....—
Borden & Selleck Co.....xvii
Braun Illustrating Co xxi
Brownlee & Co.....xiv
Brookfield, Wm..... xiv
Brush Electric Co xix
Burton Electric Co.....iv
Butler Hard Rubber Co .....—
Buxton, Geo. B .....xv.ii
C. B. & Q. R. R.....—
C. & E. R. R.....xvi
C. & C. Electric Motor Co....xviii
Card E. Motor & Dynamo Co..—
Central Electric Co..... ... v
Chicago Electric Mfg. Co xix
Chicago Electric Motor Co.....xv
Chicago Insulated Wire Co xix
Colburn Electric Mfg. Co xvi
Consol. Elec. Mfg. Co., The...—
Crocker-Wheeler Elec. Mo. Co...xv
Day's Kerite Insulation.....I
Dayton Globe Iron Works Co..xxi
Delaware Hard Fibre Co.....xv
Detroit Electrical Works.....xxvi
Densmore Typewriter Co.....xiv
Eastern Electric Cable Co xv
Easton Electric Co..... xviii
Edison General Electric Co..... vi
Edison General Electric Co., Cable and Wire Department..... vi
Electric Construction & Sup.Co .. ix
Electric Merchandise Co.....iv, xii
Electric Secret Service Co.....xii
Electrician Pub. Co... xii, xviii, xx
Elec. Construction Co., The.....xv
Elec. Eng. & Sup. Co., The.....ix
Elec. Supply & Contracting Co..xi
Electrical Supply Co., The... xxiv
Elektron Mfg. Co.....iv
Empire China Works..... .xviii
Evans Friction Cone Co..... xix
For Sale.....xiv
Foster, O. A.....i
Fort Wayne Electric Co..... xxvi
Gleason & Bailey Mfg. Co. Ltd..xi
Globe Carbon Co.... xvii
Great Western Elec. Supply Co.. xi
Greeley & Co., The E. S.....i
Goodrich-Coleman Elec. Wks..xvi.i
Heisler Electric Co.....iv
Hemingray Glass Co xv
Hill Clutch Works.....xi
Hirlimann, C. J xvi
Hine Eliminator Co.....—
Holmes, C. H xv
Holmes, Booth & Haydens.....xi
Hood, Wm.....xii
India Rubber & Gutta Percha Insulating Co.....viii
Interior Conduit & Insulation Co..xii
International Okonite Co.....i
Kartavert Mfg Co.....xvi
Keller & Degenhardt.....i
Knapp Electrical Works xxiii
La Roche E'ectric Works..... iv
Law Telephone Co xv
Leonard & Co., H. Ward xiv
Loud, H. M. & Sons Lumber Co..xvi
McLaughlin, James ..... —
Milliken Bros. xix
Monitor Electric Co.....xii
Mosher Arc Lamp Co.....—
Munsell & Co., Eugene..... xv
Murphy, T. J.....xvii
National Carbon Co.....xvi
National Electric Mfg. Co.....—
N. Y. Belting & Packing Co.....—
New York Insulated Wire Co x
New York & Ohio Co..... I, xxv
N. W. Elec. Specialty Co.....—
Nuttall Company, R. D..... i
Ostrander & Co., W. R xvi
Paiste, H. T..... xv
Page Belting Co..... xxi
Partrick & Carter Co..... —
Payne & Co., Geo. W xvii
Pearson & Co., W. B.....xxi
Pelton Water Wheel Co.....xvi
Phoenix Glass Co.....xviii
Pond Engineering Co xxi
Powell Co., The Wm.....—
Queen & Co..... ..xv
Ries Elec. Specialty Co., The...xii
Rockford Electric Mfg. Co xiv
Royal Electric Co.....—
Samson Cordage Works. xiv
Sargent & Lundy..... xv
Sawyer-Man Electric Co.....xiii
Schawel & Co., Jas.....xiv
Schieren & Co. Chas. A.....xiv
Schoonmaker, A. O xiv
Schuyler Electric Co.....xvii
Short Electric Railway Co xiv
Shultz Belting Co.....xvi
Sperry Elec. Mining Mach. Co. xix
Standard Underground Cable Co....I
Stanley Electric Mfg. Co.....viii
Star Electrix Co..... xi
Stearns Mfg. Co.....xxi
Sterling, W. C.....xvii
Stilwell & Bierce Mfg. Co..xvi, xvii
Sunbeam Incand. Lamp Co x
Taussig, S.....—
Temple, J. C.....xvii
Thomson-Houston Elec. Co.ii, xxii
Union Electric Mfg. Co., The..—
Union Electric Works.....xi
Union Hardware Co..... ..xiv
U. S. Electric Lighting Co....xiii
Van Nuis C. S..... i
Vulcanized Fibre Co.....xvii
Wanted..... xv
Wasatch Asphaltum Co.....xiv
Washington Carbon Co., The....vii
Western Electric Co..... x
Westinghouse Elec. and Mfg Co—
Westinghouse Machine Co..... xxi
Weston Electrical Instrum't Co...xiv
Williams Engine Works.... ...xxi
Woodbridge & Turner Eng. Co. xvii
Woodhouse & Rawson, Ltd.... xvi
Worthington, Henry R..... xiv

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Samson Cordage Works.

Asphaltum.
Wasatch Asphaltum Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Hirlimann, C. J.
Law Telephone Co.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Blatz, L.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co.' The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Castings, Brass.
Blatz, L.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
La Roche Electric Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Clower, Harris & Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Easton Electric Co.
Electrical Engineering Co , The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
La Roche Electric Works.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Burton Electric Co.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co., The
Star Electrix Co.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E., Mfg. & Supply Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co,
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Hemingray Glass Co.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Wasatch Asphaltum Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus, Electric
Bain Electric Mfg. Co.
Brush Electric Co.
Electrical Construction Co., The.
Electrical Supply Co., The.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Card Electric Motor & Dynamo Co.
Chicago Electric Motor Co.
C. & C. Electric Motor Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electrical Supply Co., The.
Fort Wayne Electric Co.
La Rocte Electric Works.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Blatz, L.
Goodrich-Coleman Elec. Works.

Office Furniture.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co. The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway.
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co , The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co , The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co

Type Writers.
Densmore Type Writer Co.

Valves
Beckerleg, Jas. G

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co , The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

ELECTRIC HEATING.

BURTON ELECTRIC CO.,

RICHMOND, VA.

WONDERFUL IN ITS EFFICIENCY.

THE BURTON ELECTRIC HEATER costs less to operate than a stove, and requires **NO REPAIRS.**
THREE YEARS' SERVICE has demonstrated its practicability.
Circulars upon application. Information furnished.

WRITE TO THE SELLING AGENTS:

ELECTRIC MERCHANDISE COMPANY,

11 ADAMS ST., CHICAGO, ILL., U. S. A.

IMPORTANT.

THE HEISLER SYSTEM IS THE

ONLY APPARATUS

MADE FOR LONG DISTANCE LIGHTING THAT IS

SELF-CONTAINED

AND PROVIDED WITH ABSOLUTELY

AUTOMATIC REGULATION.

Our Series Socket is **SAFE, RELIABLE,** and **DURABLE,** and is protected with **INSULATED** covering, notwithstanding the claims of monopoly of these features by other manufacturers.

Series Sockets and Lamps for Arc Light Circuits.

WE INVITE INVESTIGATION.

HEISLER ELECTRIC CO.,

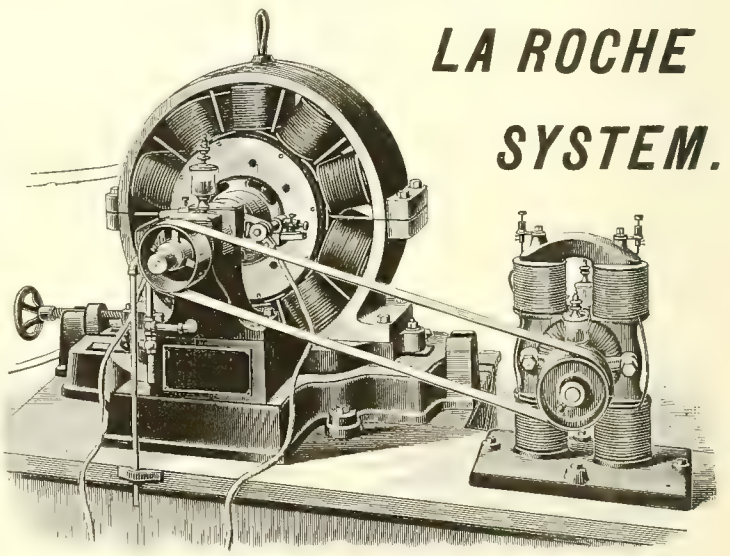
DREXEL BUILDING,

PHILADELPHIA, PA.

IMPORTANT!

BEFORE PURCHASING INVESTIGATE THE

LA ROCHE SYSTEM.



ALTERNATING DYNAMOS

FOR LONG DISTANCE LIGHTING,

FOR 100 TO 1200 LIGHTS.

AGENTS WANTED. NOTICE OUR ILLUSTRATION NEXT WEEK.

La Roche Electric Works,

116 & 118 NORTH 6th ST., PHILADELPHIA, PA., U. S. A.

YOU GET THE BEST

WHEN YOU BUY

PERRET ELECTRIC MOTORS AND DYNAMOS,

— Manufactured Only By —

The Elektron Manufacturing Co.,

NEW YORK OFFICE, 89 Liberty St. **SPRINGFIELD, MASS.**

SELLING AGENTS:

Washington, D. C., J. C. Barnes & Co., 1409 New York Ave. **New Orleans, La.,** George Baquie, 140 Gravier St. **Chicago, Ill.,** The Electrical Engineering [illegible] **St. Paul, Minn.,** F. J. Renz, 95 East Fourth St. **Philadelphia, Pa.,** Pennsylvania Machine Co., 29 North Seventh St.

WHAT'S THE USE OF BUYING SWITCHES?

WE ARE GIVING THEM AWAY.

READ THIS.

We will for 30 days from the date of this notice, give away ten, five ampere, or nine, ten ampere Paiste switches to any one sending us an order for one hundred dollars worth of goods, accompanied by this blank filled in and signed.

CENTRAL ELECTRIC COMPANY,

November 23, 1891. CHICAGO.

Central Electric Company,

CHICAGO.

Please send with accompanying order .....ampere Paiste switches, for which you agree to make no charge.

Signed.....

.....1891.

ST. LOUIS BRANCH.

OKONITE

TRADE MARK.

SOUTHERN ELECTRICAL SUPPLY COMPANY,

823 Locust St., St. Louis, Mo.

KANSAS CITY BRANCH.

OKONITE

TRADE MARK.

GATE CITY ELECTRIC COMPANY,

522 Delaware St., Kansas City, Mo.

TRADE MARK.

OMAHA BRANCH.

OKONITE

TRADE MARK.

WESTERN ELECTRICAL SUPPLY COMPANY,

418 S. 15th St., Omaha, Neb.

DENVER BRANCH.

OKONITE

TRADE MARK.

ELECTRIC POWER AND TRANSMISSION CO.,

722 Lawrence St., Denver, Colo.

TO OUR CUSTOMERS:

CHICAGO, November 16, 1891.

We have just completed arrangements with the Swan Lamp Manufacturing Company to handle their goods, and will, in future, sell this Company's lamps in preference to any others. We have heretofore been selling the Packard lamp, and in making the change, we do not wish to be understood as retracting any of our claims for that lamp. We are simply keeping pace with the wishes of our patrons, who demand a lamp of high efficiency and good average life, rather than one of low efficiency and extra long life.

As the electric lighting industry becomes one of the stable dividend paying interests of the world, station managers are obliged to pay more attention to every source of waste, and there has heretofore been none more prolific than that of low efficiency lamps, especially when the capacity of the station is about full.

The Swan lamp is one of high efficiency and good average life, say from 600 to 1,000 burning hours, while it does not blacken to any appreciable degree, even when it is nearly burned out. These lamps are made to fit any socket, and as we will carry a stock of all ordinary candle powers and voltages, orders can be promptly filled.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

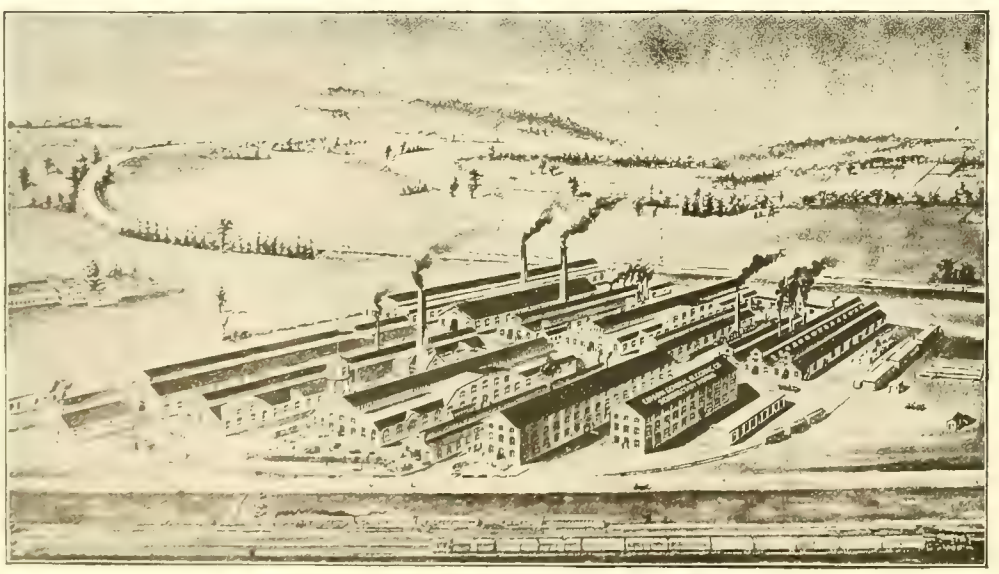
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

The CARBON TRUST'S output is much reduced since the burning of its Factory, at Fremont, Ohio.

WE HAVE A CAPACITY OF

50,000,000 CARBONS

PER YEAR.

We propose to ***continue*** in the front rank of this industry, in spite of the **VIOLENT OPPOSITION OF THE CARBON TRUST**, which is ***now*** endeavoring to monopolize the ***crude product*** of the country, and thus "freeze out" opposing concerns. We have arranged for a supply of raw material for the next two years and are prepared to meet prices, and will guarantee that our carbons are as good, if not better, than the best product of the Trust.

NOTE THE TRUST METHODS:

Companies operating under old Brush licenses are tied up to purchase all supplies from the Brush Company. The Trust bought up the Brush Carbon business because IT could ***squeeze*** these customers. **THEY ARE PAYING MORE THAN ANYBODY ELSE.** The Trust will put the pressure on you in the same way ***if*** IT monopolizes the Carbon Business as IT is trying to do.

DO YOU PROPOSE TO FOSTER A WOULD-BE MONOPOLY?

WE ARE NOT IN THE TRUST.
WE ARE NOT GOING INTO THE TRUST.
WE WANT YOUR ORDERS.
WE CAN FILL THEM PROMPTLY.

THE WASHINGTON CARBON CO.,

WASHINGTON, PENNSYLVANIA.

TAKING THE LEAD.

THOUGH ONLY

ON THE

MARKET

—FOR—

SIX MONTHS,

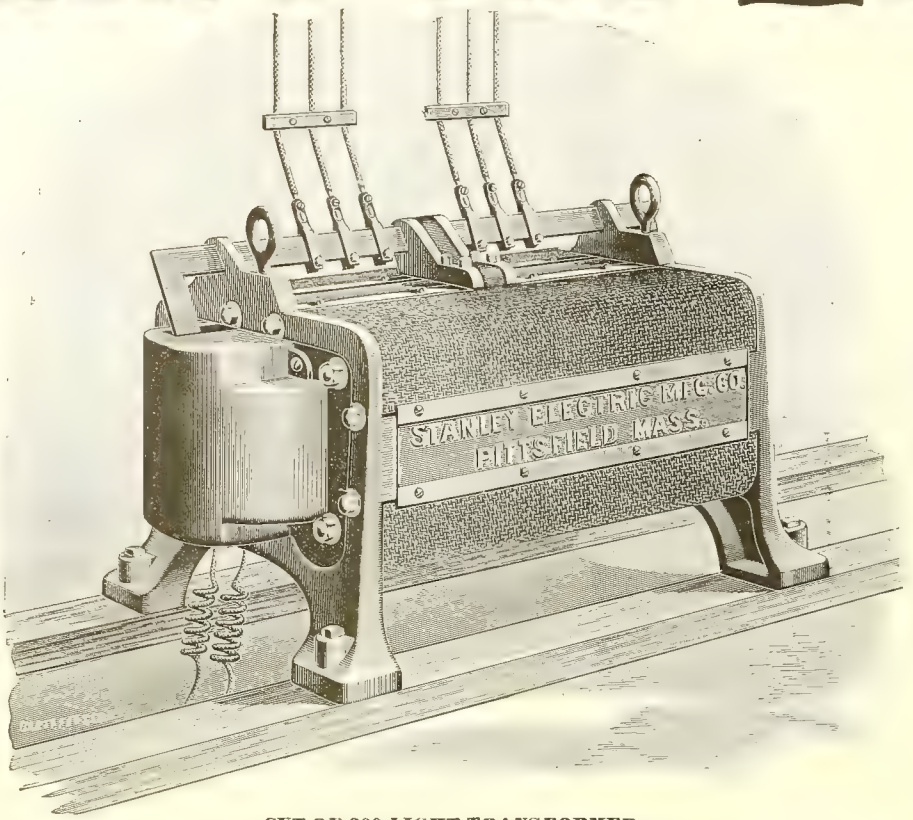
THE

STANLEY

—IS—

NOW KNOWN

—AS—



CUT OF 300 LIGHT TRANSFORMER.

THE

BEST

Transformer.

CORRESPONDENCE

SOLICITED.

STANLEY ELECTRIC MFG. COMPANY, ⋈ ⋈ ⋈ PITTSFIELD, MASS.

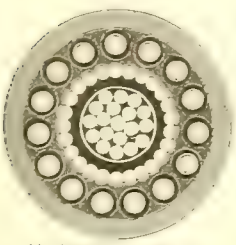
WESTERN AGENTS: The Electrical Supply Co., Corner Randolph St. and Michigan Ave, Chicago, Ill.

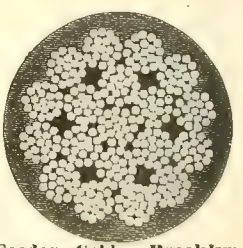
THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.

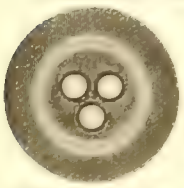
THE RUBBER USED IN

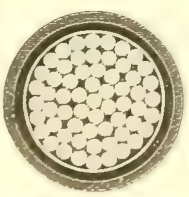
HABIRSHAW INSULATION

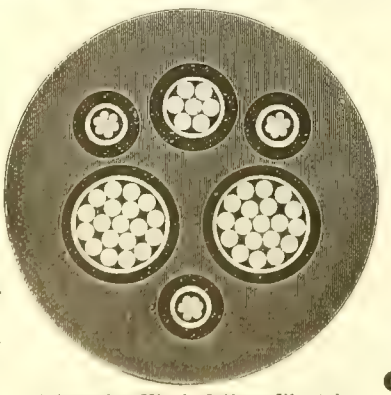
IS PURE PARA.

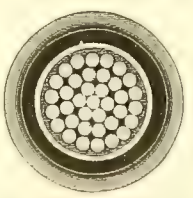

Underground Core.

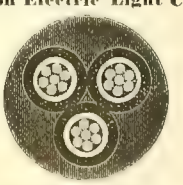

Feeder Cable, Brooklyn Edison Electric Light Co.


Underground Core, N. J. Central R. R.


Feeder Core, Broadway Theater.


Submarine Work, Edison Electric Light Co., Easton, Pa.


Naval Core, United States S. S. "Chicago."


Portable Cable, Broadway Theater.

Marine Core, used on Government Cruisers.

Naval Marine India Rubber Covered Wires.

Naval Land India Rubber Covered Wires.

PROMINENT INSTALLATIONS.

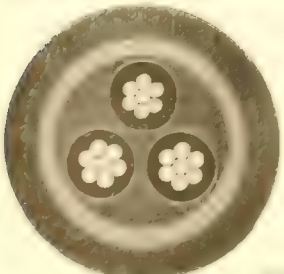
STANDARD INDIA RUBBER COVERED WIRES.

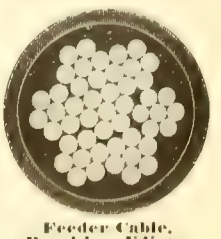
Feeder Conductor, "Drypla-es," Grand Central Depot.

Adopted by the Navy Department, and thus far employed on board the United States steamships Trenton, Chicago, Boston, Yorktown, Pensacola, Philadelphia, Petrel, Atlanta, Baltimore, Newark, Vermont, Charleston, San Francisco, Concord, Bennington and monitor Miantonomah.

SOLID AND STRANDED CONDUCTORS, TAPED, BRAIDED, FLAME-PROOF.

The Habirshaw Insulation fulfills all requirements in places demanding the "Best," and in that field finds no successful competitors.


Feeder Core.


Feeder Cable, Brooklyn Edison Electric Light Co.

FACTORY: GLENWOOD, YONKERS, N. Y.

WM. M. HABIRSHAW, F.C.S., GENERAL MANAGER.

OFFICE: 315 Madison Ave., Cor. Forty-Second St., NEW YORK CITY.

WESTERN AGENTS: THE ELECTRICAL SUPPLY CO., cor. Randolph St. and Michigan Ave., CHICAGO, ILL.

The "Packard" Lamp

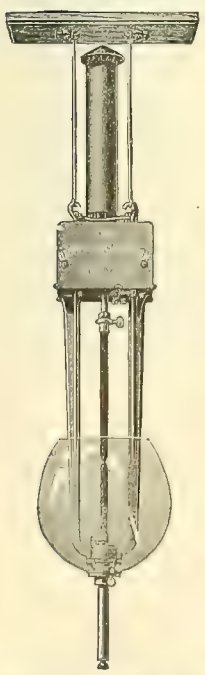
Agency has been transferred to

The Electrical Engineering and Supply Company

931 Rookery - Chicago, Ills.

The exclusive use of a strictly High Grade Lamp only will satisfy both patrons and Stockholders.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

GRIMSHAW
TRADE MARK
WHITE CORE
INSULATED WIRE

TAPES AND COMPOUNDS,
VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC,
All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,
78-80-82 Franklin Street,
CHICAGO.

MAIN OFFICE.
649 and 651 Broadway,
New York.

Geo. H. Meeker,
Western Manager.

NEW YORK INSULATED WIRE CO.
MOISTURE-PROOF
VULCA
ELECTRICAL
WIRE-DUCT
NON-INFLAMMABLE
TRADE MARK
NEW YORK AND CHICAGO.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,
227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.

SUNBEAM INC. LAMP CO.
SUNBEAM
INCANDESCENT LAMP
CHICAGO ILLINOIS U.S.A.

THE SUNBEAM INCANDESCENT LAMPS

Can be furnished of any desired efficiency or life to suit our customers. We make two standard styles of lamps, as follows:

High efficiency lamps, from 3 to 3 1-3 watts, which maintain their rated candle power from 750 to 1,000 hours.

Long-lived lamps, from 3 6-10 to 4 watts, which maintain their rated candle power from 1,500 to 3,000 hours.

Each style will be found to give more light per dollar expended in current than similar lamps made by other manufacturers.

SUNBEAM INCANDESCENT LAMP CO.,
805 Chamber of Commerce Building, Chicago.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

UNION ELECTRIC WORKS,

207 South Canal St., CHICAGO, ILLINOIS.

The **Best Electric Bell** in the market; Nickel plated Gongs; Double Magnet, Platinum Contacts, side adjustments with set screw. The simplest and most durable Annunciator, all sizes, for elevators, hote's and offices.

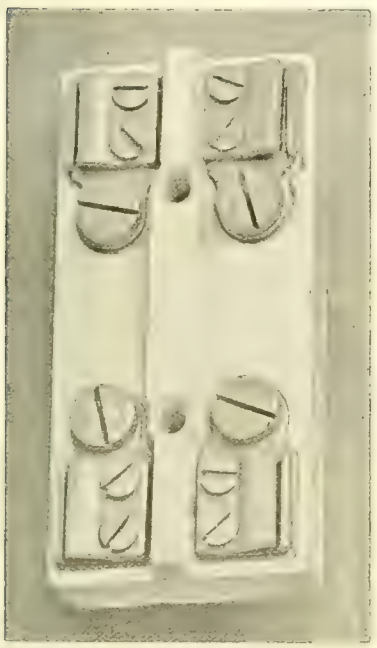
WRITE FOR PRICES.

Also Test Instruments, Spark Coils, Induction Coils and various Standard Electric Devices for Medical and Mechanical Purposes

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class work

MOVE UP FRONT!!!

WE ARE ALREADY THERE ON



SWITCHES,
ALL KINDS,
ONE POLE AND
TWO POLES.

SOCKETS,
WITH AND
WITHOUT KEYS.

CUT-OUTS,
COVERED AND
UNCOVERED.

—— (o) ——

PRICES OF
RARE QUALITY.

THE STAR ELECTRIX CO.,

641 NORTH BROAD ST.,
PHILADELPHIA.

Gleason & Bailey Mfg. Co.,

(LIMITED)

Manufacturers of, and Dealers in, a line of General

ELECTRICAL MERCHANDISE.

ALSO ELECTRIC AND COMBINATION
FIXTURES AND CLASSWARE.

Rubber Covered Weather-Proof Wires
and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

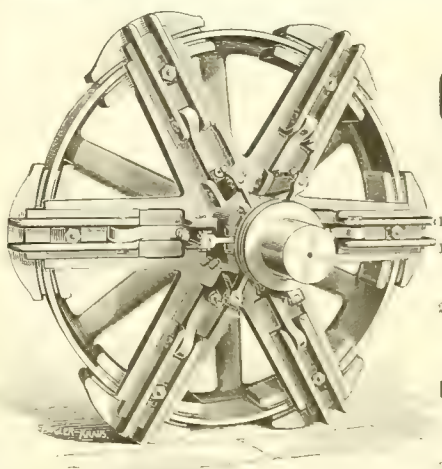
It will pay you to get our prices and new catalogue.

ELECTRICAL AND MECHANICAL ENGINEERING AND SUPPLIES.

REPAIRING

ELECTRICAL MACHINERY

The Electric Supply and Contracting Company,
S. E. Cor. Fifth and Sycamore Sts., (Nevada Building.) CINCINNATI, O.



HILL Clutch Works,

CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 25 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS

Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire. Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K."

PATENT "K.K." LINE WIRE

TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

SPECIAL NOTICE TO THE TRADE

ON AND AFTER DECEMBER 1ST, 1891,

The Price of our No. 1 Ries Regulating Socket (for lamps 16 to 25 C. P., 50 Volts) will be

$1 27½ EACH ——$3.00 EACH LESS 57½ per cent. DISCOUNT—— $1 27½ EACH

Making the NET PRICE $1.27½.

THE RIES ELECTRIC SPECIALTY COMPANY,

Baltimore and Eutaw Sts., BALTIMORE, MD.

PATENTEES AND SOLE MANUFACTURERS REGULATING SOCKETS.

FOUR GOOD BOOKS.

DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION Hand-Book.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO, ILL.

ONE DOLLAR EACH.

SUBSTANTIAL. NEAT. ECONOMICAL.

ELECTRIC RAILWAY SUPPLIES EXCLUSIVELY

OUR BUSINESS.

ELECTRIC MERCHANDISE COMPANY,

CHICAGO,

11 ADAMS STREET. ILL. W. R. Mason, Gen. Mgr.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.
Any Socket.
Any Candle Power.

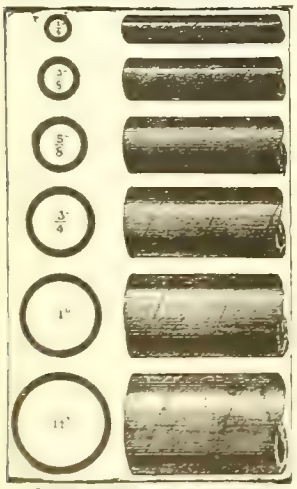
PRICES:

16 C. P. Less than 100 lots, 55 Cents.
" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding ELECTRIC CONDUCTORS

Wherever and for whatsoever purpose employed, is to be found in the

CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND CONDUITS

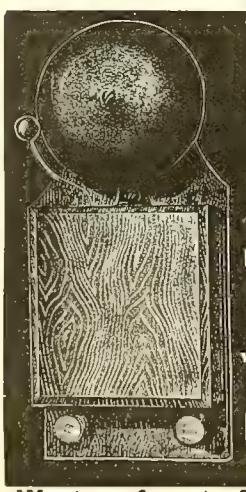
MANUFACTURED BY

INTERIOR CONDUIT AND INSULATION CO.,

WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,

General Offices: 42 & 44 Broad St., New York.

Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 226 Pearl St. Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.



MONITOR WOOD-BOX BELLS

ARE THE BEST.

Polished Case, Nickel Plated Trimmings, Heavy Magnets, Quick Stroke, Clear Ring.

Write for Quotations to

C. A. HARMOUNT, M'gr,

MONITOR ELECTRIC COMPANY

149 Wabash Av., CHICAGO, ILL.

Western Agents Alfred F. Moore's Wires and Cables.

THOMAS STURGIS, Prest. Wm. C. LANE. Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY. NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

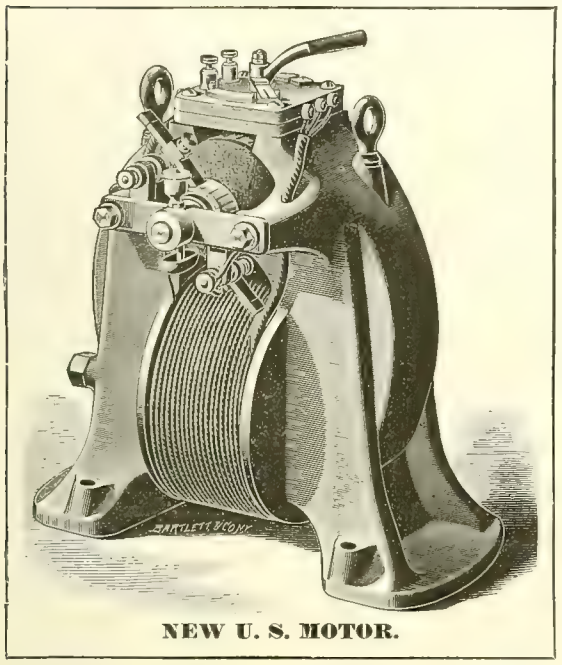
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

MOTORS and GENERATORS

Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

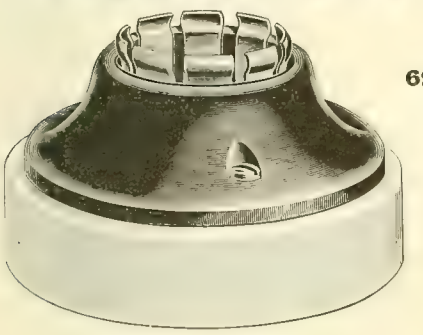
GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.

SAWYER-MAN ELECTRIC CO.,

BOSTON, 620 Atlantic Avenue.

NEW YORK, 510-534 West 23d Street.

CHICAGO, 217 La Salle Street.



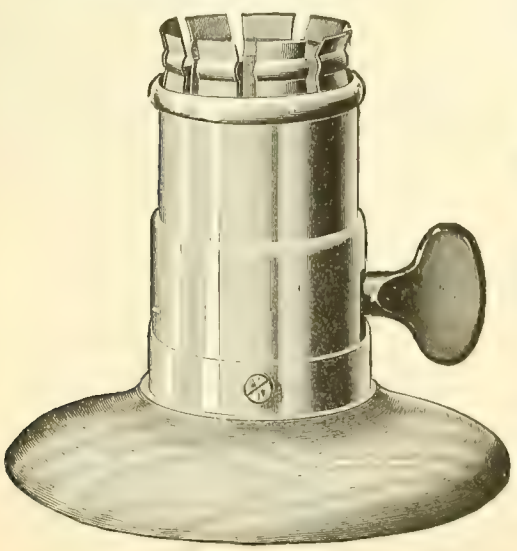
No. 135. All Porcelain Keyless Wall Socket.

INCANDESCENT LAMPS.

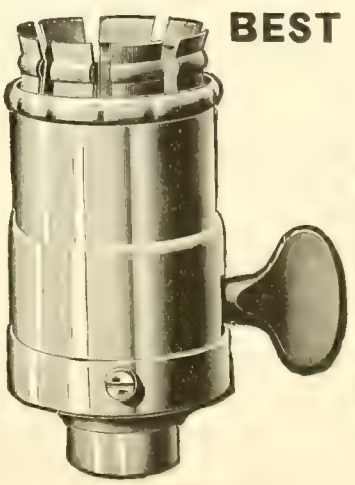
Orders Executed Correctly and Promptly.

SOCKETS.

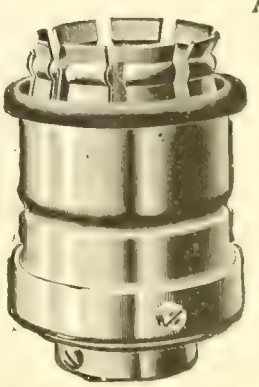
BEST AND CHEAPEST.



No. 125. Key Wall Socket—Porcelain or Wood Base.



No. 110. Key Socket.



No. 120. Keyless ⅜ inch Socket.

ALSO—

No. 115. Keyless Socket, 1-8 in.

No. 130. Keyless Wall Socket—Porcelain or Wood Base.

No. 145. Keyless Socket for 75, 100 and 150 c. p. Lamps.

No. 150. Waterproof Socket.

No. 140. Attachment Plug, with Fuses.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

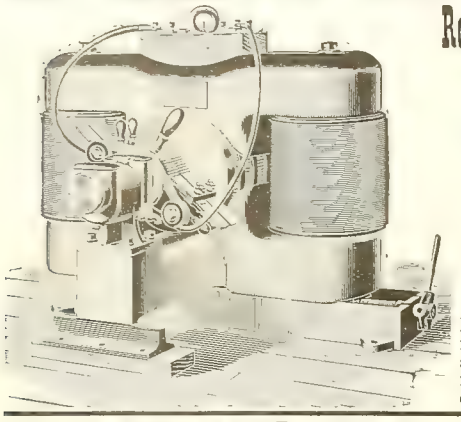
PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO. ILL.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway).

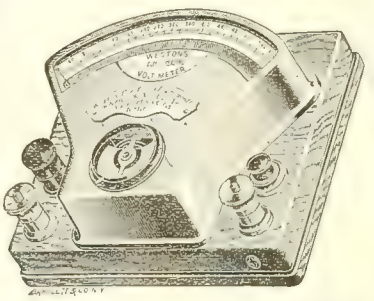
Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114 & 116 William Street, **Newark, N. J.**

PLATINUM. JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

NOW THEN! FOR SALE CHEAP!!

Six 400 light Thomson Houston Incandescent Dynamos, 110 volts. Perfect order.
Three 25 light 2,000 candle power American Arc Dynamos. A 1 order.
Two 50 light 2,000 candle power Sperry Arc Dynamos. A 1 order.
100 Goose Necks, Sockets, Lamps, etc., complete, good.
50 miles No. 10 American Electric Co. Wire, good order, used one year. In ½ mile reels.
Two 400 light Thomson-Houston New Armatures.
70 American Single Carbon 2,000 candle power Arc Lamps. A 1 order.
Two 50 H. P., 700 volts, Edison Generators, used six months.
Ten 5 H. P. Sprague Motors, used six months.
Two Edison Electric Mining Rock Drills, used six months.
High Speed Engines and Full Station Equipments, Poles, etc.
Eighty 2,000 candle power American Double Carbon Arc Lamps, used three months.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

Wasatch Asphaltum COMPANY.

Proprietors of the largest and richest Asphaltic Limestone mines in the world.

MANUFACTURERS OF

ROCK ASPHALT MASTIC,

For Paving, Roofing, Basements, etc.

ASPHALTINE

(Or Liquid Asphalt),

For Coating Piles, Ties, Poles, etc.,

ALSO SOLE AGENTS FOR

The Salt Lake Gilsonite Co.'s

"Uintaite," "Grahamite,"

OR

PURE GUM ASPHALTUM

For all INSULATING Purposes.

Office, 71 Culmer Block,

SALT LAKE CITY, UTAH.

Correspondence solicited, and samples furnished.

SOLID BRAIDED CORD.

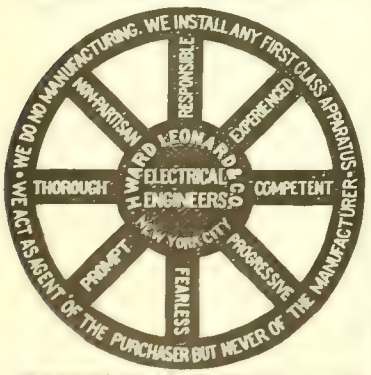
Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

H. WARD LEONARD & COMPANY.

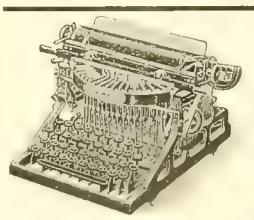


Supplies from any Electrical Apparatus or Construction Works for Railways, Lighting, Telephones, Power Wiring, etc.

Electrical Exchange Building, NEW YORK CITY.

You Will Oblige

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.



The "DENSMORE,"

The World's Greatest Typewriter,

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type-bar machines.

Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Steel throughout.

STANDARD KEY-BOARD, with shift carriage for capitals. Call or send for catalogue.

"A perfect machine. Am delighted with it. A pleasure to run it." —CHAS. D. KELLY, Stenographer West Shore R. R., New York.

We will appoint a reliable dealer in all cities as soon as possible, and in the meantime will ship machines on approval to parties having a good commercial rating.

DENSMORE TYPEWRITER CO., 202 Broadway, New York.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

THE SHORT DYNAMO.

Efficiency, 92 Per Cent.
From 75 to 500 Horse Power.
Flat Ring Armature.
Multiple Brushes.
Large Commutator. Independent Coils.
Perfect Ventilation.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.

THE UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

35 CHAMBERS STREET, NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, DECEMBER 5, 1891. No. 23

New Thomson-Houston Freight Switching Electric Locomotive.

About a year ago, at a meeting of the Chicago Electric club, there was considerable discussion as to the possibility of electricity being applied on steam roads. There was a concensus of opinion that it would, perhaps, be some time before the electric system would come into general use on extended steam lines. But the discussion turned on the question as to the practicability of the introduction of the electric motor for switching work in large railway freight yards. It was very generally conceded that such an application would be not only practicable, but in many cases very advantageous. To-day the problem is found to be fairly on its way to solution. The illustration presented herewith speaks for itself. The Thomson-Houston company has taken hold of this problem, and the cut shows the extent to which it has carried its experiments.

For some time this company has employed in the yards of the factory at Lynn quite an extensive system of tramways. The works at Lynn cover a very large area and these tramway lines extend like a network throughout the inclosure to points wherever it may be necessary to handle stock, heavy parts, or completed pieces of apparatus. The gauge of these tramways is standard, 4 feet 8½ inches. The freight locomotive was designed for the heaviest switching work in the yard. At present it is employed handling freight cars. The design of this new locomotive is substantial in every respect, it being the Thomson-Houston company's practice to pay more attention to strong and solid construction than to ornamentation.

The motor proper of the new machine is estimated to be from 80 to 100 horse power. It is set in the bed of the car and connected by gearing with one axle of the two. Direct connection with the second pair of wheels is made by means of the side rods in a manner similar to that employed in coupling locomotive drivers. The frame of the machine is of cast steel. The drivers are 48 inches in diameter. The motor is wound for 500 volts, or in other words for the factory overhead system. The weight of the machine is 60,000 pounds.

NEW THOMSON-HOUSTON FREIGHT SWITCHING ELECTRIC LOCOMOTIVE.

Double Carbon Suit.

Considerable interest has been manifested in the new suit brought by the Brush company against the Western Electric company for the alleged infringement of the former's double carbon arc lamp patent by the manufacture and sale by the defendant of the "Twin" arc lamp. The defendant's appearance must be entered by December 7th and its answer filed on or before the first Monday in January. On the part of the defendant affidavits were offered in the contempt proceedings, in which the claim set up in the present suit was brought forward, by Prof. J. P. Barrett, Prof. Davies of the University of Wisconsin, Prof. Elisha Gray, Thomas D. Lockwood, Franklin L. Pope and others. Prof. Gray deposed that the "Twin" lamp "was built up of two separate and independent lamp mechanisms, each in itself completely operative, and the two mechanisms act to control the carbon rods of the two lamps independently, and no action of the one mechanism can in any way actuate, affect or modify the motions or adjustments of the other, and the statement to the contrary found in Prof. Morton's affidavit is untrue, whether based upon an examination of the mechanism of the lamps or upon the incorrect representations in the diagram of the affidavit." Prof. Barrett also says, in his affidavit, that the lamp contains two complete regulating mechanisms, each operating independently of the other. The case is one that will be watched with interest by the entire electrical fraternity.

Electricity at the World's Fair.

Prof. Charles A. Perkins of Hampden Sidney [illegible] has written to Chief Barrett [illegible] collection of historical apparatus [illegible] connection with the display of electrical exhibits. He thinks that such an exhibition would be especially attractive to those in attendance at the electrical congress. He speaks of the instruments of Gauss at Heidelberg, Maxwell at Cambridge, Faraday at the Royal Institution of London, Hertz at Carlsruhe and Bonn, Henry at Princeton, and Rowland and Hall at Johns Hopkins. "The exhibition of the Sorbonne at the Paris exposition," says Prof. Perkins, "was to me one of the most interesting in the place, and they might very likely duplicate the exhibition. Such an exhibition might bring together apparatus which can only be seen with extreme difficulty, even if one makes careful search in European institutions."

The bureau of construction has contracted for a [illegible] horse power Armington & Sims engine for use in connection with the temporary light and power plant.

The rules for the department of electricity, which have been in preparation for some time, have been approved by the director-general and were issued last week. They are as follows:

1. Applicants for space in this department are requested to furnish the following information as near as possible:

A drawing to the scale of one-quarter inch to the foot, showing size of space desired and general distribution of articles to be exhibited; also aisles, if any, among exhibits. Express length, breadth, etc., in feet and inches.

State whether current for motors, lamps, or other devices is required, specifying quantity and potential in volts and amperes.

If power for operating machinery is required state number of horse power wanted.

The above information is absolutety necessary for the proper allotment of space.

2. Applicants accepting space must agree [illegible]

n accordance with the rules and regulations except when special arrangements are made in writing with the chief of the department, and are requested to give earliest possible notice if they decide not to exhibit. Whenever exhibits will admit the exhibitor is requested to display in glass cases.

3. No exhibitor can exhibit in other than his own space without obtaining the written permission to do so from the chief of the department.

4. No exhibitor will be allowed to arrange his exhibit in a way to occasion inconvenience or affect the display of other exhibitors. The chief of the department reserves the right to order any change in the design or arrangements of exhibits in the interest of harmony or the protection of other exhibitors.

5. The floor of the electrical building is designed to sustain a weight of 150 pounds per square foot. Any exhibit requiring an extra support, in the judgment of the chief of the department, must be furnished with satisfactory support or foundation at exhibitor's expense.

6. All exhibits of dynamos and dynamical current generating apparatus intended for operation, with full, or more than a very small percentage of their full, capacity, will be located in Machinery Hall, and will be placed in practical operation for transmitting current to the exposition buildings. Applicants for space desiring to offer their exhibits of dynamos and generators, etc., for the service of the exposition for lighting the grounds and buildings for artistic effects, or for furnishing power to the various departments, should communicate with the chief of the department of electricity as early as possible.

7. All platforms, railings, counters, signs, partitions and show cases must be erected at exhibitor's expense and shall not exceed dimensions given below. All designs for the above with location of same in exhibitor's space must be submitted to the chief of the department for his written approval before installation is begun. Show cases shall not be higher than fifteen feet above the floor of the main aisles. Counters shall not be higher than two feet ten inches above the floor of the main aisles. Railings may be erected, but must be of a uniform height of two feet six inches and subject to the approval of the chief as in rule 8. Platforms will be allowed only in certain parts of the building. All exhibitors wishing platforms to cover their space must build them to a uniform height of eight inches. Partitions will be allowed only in certain parts of the building, and in all cases must not exceed fifteen feet in height, and must be approved in writing by the chief of the department before their erection is begun. Signs must be ornamental in character, and designs for the same must be submitted to the chief of the department for his written approval. No signs will be allowed to extend beyond the

[illegible]

will be allowed for moving machinery in this building, and must be furnished at the expense of the exhibitor. Shafting and motors will be under the care of the exhibitors requiring them, but can be erected only on receipt of a permit from the chief of the department. Exhibitors must arrange their exhibits in such a manner as to require a minimum of shafting by using motors connected or belted to their machinery direct.

11. Exhibitors may employ watchmen to take care of their machinery and exhibits at night, but such watchmen will be subject to the approval of the chief of the department.

12. Exhibitors will be required to have their space cleaned and all rubbish swept into the aisles within one hour after the close of the exposition at night. In cases where this rule is not complied with the work will be done by the department and charged against the exhibitor. No sweeping will be allowed during exposition hours.

13. The distribution of cards, circulars, pamphlets or samples about the building or its vicinity will not be permitted under any circumstances. Exhibitors can distribute such articles only from their own space, but will not be allowed to solicit their acceptance.

14. The arrangements and erection of electric conductors in all parts of the building shall be wholly under the supervision of the chief of the department, whose directions must be followed, and whose decisions shall be final.

15. Exhibitors will be required to attach to each exhibit a printed or typewritten description in the English language of the use and operation of the object exhibited for the information of the public.

16. Exhibitors or their agents will be furnished by the department with duplicate cards upon which must be the name or description and the catalogue number of each article entered for exhibition. These will be countersigned on receipt of articles into the exposition. One of these cards shall be conspicuously attached to the article described and the other to be retained by the exhibitor to serve as his order for the article at the close of the exposition.

FIG. 1. OPERATING A TELEPHONE TRANSMITTER WITHOUT AN INDUCTION COIL.

FIG. 2. OPERATING A TELEPHONE TRANSMITTER WITHOUT AN INDUCTION COIL.

Operating a Telephone Transmitter Without an Induction Coil.

In a recent issue of the WESTERN ELECTRICIAN there was illustrated an alternating current telephone transmitter devised by J. J. O'Connell, E. E., of the Chicago Telephone company. The accompanying sketch, Fig. 1, shows a circuit and the mode of operating such a transmitter directly from battery or dynamo current without the aid of an induction coil. The instrument, it is stated, worked as well as when the induction coil was used. The humming noise caused by the varying current of the dynamos was reduced to a minimum by placing retardation coils and a condenser in circuit as shown by the diagram. With this circuit, .22 ampere was used to operate the instrument. Mr. O'Connell is satisfied, though, that with the transmitter provided with platinum contacts and so adjusted that there would be a "make and break" alternately between each of the two [illegible] a smaller amount of current would do the work satisfactorily. A repeating coil was cut into circuit [illegible] This was dispensed with [illegible] storage battery [illegible] the retardation [illegible] condenser.

Fig. 2 [illegible] a storage battery was [illegible] and the instrument worked as well as when operated with an induction coil. This system has been worked on lines between Chicago and [illegible]

Electric Cigar Lighter.

The device shown herewith is an electric cigar lighter, designed to be automatically thrown into circuit, and thus become incandescent when turned to the proper position for applying it to furnish light to the end of a cigar.

The operative parts of the lighter are inclosed in an outer casing formed in the shape and about the size of an ordinary cigar. This casing consists of a shield of wood covered with binding paper or cloth so as to imitate a cigar as closely as possible. The casing is made hollow at the enlarged end, and across it extends a wire of platinum shaped as shown. The wire is partially surrounded and backed up by a filling of asbestos fiber. Within the casing and between conducting strips there is a metallic ball, adapted, as the casing is turned to an upright position, to roll between the strips and thus form an electrical connection, causing the current to heat the wire to incandescence. A cigar may be lighted by placing the end against the exposed surface of the wire in the same manner that a light could be obtained from another cigar.

G. N. Engert of Springfield, O., is the inventor.

Suggestive to Hotel Proprietors.

"Put out the light when you leave the room" are the words of an injunction which, if there was any chance of its being obeyed, would be posted by that long suffering individual, the hotel proprietor, in every room of his house. But as long as there are rooms and lights which have to be put out, just so long will many of the careless people which the world is so full of leave them burning. It was this peculiar failing of weak humanity that led E. J. Hodgson and J. W. Stearns, Jr., of Denver, Colo., to devise a method of controlling the incandescent electric light circuit of hotel apartments, by the shooting or withdrawing of the bolt of the door. It is the hope of the inventors to prevent by their method the burning of the lamps in cases where by inadvertence or mistake, the occupant had left his room without turning off the lamps. The details of the device through which they expect to accomplish their purpose is shown in the accompanying cut.

As will be readily seen, the essential mechanism by which the lights are controlled is set in the door frame. The switch proper is nothing more than a plunger so arranged within a cylindrical shell carrying the necessary contacts, that the shooting of the bolt in locking the door forces the plunger to the position indicated, and breaks the circuit, and so extinguishes the lights.

SUGGESTIVE TO HOTEL PROPRIETORS.

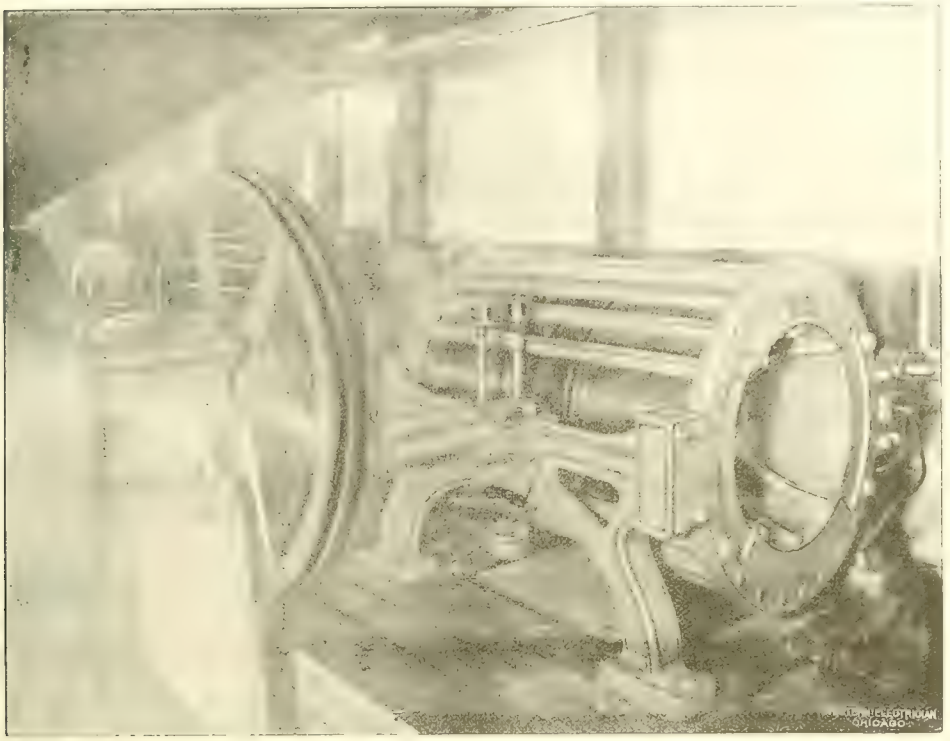
It is supposed that in shooting the bolt it will be done from the outside of the door by turning the key in the usual way. As soon as the door is unlocked or the bolt withdrawn the circuit is again established, and the lights in the room turned on.

The fastening of the door from the inside may be by a sliding bolt or by another key-actuated bolt manipulated through another key-hole. While the practicability of the invention as here described may be questioned, the idea embodied is suggestive.

Comparatively few people are aware that Chicago has a building almost wholly built by the students of an industrial school. The new building of the Institute of Technology, 147 Throop street, is the first building west of New York city constructed wholly or in part by students. No better evidence of the practical character of the instruction of a school could be desired. The teaching of trades is in accordance with the broad plan of this institute, which proposes to teach "Any person any study, day and evening." It now announces the organization of evening classes in plumbing and bricklaying, as well as architecture and engineering. Draughting of all kinds is made a specialty, three instructors being employed.

Chicago "Herald" Building's New Electrical Equipment.

The new *Herald* building on Washington street, Chicago, is one of the handsomest and most imposing commercial structures in the city, as well as one of the most complete newspaper plants in the country. It is scarcely necessary to say that electricity plays an important part in the equipment of the building. Attention is attracted to the building by the huge sign stretched across the roadway in front of the building. This sign contains 334 incandescent lights arranged so as to form the words, *Chicago Herald*. Each letter is made upon a separate board suspended from the cable, the successive letters being fastened by the wires, which run upon the back, so that the entire sign can be moved bodily along the street cable. Care was taken in the construction of the sign that it might withstand the changes of weather, a shower of rain or a snowstorm.



CHICAGO "HERALD" BUILDING'S ELECTRICAL EQUIPMENT.—ARC LIGHTING PLANT.

The handsome counting room of is one of the most attractive parts of the building. Five longitudinal and four transverse beams divide the ceiling into twenty panels, the centerpiece of which, surrrounded by arabesque work in gold relief, is a cluster of incandescent lights shaded by beautiful opalescent globes, which mellow the radiance of the lights into a bluish-green tint that completes the harmonious blending of colors. There is light in profusion, not less than two hundred incandecent lamps and thirty arc lights being employed in the illumination of the ground floor alone.

The numerous offices of the building are all connected by an electric signaling system, which will no doubt prove very advantageous. The publisher's office is not only connected with all the other departments, but it has direct telegraph communication with the outside world.

This idea of utilizing electricity in place of messengers is found in all departments of the paper. Every reporter's desk is connected with that of the city editor, and the latter by pressing a button may summon to his private office any of his thirty assistants. The same plan is followed in the composing room, where the foreman notifies the compositors that there is copy on the hook by a buzzer system. There are many other ways in which electricity is utilized, but the greatest interest is centered in the plant located in the basement, which supplies light and power throughout the building. Two views of this plant are presented in the accompanying illustrations.

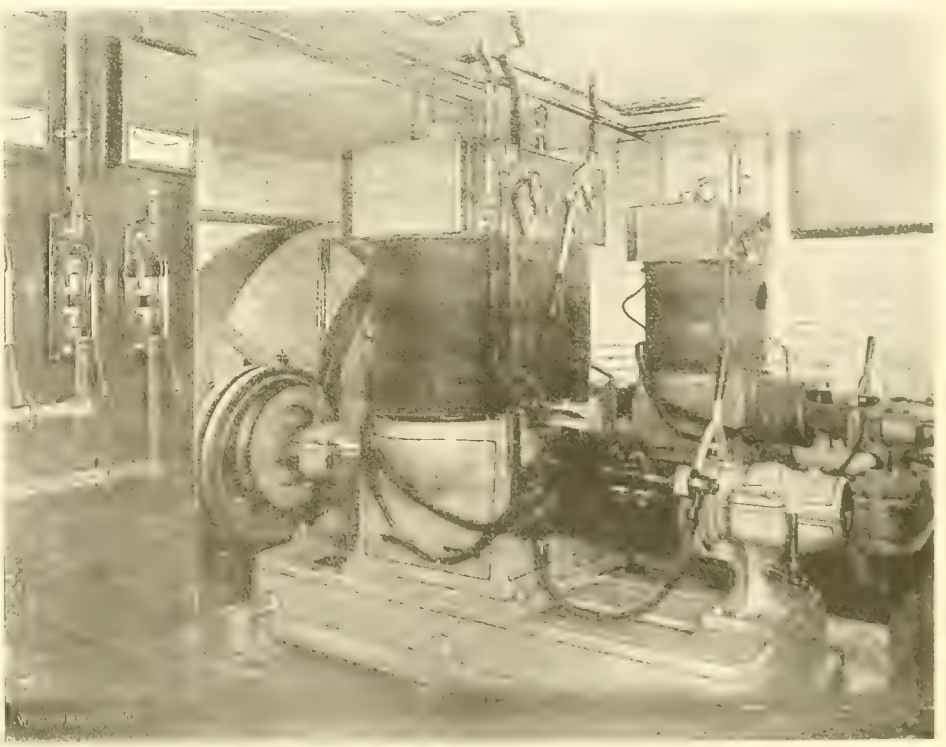
There are two Edison compound wound 800 light machines and two Thomson-Houston arc light dynamos. The building is also connected with the central station of the Chicago Edison company on Adams street, so that in case of an accident in the power room of the *Herald* building the offices will not be without light, as by throwing a switch the entire building can be transferred to the central station. Directly south of the dynamos the Edison switchboard is located. It is of black Belgian marble, upon which is placed the indicating and regulating apparatus for the dynamos, together with the switches for throwing the dynamo on [illegible] and off circuit. The electrical conductors used upon the switch board and ceiling are very highly polished rectangular copper bars, mounted upon black marble [illegible] and held in place by polished brass cleats. All the cleats and castings upon the switch-board are of special design, and the polished copper against the highly finished marble background presents a very handsome appearance.

The building has been wired on the three-wire convertible system for 3,000 incandescent lamps. There are over 60,000 feet of wire. The plant was installed by the Chicago Edison company.

There are fifty arc lamps distributed through the building and ten electric motors. The latter are used principally in the engraving, stereotyping and press rooms.

The facilities for handling telegraph news are simply superb. The offices and operating rooms of the United Press association are in this building and they are well equipped. Twenty loops run to the switch-board—ten from the Postal and ten from the Western Union company's main office. There are four sets of button repeaters [illegible] charged from the plant in the basement.

The [illegible] editor and telegraph readers, is provided with the most [illegible] instruments for twelve operators, and eight of these are so [illegible] of the desks, which are closed when the instruments are not in use. Four other telegraph tables are not provided with typewriters.



CHICAGO "HERALD" BUILDING.—ELECTRICAL EQUIPMENT IN [illegible] PLANT.

Triumphs of Electricity.

If the daily papers have anything to say about it, no obstacles will be thrown in the way of the application of electricity in any line proposed, for they have, apparently, unlimited faith in it. This is the enthusiastic style in which the *Cleveland Leader* treats of the subject:

One advantage possessed by electricity over steam power, the importance of which is seldom duly considered, is made conspicuous by the action of the Columbian Exposition management in constructing an electric plant at Jackson Park sufficient to permit the doing away with steam engines within the grounds of the World's Fair. The purpose is to reduce the risk of fire. It requires no very active imagination to see in this simple fact a fair promise of changes which will save a multitude of lives and a vast amount of property. Little or no doubt exists that the steam locomotive "must go," together with the car stove and the railway lamp. We shall see railway trains heated, lighted and propelled by electricity, which will be kept under such control that there will be no more horrors of fires added to the other awful features of railroad wrecks. Wounded passengers will not perish miserably while imprisoned in the debris of broken cars, and freight trains which come to grief will not burn the ties out and destroy the track while valuable merchandise is being reduced to ashes. Later more momentous changes may be brought about by the distribution of electric power, electric heat and electric light to all parts of cities, including mills and factories, from a very few great central reservoirs of electric energy, filled either by steam power, or, perhaps, by the force of the wind and the tides and the waves of the sea. It need hardly be said that the result will be an immense decrease in the number of fires. It amounts to nothing that electricity in its present very limited uses causes many fires. The appliances now in vogue will be so much improved upon that the fire risk will be reduced to a minimum, and the danger to human life will also be much less than it is now. With the general substitution of electricity for steam power, heating apparatus in which fuel is burned and gas and oil lights will come the solving of the smoke problem [illegible] and a marked consequent improvement in [illegible] sanitary conditions of the great centers of population, to say nothing of comfort and æsthetic considerations. Manufacturing cities in which [illegible] would gain enormously in attractiveness by the concentration of the [illegible]

power houses, where the very best smoke-consuming devices could be employed, and which might be located outside of the thickly populated districts. The subject is one of rare fascination for the imaginative mind. At present we can only catch glimpses of the coming wonders of the age that are to be characterized by that mysterious form of energy of which we at present know so little and hope for so much. What has already been accomplished, however, is only a hint of the triumphs sure to be witnessed in the future, if the history of the great advances in the control and use of natural forces may be taken as a guide.

Combination Electric Railway Section Insulator and Lightning Arrester.

It will be remembered that Elihu Thomson, about a year ago, brought out a lightning arrester in which there was employed a series of conducting plates separated from each other by intervening plates of insulation. The principle of this arrester is well known. These plates and the insulation were so proportioned to the potential of the current that an arc, it was claimed, could not be formed throughout the entire series. Prof. Thomson has just embodied this principle in an arrester and section insulator for the overhead electric railway system. The

FIG. 2. COMBINATION ELECTRIC RAILWAY SECTION INSULATOR AND LIGHTNING ARRESTER.

details of the arrester are shown very clearly in Fig. 1. The manner in which the device is employed in its dual capacity as section insulator and arrester may be understood from Fig. 2. In the latter cut the ground connection is shown.

The device in detail consists of a number of conducting plates arranged in line with the trolley wire and separated from each other by an intervening insulator. The plates are threaded upon a bolt covered by an insulating tube throughout its entire length. The bolt passes through central openings in the plates. The washers of mica and the air spaces separate the plates and prevent any electrical connection from one to another. The bolt connects mechanically the two ears into which the bent ends of the trolley wire are inserted and fastened by set screws. The washer at the nut on the end of the bolt and the one at the head, guard effectively against any electrical communication being established between the plates and the bolt. An insulated pin, shown in the cut just above the bolt, holds the metal and mica plates in line. Over the whole device there is, as indicated, a hood of insulating material. Where there is an earth connection the current will ordinarily be made to pass to the middle plate of the series, so that the flow from either connection will be intercepted at the center of the device and the discharge carried to the ground rather than pass the entire series of plates. Lightning discharges reach the ground by jumping the air spaces between the plates until the one in the middle is reached, whence they pass to the earth.

Fire at the Thomson-Houston Carbon Works.

[illegible] a considerable portion of [illegible] Houston Carbon com[illegible] was insured for $120,000 in twenty five eastern and foreign companies. The spike works were valued at $50,000 and were insured for $25,000. The fire spread with great rapidity owing to the high wind. The buildings covered nearly three acres. Two hundred and fifty men are thrown out of work.

It is claimed that the fire will not greatly interfere with the company's business, however.

The Telegraph Thirty Years Ago.

"This Day Thirty Years Ago" is the title of an article of unusual interest in a recent number of the New York *Sun*. It is based upon the history presented in a copy of the *Sun* published during the great civil war, when little attention was given to anything else and newspaper readers had little idea or care for any news other than such as came from the seat of war. Hardly any other intelligence reached the dignity of news in the estimation of the people. "Kings might come and go and thrones be shaken; but what did the telegraph bring from the army?"

There was no cable, but much interest was manifested in news from England, for Mason and Slidell had just been captured, and the outlook for a passage-at-arms with Great Britain was promising. The news from Europe came by the way of Newfoundland and frequent attempts to intercept it were made. It appears that the telegraph companies even at that remote period had to contend with wire cutters, and a repair force of linemen was kept pretty busy in the neighborhoods of St. Johns those days.

In the copy of the *Sun* referred to there appears this significant telegraph dispatch from St. Johns, N.F.: "The telegraph line breakers are still at work. The wires were cut on Tuesday night at 8.30 o'clock thirty-three miles from here and repaired by 7 o'clock this morning. There is an improvement in the manner of cutting the wires. They are filed off instead of being clumsily cut with a stone." From this it would seem that the telegraph company realized the necessity of keeping even at that early day a repair gang for such occasions. Truly the *Sun* says: "It is one characteristic of a newspaper that it is fully as interesting when it is a half a century or a century old as on the day when it comes damp from the press."

Following the Lead of America.

In urging that an electrical congress be held in connection with the coming Crystal Palace electrical exhibition next year, the *Electrical Engineer* of London uses the following complimentary language:

When Frenchmen initiate an electrical exhibition at Paris, a congress or conference follows as a matter of course. When Germans initiate an exhibition at Frankfort the inevitable congress is also held. When Americans condescend to go in for a universal exhibition a congress will be a necessity, and we may be sure that it will be thoroughly organized and be successful. By the by, has any student of language noticed how rapidly Americanisms are becoming common? This is largely due to the fact, no matter how we may kick against it, that America is becoming the center of the world's action. Its newspapers initiate new departures, and the Old World copies, sometimes with acknowledgment, more often without. Hence we, too, often "locate" an engine instead of "place" the engine. Its "location," not its position or "situation," is good, bad or indifferent. It is the Chicago "exposition," not the old English "exhibition," and so on through the whole gamut of newspaper literature. Then again, many people in this country have suggested the necessity of meetings somehow and somewhere of the "conventions" kind so common in America, where papers on practical questions are read and discussed. The English characteristic is to pretend all one's manufacturing and constructional details are of immense value, and keep them absolutely secret. The Englishman, in fact, pretends to a supernatural knowledge of details over and above his fellows. The secrecy about matters electrical is ridiculous, for there is no bigger practical detail that is not easily [illegible] to anyone who likes to investigate. As for [illegible] hundred and ninety-nine paper details, many of [illegible] find their way to the Patent Office, they are not worth the paper they are written upon. We contend, [illegible] the Englishman might well be a little freer with information of manufacturing and constructional detail, [illegible] better.

[illegible] LIGHTNING ARRESTER.

[illegible]

Underground Electric Roads in Germany.

Several projects for supplying Berlin with underground railways have been brought before the German government and the Berlin civic authorities. The projects include a line to run from the north to the south of the city, one to run from the east to the west side, and also a circular suburban line. The circular line will pass through the terminal stations of the two other lines, and will also pass close to the existing principal stations, and connecting staircases will be erected so that communication can be easily made from station to station. Each of the underground lines will be placed at a different level, so that there will be no danger arising from the risk of collision. It is proposed to construct the north and south line first, and it is to be placed at a depth of 29 ½ feet below the level of the street. Where the line goes under the bed of the River Spree, it will have a depth of 36 feet. It is not expected that the water percolating through from the river will offer any great difficulty to the construction of the tunnel, which will consist of iron tubes bolted together. The iron tubes are to have an external covering of cement. The power is to be furnished by electricity conveyed to the motor cars by conductors. Each train will consist of a locomotive and three passengers cars, each capable of accommodating forty passengers. The speed to be obtained on the line is about 9½ miles per hour. Two years are to be allowed for the construction of this line, the estimated cost of which is about $3,000,000.

Wheeler's Cut-out.

A simple multiple fuse cut-out, the invention of G. K. Wheeler of the western department of the Thomson-

WHEELER'S CUT OUT.

Houston company, Chicago, is illustrated in the accompanying cut. By the use of this device a number of fuses may be successively inserted into a circuit without any delay or chance of a shock. The construction of the cut-out is so clearly shown in the cut that no more than a word is necessary to describe it. On a substantial base-piece there is pivoted a disk of insulating material provided with a handle. This disk is free to turn, and has attached at its edge a number of contact pieces which project a short distance. The fuses are secured to these contact pieces by screws, as shown. As the disk is revolved, every fifth of a turn a new fuse is inserted in the two contacts shown to the left.

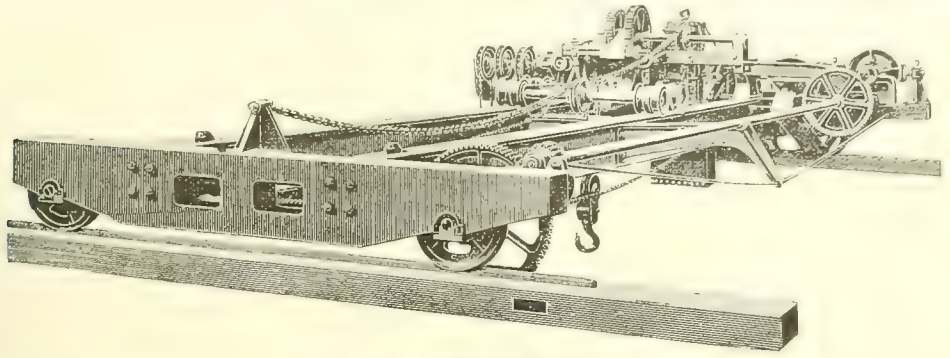
Electric Lights in the Cook County Abstract Building.

The Cook County Abstract building is now in process of erection on the south side of Washington street, between Clark and Dearborn. It is to be sixteen stories high, absolutely fireproof in construction, and will, when finished, be one of the largest and finest office buildings in Chicago. The building will be lighted by 3,000 incandescent lamps; current to be supplied from the Adams street station of the Chicago Edison company. The building will be wired upon the three-wire convertible system, using Simplex rubber-covered wire in interior conduits. The contract for the construction work has been awarded to the Chicago Edison company.

Allentown, Pa., capitalists are negotiating with the Lehigh Coal & Navigation company for the use of the water power at that city, with the idea of utilizing it for electrical purposes.

English Traveling Crane.

The example of an overhead traveling crane operated by electric power shown in the engraving is interesting as illustrating the English practice in the manufactue of these powerful mechanisms. The crane was constructed by R. Bolton & Co. of London, and is designed to lift a load of two tons and operate at the following speeds: Lifting speed, 20 feet per minute; cross traverse speed, 50 feet per minute; longitudinal traverse, 100 feet, per minute. The cross-beams are of I section connected to cast-iron end carriages carrying the motor and gearing. All the motions are controlled and reversed from the ground level by three hand chains The motor is a compound-wound machine



ENGLISH TRAVELING CRANE

of five horse power running at 45 volts tension and 900 revolutions; it is practically noiseless. The lifting is accomplished by a two-part chain run over the jenney and through a sheave block and out to a dead eye at the farther end. The cross traverse is by double endless chains running over cup drums; the longitudinal motion is by spur gearing. The driving is done from both ends of the motor shaft, so that the power is distributed evenly to the bevel frictional cones. A three-eight inch copper lead is suspended from the roof of the building over the center line of the motor, and the crane is fitted with a copper slipper, which has a slight upward spring to keep it in contact with the conducting wire. The combined switch and resistance are fitted to the crane overhead, and controlled by one cord from below. The cut was reproduced from *Engineering*.

Electricity at the Corn Palace.

Quite an extensive electrical display is presented at the Sioux City Corn Palace this year. In addition to the plant which lights the buildings there is an exhibit of electric specialties and novelties which is one of the chief attractions at the palace. Visitors to this exposition of the products of the Northwest say that the introduction of electric lights has changed the character of the display completely. It should be remembered that the palace is so constructed that the entire structure is wholly dependent upon artificial illumination day and night, and inasmuch as electric lighting has been adopted it gives an excellent opportunity for a brilliant display. Incandescent lamps are scattered everywhere throughout the building, and many pleasing effects are presented. Miniature lamps are largely used in securing decorative effects. These are placed among the grain on each side of every post, including every arch, and distributed among all the panels and designs, to bring out and add to their beauties. Most prominent is the sign "Diamond Lamp" formed of lamps of that name, which are almost entirely used in the palace. It is directly in front of the main entrance. To the left is one circle of white and one of red light revolving in opposite directions. These are produced by lamps placed in the fly wheels of the engines which operate the electrical display. Directly above the band stand, in the dome, there is a cluster of 100 large incandescent lamps. The ceiling of the exhibition halls are studded with lights.

In the main gallery, besides their use for general light and decoration, the lamps are buried in fireplaces, giving a very realistic, cheery appearance. A band of miniature lamps encircles the chariot on the north wall, and the Cupids hold the bulbs aloft for torches. The statue of liberty holds a large lamp aloft, and her crowned head is emblazoned with a circle of light, making an almost perfect representation of the statue in New York harbor as seen from a distance.

The miniature sheol in the north end is inhabited by dragons whose fiery eyes are only specially made lamps, and whose flaming tongues are only reddened by their reflection.

In the milkmaids' booth near the west stairs the moon and stars are all electrical. Among the applications of electricity which interested the ladies was an electric coffee urn, which supplied "corn coffee" to the visitors.

The electrical equipment was made [illegible] Sioux City Electrical Supply company. This company has a special display of the apparatus and devices which it handles. It includes three sections on the first floor opposite the main entrance. The three panels in the ceiling are probably the handsomest in the palace. From the center of each is suspended a neat electrolier, and the drapings are studded with incandescent lamps. The background is of Moorish architecture Four pillars support the company's name, above which is a beautiful frieze of scroll work in vari-colored corn with shades of husks reflecting back the delicate colors of the many tinted globes.

The space under the east arch contains a very appropriate design showing the goddess of electricity, crowned with small amber and ruby lights, holding a brilliant incandescent lamp in her hand. In contrast shrinks Father Time, shading his eyes from the glare of the new light with one hand, while holding an old-fashioned lantern with a dim tallow candle in the other. Beneath this design is a showboard on which is arranged push buttons, switches and other devices. There are also shown in this display all grades of conductors.

Under the center arch is the "Diamond lamp" design, made with over 200 bulbs. Below it are many brackets of novel pattern decorated with imported and domestic shades of various tints.

The space under the west arch is decorated by the Sioux City engine works in a very tasteful manner, and in front of it stands a 100 horse power Corliss engine of the company's

ELECTRICITY AT THE CORN PALACE.

East of the Corliss stands the switch-board containing [illegible] rent.

[illegible]

The [illegible] vator annunciators and telephone apparatus, and very neat show boards of H. T Paiste specialties; Interior Conduit, and Insulation company's system; also John A. Roeblings Sons company's wires and cables for underground and street railway use.

On the counters are to be seen many novelties—electric welding machines, electric heating apparatus, desk lamps, motors made by the Edison, Westinghouse, Stanley, Excelsior, Hawkins, [illegible] Supply companies, the last named belted direct to a frictional machine throwing sparks six inches long; also show cases filled with [illegible] of all kinds, telegraph instruments, burglar alarms and gas lighting apparatus, cut-outs and safety appliances and tools. The display altogether, is the most complete of the kind ever shown in that part of the country, and gives an excellent idea of the extent to which electricity is applied.

Cornell Men at Chicago.

The Cornell football team failed to gain a victory from the Chicago team on Thanksgiving day, but its members enjoyed a very pleasant visit and gained much valuable information before returning to their studies at Ithaca. On Friday the Cornell team visited the Adams street station of the Chicago Edison company and examined the details of the plant with much interest. The visitors were conducted through the station by [illegible] are now with the Edison company. They expressed great admiration for the manner in which they were entertained in Chicago.

The Fort Wayne Electric company has declared a semi-annual dividend of 75 cents per share, payable November 16, 1891, to stockholders of record November [illegible]. Transfer books will be closed from November 7th to November [illegible] inclusive.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, ... Editor and Publisher
J. B. O'HARA, ... }
F. L. PERRY, ... } Associate Editors.
W. E. KEILY, ... }
J. L. BAKER, ... Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE.
New Thomson-Houston Freight Switching Electric Locomotive. Illustrated 327
D[illegible] Carbon S[illegible] 327
Electricity at the World's Fair 327, 328
Electric Cigar Lighter. Illustrated 328
[illegible] Telephone Transmitter without an Induction Coil. Illustrated 328
[illegible] Hotel Proprietors. Illustrated 328
Chicago Herald Building's New Electrical Equipment. Illustrated 329
[illegible] Electricity 329, 330
[illegible] Electric Railway Section Insulator and Lightning Arrester. Illustrated 330
[illegible] Thomson-Houston Carbon Works 330
[illegible] Thirty Years Ago 330
[illegible] America 330
[illegible] Electric Roads in Germany 330
[illegible] Illustrated 330
[illegible] Crane. Illustrated 331
[illegible] Illustrated 331
[illegible] at Chicago 331
[illegible] 332
[illegible] Carriage. Illustrated 332
[illegible] Arc Light & Power Company's Station Burned 332
[illegible] By A. [illegible] 333
Chicago Electric Club 333
[illegible] Illustrated 334
[illegible] Illustrated . . . . [illegible]
[illegible] 334
[illegible] By Edwin J. Houston 334, 335
[illegible] Large Cities 335
[illegible] 335
[illegible] Hazards. By [illegible] . . . . 335, [illegible]

DEPARTMENTS.

[illegible]

power and electric decorative effects. The managers of the exposition have faith in electricity.

THE fire which practically destroyed the extensive plant of the Chicago Arc Light & Power company on the evening of November 30th is particularly unfortunate in coming at the busiest season of the year. We hope that Chicago's representative arc light company will soon be in a position to again supply its customers, with a larger and better equipment than ever.

IN the December *Harper's* Mark Twain has written an article which, in an elaborate prefatory note, he says is written in a serious vein. 'Mental Telegraphy," the subject which he discusses, is a name for the process through which "one human mind (still inhabiting the flesh) can communicate with another over any sort of distance, and without any artificial preparation of 'sympathetic conditions' to act as a transmitting agent." The writer mentions a number of interesting illustratory incidents which have happened within his own personal experience; he states for example that the idea once occurred to him to secure the publication of a certain book; he determined to ask an old friend in the West to prepare the volume. He wrote him a note, but neglected to send it; within a few days the same friend sent him a letter stating that he was considering the idea of writing a book. He sketched out the plan of the book exactly as Mark Twain had done. Comparison of experiences showed that the Westerner had thought of the matter first. According to Mark Twain's theory this could not have been a mere coincidence; it was the telegraphic communication of the idea by some mental sympathy. The interesting fact to electrical readers consists in the writer's application of his theory to explain the apparently simultaneous invention of a device by several different persons. This extract gives his idea: "Consider for a moment how many a splendid 'original' idea has been unconsciously stolen from a man three thousand miles away. If one should question this fact let him look into the cyclopedia and con once more that curious thing in the history of inventions which has puzzled every one so much—that is, the frequency with which the same machine or other contrivance has been invented at the same time by several persons in different quarters of the globe. The world was without an electric telegraph for several thousand years; then Prof. Henry, the American, Wheatstone in England, Morse on the sea, and a German in Munich, all invented it at the same time. The discovery of certain ways of applying steam was made in two or three countries in the same year. Is it not possible that inventors are constantly and unwittingly stealing each other's ideas whilst they stand thousands of miles asunder?"

IN view of the exaggerated notions which have been current during the last few weeks relative to the possibility of the introduction of electricity in place of steam on extended steam railway lines, the front page illustration presented this week may be considered most suggestive. Without reference to the amusing editorial and reportorial flights of fancy with which we have been regaled, it will be sufficient to say that the laymen of the period might do well to study facts to learn something of the real progress that is being made in the development of the electric locomotive. The growth of the new system of train propulsion has been an exceedingly rapid one, but that is no excuse for wild speculation. The present application, though, may be taken as a well marked step forward. Without attempting again to discuss that now somewhat well-worn topic, it will merely be necessary to point out that an oft made prophesy is now on a fair way toward fulfillment. It has been pretty well agreed all along that the electric locomotive would be an eminently suitable apparatus for switching work in the large railway yards. This fact has been repeatedly pointed out, and the building of this powerful engine for just such service may be taken as indicative that it is only a question of a little time when the wedge, so to speak, will be entered into the steam system and the switching engine give way to something better.

D[illegible] the past week there has been, of course, a great deal of speculation and not a few startling prophecies as to the [illegible] of the Berliner patent to the Bell Telephone company. The daily press, representing the general public, seems convinced that the Bell company will rely on this [illegible] patent [illegible] strongest fortress behind which its monopoly may be securely ensconced for [illegible] of the [illegible] being made it behooves a thinking man, then, to take a broader view of the situation. One of the first questions to arise [illegible] company has to maintain its alleged right to the most essential transmitter. The Berliner claims are strong ones, and although it is not at all likely that they will not be sustained in the courts, with that immense amount of both capital and brains behind them, it would be well for the hopeful anti-monopolists to curb their enthusiasm until it is clear that a failure to establish the invulnerability of this one patent would be a very serious matter to the Bell company. To get at the root of the matter let us suppose, for instance, that both the transmitter and the receiver were at the disposal of the public to have or to hold or to do with them as they liked. What would be the chances of a rival corporation making a good fight for telephone business? Where the instruments were "retailed" an immense business would undoubtedly result. Where small exchanges were established judicious management would, of course, give the late comers their share of business. But in the large cities the work of securing subscribers by taking them from a system offering advantages secured only after many years of hard work would be, to put it mildly, discouraging. But to argue with the above as premises, would lead to false conclusions. There has been a general forgetfulness of a few facts of paramount importance. Is it likely that such a company as the Bell, managed and counseled as it is by some of the leading business men and lawyers on the continent, would rely on two patents to sustain a monopoly worth millions and likely to be worth more? We think, most decidedly, not. Does anyone suppose for an instant that this company has failed to cover and protect itself on hundreds of details and auxiliary apparatus absolutely essential to the successful operation of a telephone system? Is it not reasonable to suppose that any competitor will find the way beset with litigation based upon such outside and at present apparently unimportant patents? Such questions as these are pertinent, and should be carefully considered by the opponents and advocates of the Bell interests.

MANY absurd stories have been circulated in Europe in relation to the World's Fair. In France especially, where there seems to be a tendency to describe everything that is outlandish, uncouth and brutal as American, a number of these old woman's tales have been current. Nearly all of these stories are so ridiculous as to bear their refutation on their faces, and they excite only amusement here. In the British Isles, however, it is reasonable to expect that a larger degree of information will obtain, and, indeed, it is only fair to state that many English daily and technical journals have been at considerable pains to publish accurate descriptions of the scope and progress of the exposition. But through false dispatches from alleged American sources several disparaging statements about the fair have appeared. If true, these facts are calculated to throw serious discredit on the fair and bring it into merited disgrace.

One of these lying statements had for its basis the alleged unsafe condition of the foundations of the electricity building, and it may easily alarm intending exhibitors in this department, if not contradicted. It appeared in this shape in the London *Electrical Review:*

> A *Times* telegram from Chicago states that the large structure in the World's Fair buildings known as electricity hall has been declared unsafe, and the architects are debating whether they will tear up the foundations and do the work over again, or endeavor to strengthen the substructure. The building has been so badly planned that it would, when completed, scarcely sustain its own weight, and at least $75,000 will be required to make it safe.

Of course the absurdity of this is at once apparent to anyone conversant with the work now in progress at Jackson Park. In order to obtain an authoritative statement of the facts, however, the WESTERN ELECTRICIAN brought the matter to the attention of D. H. Burnham, chief of the bureau of construction, on Saturday last. In a written reply Mr. Burnham said: "The foundations of the electricity building are firm and strong. The work of the entire building is going rapidly forward, and it will be all up in two months, so far as the structural parts are concerned. The only criticism that can be made is that we are pushing our prudence to extremes; but I do not propose to take the remotest chance in construction, when such enormous interests are at stake." This is an effective refutation, and our foreign electrical contemporaries, at least, should give it as wide a circulation as the original misstatement. The electrical building will be perfectly safe, and it will be by far the finest structure for the display of electrical apparatus ever erected.

It is stated that the mischievous cablegram emanated from an unfriendly news agency, and was sent by a representative in Chicago who had applied for employment in connection with the World's Fair, and had been refused. If this is true, the rascal should be punished.

[illegible]

An Electric Carriage.

The graceful vehicle illustrated in the accompanying picture is interesting as being undoubtedly the first carriage propelled by electricity built in the West. It is the invention of William Morrison of Des Moines, Ia., and was built by Morrison & Schmidt of that city. It is intended for operation on ordinary city and country roads, and will carry twelve people comfortably, although the inventor says that it could be easily arranged for double that number.

The power is furnished by 24 storage battery cells placed beneath the seats. These accumulators are of Mr. Morrison's own design, and he claims to have produced a battery that cannot be considered an infringement on other accumulator patents. He says that the combined output of the cells is equal to 112 amperes at 58 volts. Each cell weighs 32 pounds, making the total weight 768 pounds. The cells are charged without being removed from the carriage, the process taking ten hours. It is proposed to do this at night.

This motor is of four horse power, although, on a pinch, it is claimed that it can be worked up to eight horse power. It is of the ordinary street car type, with a Siemens armature, but Mr. Morrison claims an improved method of winding by which the replacing of burned-out armatures is greatly facilitated. As will be seen by the illustration, the motor is sustained by a framework underneath the body of the carriage, and is geared to the rear axle.

The steering apparatus is attached to the forward axle and is controlled by a hand-wheel in the front of the carriage. It is claimed that this attachment has been perfected to such an extent that a light touch on the wheel will alter the course of the vehicle. The motor is thrown in and out of circuit by a switch placed in the forward part of the carriage and intended to be moved by the foot of the person guiding the movements of the vehicle. Thus one person is enabled to control the speed of the carriage and steer at the same time. No rheostat is used, the speed of the motor being regulated by the number of cells cut in or out.

Mr. Morrison claims that his carriage has been exhaustively and successfully tested in Des Moines, and that it has been run continuously 13 hours, attaining a speed as high as 14 miles an hour. He thinks that a much higher velocity can be attained if desirable. The carriage is to be soon exhibited in Chicago by Harold Sturgis and John A. Qualey.

AN ELECTRIC CARRIAGE.

Chicago Arc Light & Power Company's Station Burned.

A disastrous fire destroyed the building of the Chicago Arc Light & Power company, corner Washington and Market streets, on Monday evening. It is supposed to have been caused by a short circuit and spread with great rapidity. The loss on building and contents is estimated to be $200,000, and C. H. Wilmerding, secretary of the company, places the insurance at $130,000. A number of small manufacturing firms also had quarters in the building, and nearly all suffered a total loss. The building was purchased last January by the Arc Light & Power company, and had since then been entirely remodeled It had a frontage of fifty feet on Washington street.

So sudden was the fire and so instantaneous its spread that the occupants of the building at the time barely escaped with their lives. Fortunately, as the men were leaving, Thomas Rallston, one of the night engineers, shut off the steam and the current was cut off. The company had by far the largest central station for arc lighting in Chicago, and is said to have supplied 2,000 lamps. The fire, of course, caused great annoyance to its customers, although many were also supplied with incandescent lights from the Edison stations, which were, of course, unaffected. But gas was resorted to in many instances. The bridge tender at the Dearborn street bridge, which for the last few months has been swung by electricity, was about to swing the bridge to allow a vessel to go through at seven o'clock when his current was shut off by the fire. The vessel was forced to wait till the steam turning gear could be gotten into working order.

Prof. Barrett, city electrician, with the sanction of Mayor Washburne, tendered the temporary use of the North Side city station, at Sedgwick and Superior streets, for the accommodation of the company.

Electric Tramways with Overhead Conductors.[1]

By A. Recklenzaun

Dear old Boston, the reputed American center of literature, culture and refinement, has also become the center of electrical science. If any city in the United States raised the cry against overhead conductors in streets it was Boston or rather its æsthetic inhabitants. Three years ago the "hub of the universe" had not a single mile of electric railways within the city boundaries, and now upwards of 400 electric cars run through its streets, requiring some 180 miles of overhead wires, including feeders, for their propulsion, and 250 more cars will be put on the roads within the next few months. From the electrical point of view, Boston is at present the most interesting city in the United States. Overhead conductors running parellel with the streets, strung upon ornamental posts, are not nearly so ugly as most people, who have not seen them, would imagine. That the inhabitants of Boston have taken kindly to the system is evidenced by unmistakable statistics. According to averages extending over five months the ratio of electric earnings over horse car earnings was nearly 55 per cent. The electric cars are handsomer, more comfortable, and run faster than the horse cars, therefore the public patronizes them. The electric cars involve between 30 and 40 per cent. less operating costs, therefore the shareholders and directors of the West End Street Railway like them better than horse cars.

Let us look nearer home—to the continent of Europe. For seven long years there were only two important electric tramways with overhead conductors, viz., one at Frankfort, in Germany, and the other at Moedling, in Austria; both have worked, and are working satisfactorily. These are suburban lines, however, and no decided move has been made in the direction of carrying overhead conductors through the heart of a city until the early part of this year, when the ancient historical city of Halle, in Germany, opened its electric tramway, the work of the Allgemeine Electricitats Gesellschaft of Berlin. Emil Rathenau, director of the Allgemeine Electricitats Gesellschaft, told me some interesting stories anent the early development of this enterprise, and about the struggles with the German government on account of the interference with the working of telegraph and telephone line circuits due to induction. The Allgemeine Electricitats Gesellschaft came out triumphant; the courts decided that the streets of a city belonged to the people and its traffic, and the government had to remove its wires beyond the influence of the electric tramway circuits. The line in Halle is built in three sections, all having their terminus

[illegible] and the gross expenditures £467, giving the exceedingly favorable [illegible] cost of horse traction which usually amounts to at least [illegible] twenty-five cars, central station, overhead conductors, etc., [illegible] of every [illegible] struction, built of wrought iron lattice work, and there is absolutely nothing objectionable about the appearance of the whole line.

Visitors to Frankfort-on-the Main who have seen the electric tramway running from the exhibition to the Opera Platz were almost unanimous in their opinion that the system shown there by Siemens & Halske would not disfigure the most beautiful city. In this case the number of span wires usually necessary at curves was avoided by the rod on the top of the car being provided with horizontal arms so as to follow the deviations of the straight wires from the curvature of the rails.

We have now in England an electric tramway with overhead conductors, which is likely to be the forerunner of many similar undertakings. Reference is made in detail to the opening ceremony and construction of the Roundhay Electric tramway. I am sure the posts and overhead conductors along Roundhay and Harehills roads are far less unsightly than the two story cars moved by steam locomotives through the streets of Leeds.

Whilst the [illegible] was in course of construction Curruthers Wain, the indefatigable chairman of the South Staffordshire tramways, moved the local authorities and obtained a favorable ear from the corporations along the route, so that in the course of next year we may see one of the most important tramways in the United Kingdom running by electricity from overhead conductors. The South Staffordshire tramways have been using steam locomotives from almost every maker in the world. They have made most strenuous efforts to make the lines pay, and they have introduced all the best engineering skill to render steam traction successful, nevertheless the gross expenses amounted to nearly 92 per cent. of the revenue. The steam locomotives are practically worn out, and the directors are not inclined under the circumstances to renew them.

To go back to horses would be almost as bad. Now they are going to give electricity a chance, and with this they will undoubtedly succeed, provided that the necessary care will be given to constructive details. Almost with out exception, the earnings of electric cars are higher than those of horse cars, for reasons already stated. The earnings of the South Staffordshire tramways are by no means below the average, but if the same are increased, as they are sure to be with better accommodation and service, and if the working expenses are materially reduced as has been the case with nearly all old tramways when converted into electric ones, then brighter prospects are in store for this undertaking, and good dividends may be expected, in spite of the additional capital which has to be invested for the purpose of conversion. Alderman Newman, deputy mayor of Walsall, informed me that it had been suggested that the posts for the overhead conductors on the Staffordshire lines shall be 25 feet high in order to clear the fire-escapes, also that the same posts will probably be used for street lighting: in narrow streets, wherever permission can be obtained from owners, the span wires will be attached to houses; the maximum speed in populated streets is to be eight miles an hour.

The signs of the times just now are in favor of electric traction with overhead conductors; the system has been eminently successful, and it has proved itself the most economical in every respect. It is the most suitable at the present moment, and public opinion is bound to further its own interests.

[1] Abstract of paper [illegible]

Chicago Electric Club.

At the next meeting of the Chicago [illegible] will be held on Monday evening, Dec. 7th, C. C. Haskins will read a paper on "Safety Devices." This will be a regular literary meeting, and a good attendance is looked for.

George B. Grant of the Thomson-Houston factory at Lynn, has invented a [illegible] which [illegible]

Lamp Shades and Holders.

The lamp shade and holder illustrated herewith is about to be put upon the market by the Cutter Electrical & Manufacturing company, Philadelphia. It will carry any size or style of lamp and is provided with its own holder, which is adopted to automatically fit any and all systems. It permits the renewal of an exhausted lamp without trouble, directs the light where it is wanted, is made of aluminum and glass, weighs less than five ounces and may be knocked down and "nested" for shipment. Briefly, this reflecting shade may be described as a combination of a parabolic with a plain radiating reflector, to which is attached a diffusion plate of ground glass, and the arrangement of these different parts is such as to direct the main portion of the rays of light into a given zone of illumination, while a minor portion is radiated and diffused throughout the room.

FIG. 1. LAMP SHADES AND HOLDERS.

The diffusion plate is affixed securely to the radiating portion of the shade by means of a simple interlocking device, which permits of an easy separating of the two when it is necessary to remove or replace a lamp.

At the apex of the parabolic reflector is an aperture sufficient only for the passage of the stem or shank of the lamp, and upon the rim of this aperture is affixed the automatic shade holder, which is a novel arrangement of three spiral springs that close in upon the shoulder formed by the junction of the bulb with its brass mounting, when the stem of the lamp is passed through. Thus, the top of the shade fits closely around the stem of the lamp, shutting off all vertical rays, the general result a being strong white light immediately in front of the shade, and a mild light diffused throughout the room, there being no marked boundary to the zone of illumination.

Fig. 1 shows the shade with automatic shade holder attached.

Fig. 2 illustrates a portable lamp stand with an adjustable arm, mounted and wired, to which is attached a combination reflector shade.

The stand consists of an upright metal tube mounted

[illegible]

[illegible]

[illegible]

[illegible]

tect the conducting cord from being crushed or abraded, however the arm may be coiled or bent. The flexibility of the arm enables the user not only to concentrate his light upon any desired point at will, but it permits him in so doing to form the arm into almost any graceful curve that may be suggested. This flexible arm is also modified into a wall bracket which may be curved or coiled into any desired form.

Insulating or Break Knob.

The cut shows an insulating or break knob placed on the market by the Hemingray Glass company of Covington, Ky. This device is designed for use in insulating span wires, guy wires and arc lamps, and is also used for a lamp hanger.

The New Electrix China Switch.

The accompanying cut illustrates the new china switch which is placed on the market by the Star Electrix company of Philadelphia. This switch is made entirely of the finest imported china. The cover screws on the base with a thread cut in the china.

The interior of the switch is made after the style of the standard switch of the company.

Is Actinism a Species of Electrolysis?[1]

By Prof. Edwin J. Houston.

In the present paper I have arranged and amplified the substance of the informal remarks made at the last meeting of the section, concerning the possible identity of actinism in the growing leaf, when exposed to the sunlight, and electrolytic decomposition.

In the growing leaf, in sunshine, a series of complex decompositions occur, which result finally in the deposition of carbon and the evolution of free oxygen.

Assimilation in plants consists, with few exceptions, in a process of deoxidation. The food materials absorbed by plants are generally highly oxidized substances, which are deoxidized during assimilation. This assimilation takes place mainly in cells containing chlorophyll, and this, almost without exception, occurs only in the presence of sunlight.

Sachs, in his "Text-Book of Botany," says: "It is only the cells that contain chlorophyll, and these only under the influence of sunlight, that have the power of decomposing the carbon dioxide taken up by them, and, at the same time, setting free an equal volume of oxygen, in order to produce organic compounds out of the elements of carbon dioxide and water; or in other words, to assimilate."

In nearly every species of plants the leaf is presented with one of its faces toward the sunlight, so that one face is illumined and the other non-illumined; or, at least the illumination of one face exceeds the illumination of the opposite face. This latter is especially the case with leaves that are formed of comparatively transparent substances.

That differences of potential exist in the various parts of a growing plant is a fact that is now generally recognized. Too little, however, has been done in this direction to ascertain the exact character of these differences of potential.

Probably one reason so little is correctly known to-day concerning the differences of potential of growing plants arises from the fact that such differences of potential can be brought about by so many different causes, that probably the differences of potential arising from one cause or set of causes mask or neutralize those produced by another cause or set of causes.

I desire in the present paper briefly to call attention to another probable source of difference of electric potential, that may still further mask or render difficult of detection the differences of potential existing naturally in growing plants.

Before doing this, however, I will briefly review some of the more important causes which produce differences of potential in growing plants. The principal of these are as follows, namely:

(1) Various chemical processes that occur in the cell walls of the growing plant.

(2) Molecular movements of liquids throughout the plant, which result in the production of diaphragm currents. These molecular movements may either be those caused during the growth of the plant, or may be caused by the mere bending of the plant, by the wind or other cause external to the plant.

(3) Differences of potential developed in plants which would result in currents of the general character of the demarcation currents observed in animals; that is, currents due to the chemical action of the various liquid materials exuded at the surfaces of injured or abnormal plant tissues.

(4) Differences of potential due to the evaporation of moisture from the surfaces of the leaves, derived either from the rain or dew, or from the evaporation of liquid substances given off from the body of the plant.

(5) Differences of potential arising from the electrolytic decomposition of carbonic acid, or the various forms which carbonic acid derivatives assume during assimilation.

The causes above enumerated refer to the differences of potential that have their seat in the structure of the plant itself. Another source of differences of potential is to be found in the differences of electric potential that generally exist between the atmosphere that surrounds the plant, and the earth in which it grows. These differences of potential [illegible] the various parts of the plant

[1] [illegible]

itself would, of course, result in the production of electrical currents.

I desire to call special attention to the fifth head under which I have classed differences of electric potential in plants viz.: those arising from the electrolytic decomposition of the various oxygenated carbonic compounds derived mainly, if not entirely, from the carbonic acid of the atmosphere.

That the action of sunlight on growing plants should partake of the nature of electrolytic decomposition is, perhaps, to be inferred from the general views now held in accordance with Hertz's theory as to the identity

INSULATING OR BREAK KNOB.

between sunlight and electro magnetic radiations of waves.

These remarks should be regarded merely as suggestions made in the line of further investigations.

As far as our knowledge of growing plants extends, the oxygen which results during the general process of deoxidation, under the influence of sunlight, appears to be evolved mainly from the non-illumined or darker face of the leaf, while the carbon, or the less highly oxidized carbon compounds, which are utilized by the plant for the production of its woody fiber and woody tissues, though afterward deposited in all parts of the leaf, are probably mainly liberated at or near the illumined face.

If these facts be as above mentioned, the decomposition in the leaf, under the action of sunlight, of the carbonic acid or its derivative compounds probably partakes of the nature of electrolytic decomposition.

In this direction I would suggest the following lines of investigation, namely:

(1) To ascertain experimentally whether there exists on the opposite faces of a growing leaf, when exposed to the full action of sunshine, a difference of electrical potential resulting from the polarization which always accompanies electrolytic decomposition; and it if be so, what is the nature of such polarization.

If such differences of potential actually exist, it would of course follow that the illumined face of such leaves, under polarization, would be mainly electro-negative, since it is at or near this face that the carbon or less highly oxidized carbon compounds appear, while the dark or less illumined face would be electro-positive, since it is here, for the greater part, that the oxygen is liberated.

(2) Whether electrodes suitably connected to the opposite faces of a growing leaf in the presence of sunshine

NEW ELECTRIX CHINA SWITCH.

will show the presence of an electric current arising from an equalization of the difference of electric potential.

The value of these differences of potential on the opposite faces of growing leaves might, of course, be ascertained by the proper use of an electrometer.

(3) Whether a suitable leaf-battery could not be devised, by connecting, in alternate succession, the opposite faces of a series of leaves on a plant stalk.

That is to say, connect the illumined face of one leaf with the non-illumined face of another leaf, and so on in series until any feeble differences of electric potential that there might exist are sufficiently multiplied to sensibly affect the needle of the galvanometer.

(4) A comparison of the effect of sunlight and artificial light, such as an electric light, on such electrolytic decompositions.

(5) Whether any differences exist in the case of the light produced by an alternating current arc light and that produced by a constant current arc light.

(6) Supposing the presence of the differences of electric

potential due to the electrolytic decomposition to be established, and the direction of the electric currents so produced known, to ascertain whether an electric current led through the plant in the same direction as the current produced by actinism, would not tend to increase the assimilation and the subsequent growth of the plant, and whether, on the contrary, an electric current sent in the opposite direction through the growing leaf would not tend to check such assimilation or growth.

According to some experiments recently made in France, it was shown that electric currents sent through plants under certain circumstances promoted growth. These currents were sent through the soil in which the plants were growing, by electrodes placed in the soil. The nourishing substances in a quantity of manure, placed near one of the electrodes, were clearly carried in the line of the current, or between the electrodes.

(7) To ascertain experimentally whether the converse of the proposition is true: namely, whether an electric current of approximately the same strength as that produced by actinism, when sent through the leaf in the opposite direction, would not result in the production of luminous phenomena in the leaf.

The following facts, well recognized in botany, would seem to show, to some extent, at least, the presence of a species of polarization in certain plants during active growth in sunshine.

In the case of those plants which bend or become concave on the side most exposed to light the curvature is due to the fact that a smaller growth occurs on the illumined than on the dark side. This is well recognized in botany, and such plants are called in general *heliotropic* plants. Since they are for the most part highly transparent, considerable light must therefore pass through their entire structure, and the difference in the illumination between the light and dark faces must be comparatively slight. This shows that such differences in growth may occur under comparatively small differences of illumination.

In the case of plants that turn toward the sun: It is a well-known fact that some plants turn toward the light. It is possible that this motion is in some manner the result of the polarization effected, during growth, by the sunlight.

In a series of experiments concerning the effects of the electric light on plant growth, made at the experimental station of agriculture of the Cornell University, some important facts were discovered concerning electric plant culture.

These experiments seem to show that electric light promotes plant assimilation, and sometimes hastens plant growth and therefore maturity.

The Cornell experiments made during 1889 and 1890 were with the light of a constant current Brush arc lamp. Those made during 1891 were with the light of a Westinghouse alternating current arc lamp.

It would seem to be a matter of considerable interest in the case of these experiments to ascertain definitely, whether any marked differences exist between the action of the light produced by a steady current and that produced by an alternating current. In the line of investigations here suggested it would of course seem as if the elecric decomposition would be less marked in the case of the light produced by an alternating current than that produced by a steady current. And that therefore in those cases where the electric light of the steady current had proved to be injurious to the growth and assimilation of the plants, that with the alternating current light such injurious effects should be less marked.

Burying Telegraph Wires Between Large Cities.

Anent the recent storm which crippled the telegraph business of the country and its effect upon the commerical centers, the Rochester, N. Y., *Morning Herald* advances the suggestion that the principal business centers be connected by cables placed underground. It believes before many years the telegraph companies will be compelled to adopt this course. "The plan is practical, for France and Germany have long lines of telegraph wires buried," it says, and then it adds: "The expense of so placing the wires is greater than to string them in the air, but on the other hand the cost of maintenance is less and the liability of interruption by wind and sleet storms is wholly escaped. Whenever the wires fall as they did in the blizzard of 1887, on Monday, and as they have on various occasions to a more limited extent, the loss of revenue and the cost of repairs make heavy charges against the companies, while every such interruption is a loss of prestige which is of continuing effect." These remarks are prompted by the experience obtained in the last storm. "When a storm like that of Monday," says our contemporary, "blows down and tangles so many wires that the whole vast system is paralyzed, cutting off communication between New York and the principal cities of the country, when Chicago cannot be reached by any one of more that two hundred wires that connect the two cities by a dozen different routes, when commerical messages by the thousands come in and cannot be forwarded and press operators sit at their desks hour after hour with nothing to do, it would seem to be wise to look out and adopt methods that would insure against such serious interruption to a business upon which the country so much depends."

Electrical Section of the Franklin Institute.

The annual meeting of the Electrical Section of the Franklin Institute was held December 1st, when the following communications were presented: "The Electric railway of Buda-Pesth," H. W. Bartol; "Lauffen Frankfort Alternating Current Transmission," Carl Hering; "Notes on Electro—Magnetic Machinery," W. S. Aldrich, Johns Hopkins University, Baltimore, Md.

Alternating Electric Systems and their Physical Hazards.[1]

BY GEO. P. LOW.

In entering upon a discussion of alternating electric currents and their hazards it is meet that their purpose should be explained. Why is it that the alternating system, with its extremely high voltages, fatal to life and possessing hazards to property peculiar to itself, should be used for purposes of interior illumination when the ordinary incandescent systems furnish equally good service, are incapable of inflicting even temporary injury to human beings, and are without certain hazards possessed only by the alternating system? At a first thought it may appear to the layman that alternating systems have no legitimate excuse for their existence, and that their use by electric lighting companies instead of the ordinary low potential systems exposes the public to unnecessary hazards. So far as the property or fire hazard is concerned, such an idea is entirely wrong, for, as will be shown, honors are about evenly divided between the hazards of the two systems. If the alternating system has a hazard that the low potential system does not possess, the latter also has a hazard peculiar to itself, and from which the use of alternating apparatus is exempt, but whichever system is used the attending hazard may be reduced to an iota, if not eliminated, by devoting proper care to every detail of installation. I do not consider the hazard of a poorly constructed installation to be greater than that attending the use of oil as an illuminant, and I do consider that, next to the sun, a properly constructed incandescent system is the most perfect system of illumination, either natural or artifical. As has been previously stated, to obtain light heat must be generated; and no matter in what is its condition the energy capable of creating a light-giving temperature direct may prove incendiary. Even the light and attendant heat of the sun has caused fires. Strictly speaking, therefore, there is no such thing as an absolutely safe illuminant unless it be the light of the moon or stars, which would hardly satisfy the exactions of our civilization. All methods of producing light artificially have elements of danger. Some of their hazards are great and some are only moderate, yet in electricity is found a light-producing energy that can be used with the least danger of all—and it is quite immaterial whether this opinion be applied to the light produced by the low potential or "direct" system, or from alternating circuits. The only requisite is that the circuits and apparatus be properly installed.

In the electrical exhibition at Frankfort, Germany, are incandescent lights and pumping machinery operated by dynamos driven by water power at Lauffen, 110 miles away. Although 300 horse power is transmitted that distance, yet three copper wires, each less than one-eighth of an inch in diameter, are sufficient to carry the energy consumed. The cost of the installation is such that it could be undertaken by any electric lighting company of any large city, yet to obtain equal results under the same conditions by the low potential system would necessitate investments that would appall any capitalist, syndicate or government. The solution of the problem of long distance incandescent lighting is due, therefore, to alternating systems alone.

But let us turn to the nature, characteristics, and phenomena of alternating currents, and in so doing we will study an application of electricity which presents most interesting features and becomes more and more wonderful as the research is pursued. Continuous currents have characteristics rendering them indispensable for some applications, such as in electro-plating or in installations where storage batteries are used. Moreover, in the present state of the art electric power derived from continuous current circuits, either from constant potential or from constant current systems, is far more satisfactory and efficient than electric power derived from an alternating current. Indeed, alternating currents can never entirely displace the use of continuous currents in some branches of applied electricity; yet it requires no great foresight to reach the conviction that the energy of distant water powers can best be brought into the centers of population and industry by means of electricity in a state of ceaseless alternations. In the system then rests the idea that is not revolutionizing, but which is developing electricity into a more indispensable factor of civilization. It is singular that this, the latest development in the new science, is but the perfection of the first form of dynamo-electric machinery that was devised. Then, way back a generation or more ago, the few dynamos, or, more properly speaking, the few magneto-generators used, produced alternating currents, but its peculiar differences from the then familiar galvanic electricity led to the invention of the commutator, by means of which alternating currents were commutated or rectified into continuous currents. Alternating dynamos are the simplest electric machines in existence. They consist merely of a coil of wire passing first in front of the positive pole of a magnet, then in front of the negative pole, then by a positive pole, and so on. As the coil passes one magnetic pole, a positive potential is generated, then, as it passes the opposite magnetic pole, an electric potential of contrary sign or a negative potential is generated, and so it goes on, alternating first positive, then negative, then positive, and so on, the number of these changes effected in a given time being the number of alternations of the dynamo. In the modern alternators these potential changes occur at a rate from 500 per second up, and as previously stated, the almost inconceivable rate of 20,000 complete alternations per second has been attained in an experimental dynamo. Inasmuch as the mission of the commutator in dynamos is to rectify currents, or to straighten them out, so that they shall flow in one direction, it must be plain that there is no need for such a device in the alternator. The armature consists [illegible]

[illegible] brushes. The field magnets of alternators are of peculiar [illegible] inward radially. About these pole pieces are coils of wire, [illegible] from the fact that its current excites or energizes the fields of the [illegible] ity by means of an alternating current, as the magnetic pole changes synchronously with the alternations or directions of current flow. It is essential that the magnetic poles of the fields should alternate, the first field being positive, [illegible] continuous current must be used, the current being carried around the iron core in one direction to produce a positive pole, and in the reverse direction to produce a negative pole. The armature coils in passing these alternating poles, generate the alternating current under consideration.

We now [illegible] the converter or transformer, the study of which forms a succession of wonderfully interesting surprises, each more agreeable than its predecessor. Allusion has already been made to the belief that electricity and magnetism are but different manifestations of the same energy, and you all understand how readily interchangeable they are. Every wire carrying an electric current is surrounded by a field or atmosphere of magnetism which permeates the surrounding element in a whirling direction, no matter whether that element be air, the hand, glass, wood, metal or any other substance. In fact, there is no such thing as an insulator of magnetism known. We can insulate conductors carrying electricity very effectually, but magnetic lines of force permeate glass, or a block of brass with about the same facility as they would traverse an equal distance through air. Perhaps coming generations will invent or discover an insulation that will be impervious to magnetism, but it is something we have not yet reached. As stated, these lines of magnetic force emanate from wires carrying currents as well as from the poles of magnets. If the current flows in one direction the resultant lines of magnetism will have a given magnetic polarity or whirl, while if the direction of current flow be reversed, the magnetic whirls about the conductor will also reverse, and their magnetic polarity will consequently be changed. It follows then that when an alternating current traverses a conductor the direction and polarity of the magnetic lines or whirls of force about it are changing with equal rapidity. Again, suppose two wires are run along side by side for any distance, and that an alternating current is traversing one of them. In this event a secondary and entirely independent electrical potential will be created in the second conductor. No metallic connection exists between these wires, hence there can be no actual transfer of electricity from one to the other, but the phenomenon that does occur and which occasions a potential in the second wire constitutes induction. To more fully illustrate this, let us consider another experiment. Wrap a few hundred feet of wire into a flat coil and place it upon a table, covering the coil with a sheet of thick plate glass. On this glass, immediately over the first coil, place a second similar coil, connecting its terminals to an incandescent lamp, and on sending an alternating current through the first coil, the lamp will burn from the current generated in the second coil by induction. If iron is brought into proximity of the two coils the inductive action is increased, owing to the fact that iron affords a path of lower resistance for the magnetic lines to travel through, and that consequently a greater number of these lines or a greater magnetic intensity exists.

The earliest development of these phenomena appeared in the induction coil, consisting of a bundle of fine iron wires forming a core, about which was wound a comparatively few turns of insulated thick copper wire, called the primary. This arrangement thus far will be readily recognized as an electro-magnet. Around the outside of this electro magnet is placed an insulating wrapping of paper or gutta-percha, then over all is coiled a great many turns of insulated fine wire, called the secondary coil. It will be noted that no electric connection exists between the two coils, in fact, the higher the insulation between them, the better. Such is the construction of the induction coil; and now for its method of operation. Those who were present at the reading of the first paper of this series will remember that in speaking of the interchangeability of electricity and magnetism reference was made to the electro-magnet, and it was shown how the iron was made magnetic by the circulation of a current of electricity through the coils surrounding it, and how [illegible] through the surrounding coils as the iron core became magnetized or demagnetized [illegible] Upon this fact rests the vital principle of the induction coil, and of its perfected form, the converter. In these the mission of the primary wire is to magnetize and demagnetize the iron core in order that the magnetic rays emanating from the core may whirl through the secondary coil, first in a given polar direction, then in the opposite one, and by so doing induce a current of electricity in the secondary coil. Converters then, like dynamos, become generators of electricity [illegible] deeper let us see [illegible] are aware, [illegible] tween electro-magnetic [illegible] of magnetism of a fixed intensity. The wire on the revolving armature passes through or cuts this fixed magnetism, the potential of the armature wire is disturbed, and an electric current is generated. Now, [illegible] is no moving [illegible] wire cutting lines of magnetism as in the dynamo, the ever-varying lines of magnetism [illegible]

[1] Read before the Fire Underwriters' Association [illegible], San Francisco.

out and whirl through the wires of the secondary coil, and current is generated precisely as in the dynamo armature. In the dynamo the wire cuts the magnetism; in the converter the magnetism cuts the wire, and the result is the same.

Again, it is necessary to revert to our first paper, and impress the statement then made that electric energy does not depend alone upon volts, nor upon amperes, but upon their product, which gives us the unit of electric energy called the watt. The magnetic energy imparted to an iron core is, however, dependent upon the number of amperes traversing the surrounding coil, multiplied by the number of turns of wire in the coil, or, technically speaking, upon the ampere turns. Thus 10 amperes flowing about an iron core through 100 turns of wire gives 1,000 ampere turns, and the resultant magnetism will be the equivalent of that produced by ½ an ampere flowing around through 2,000 turns of wire. Again it consumes a fixed amperage and a fixed voltage, consequently a known wattage or energy to effect the ampere turns in the primary coil necessary to magnetize the core of a converter, and if the efficiency of the apparatus is perfect, the energy of the magnetism will be reconverted into electrical energy in the secondary coil, equal in value to that expended in the primary. If, therefore, ½ an ampere at 2,000 volts goes into the primary, an equal energy, such as 40 amperes at 50 volts, may be drawn from the secondary. It is now apperent, I hope, that alternating systems owe their ability to operate over long distances, and with small conductors to the fact that the electric energy driven from their stations to the point of consumption consists of small amperages (necessitating but small conductors) and high voltage. Then the converter transforms this energy into a nearly equal value, but of low voltage, and of correspondingly increased amperage.

There is another interesting feature in converters which is a very important factor in the economical operation of alternating systems. It is the phenomenon or fact, whichever you like, called counter electromotive force. To illustrate. A constant potential dynamo and a motor are in reality one and the same machine. Apply power to it and electricity is produced, or apply electricity to it and power is produced, either or both resulting from the rotation of the armature within a magnetic field. When the machine is running as a motor then the conditions are virtually the same as when it is being driven as a dynamo, for the armature is being revolved between magnetic fields as is a dynamo, and a current or electrical potential must therefore be generated within it. This potential, however, is in polarity opposing or counter to that of the source of electricity which drives the machine as a motor, which leads to the calling the opposing potential "counter electromotive force." A constant potential motor in running without load generates a counter electromotive force nearly equal to the voltage of the supply current, and as a result of this nearly balanced counter electric pressure, but very little current will go into the motor. If, however, a load be thrown upon the motor checking its speed, the counter electromotive force is lowered as the speed slackens, the counter pressure being relieved to a certain extent and the motor takes more current. Throw off the load, and the armature speed increases, the counter electromotive force raises, and again the motor takes but little current. Such motors are, therefore, self regulating, that is, they take current or ampereage almost in direct proportion to the work they perform, hence their economy in operation is great. If a clear understanding of this is had it will not be difficult to fathom the almost identical action that takes place in the converter. There an impulse of current circulates in the primary coil, magnetizing the core, which in turn induces a current in the secondary coil, and this secondary current is of a polarity opposite to the succeeding alternation of current which energizes the core. Inasmuch as the primary coil surrounds the core just as the secondary one does, it is plain that an electric pressure must also be induced in the primary coil synchronously with and in the same direction as that induced in the secondary coil. This is precisely what does occur, and here we have the counter electromotive force in converters. While no current is drawn from the secondary the polarity of the counter electromotive force in the primary nearly opposes the polarity of the succeeding alternating impulse that magnetizies the core, hence but little [illegible] passes into the primary, but when the current is drawn from the secondary the magnetism of the core, having work to do, does not respond to the [illegible] or, technically speaking, [illegible] counter electromotive force, and consequently greater consumption of current in the primary. Converters, then, like motors, consume current in close proportion to the work they perform.

[illegible]

of poorly constructed continuous current systems, the alternating system has a hazard distinctively its own. No matter what the make, converters will some time burn out, either from improper insulation, careless handling, or overload, and when a converter burns out, fire may be caused by any one of several causes. First, the high potential primary current may get over into the secondary coils and be distributed thence over the interior wiring designed to carry not a pressure of 1,000 or 2,000 volts, but 50 or 100 volts. The hazard of such an occurrence is apparent. Some forms of converters are saturated with imflammable compounds used to effect insulation. If such a converter burns out the insulating compounds will sometimes melt and run down like boiling tar over whatever is beneath, and boiling tar and electrical fireworks would make a combination not at all agreeable to the fire underwriter. All that is apparent in nine out of ten converter burnouts is simply a lively humming and the appearance of considerable smoke. Converters are invariably placed in iron cases and fire within them could do no external damage other than that due to smoke; indeed, in some localities the placing of converters in insured buildings is prohibited, principally for the reason that should they burn out the presence of so much smoke might lead to the calling out of the fire department and a consequent water damage, but this is an idea in which I cannot concur. These are the differences in the hazards of the two systems, and comparative consideration of them both leads to the belief that despite the hue and cry about high voltages, one system is just about as safe as the other.

The public is frequently told by those who should, if they do not, know better, that an alternating current cannot maintain an arc, and that the system is consequently free from one of the hazards of the continuous current circuits. If this statement is true, how is it that arc lamps are burned on alternating curcuits? It is certain, however, that accidental alternating arcs are very uncertain in their action. Sometimes they will draw out nearly as long as continuous current arcs of equal voltage; then the next instant the arc may almost refuse to form; in fact, it acts as though the arc depended for its length upon the position or phase of alternation at the exact instant of break in the arc producing contact. An analysis of an alternating impulse shows that it begins at a zero pressure and rises to the full potential of the machine, say 2,000 volts; then the potential falls gradually back to zero again, whence it continues falling to a potential of 2,000 volts below zero, we might say, from which point it rises to zero and continues another cycle. In a 2,000 volt alternating current there is, therefore, a maximum variation of 4,000 volts between the highest potential and the lowest potential and there is, moreover, two points in each alternation at which the potential is nil, or zero. These points may occur within less than the one one-thousandth part of a second, yet that is a material space of time when reckoned by electricity. As stated, arcs drawn from breaks in alternating circuits are so erratic in their action that they appear to depend upon the phase or condition of the current at the exact moment of break. Sometimes long arcs may be drawn out, possibly because the cycle at the instant of break is at a maximum potential; sometimes, though seldom, little or almost no arc at all will be drawn, possibly for the reason that the current was broken at the exact moment when it was at a zero potential. These are things that cannot be predetermined, yet, everything considered, it is true that alternating arcs are not as formidable or as viscious as those drawn out from continuous currents of equally high voltages.

The remarkable flexibility of electric energy, when converted from one form to another by means of the alternating current transformer, has led to the achievement of numerous results hitherto considered impracticable if not impossible. The perfection of the art of electric welding is due to alternating currents, as are also certain forms of electric heaters and some new and novel electric motors especially adopted to transmitting power over long distances. In fact, it is believed by many that the greatest advances made in electricity during the coming decade will be in the direction of alternating systems. As the use of these, like all other applications of electricity, is becoming more and more familiar to the public, the belief is slowly but surely, though perhaps unconsciously, being accepted that the hazards attending the use of all forms of properly installed methods of electric lighting or power are greatly exaggerated. In the present state of the science, where a rigid enforcement of insurance or municipal requirements, supplemented by vigorous inspection, results in the observance of safety laws, it may be truly said, even by the most conservative, the fire hazard of electric lighting is more imaginary than otherwise. The tendency of the period in electrical development is toward the use of alternating currents at higher and higher potentials, yet the safety devices designed to control these excessive voltages prove absolute in their offices, so that it is safe to predict that neither the fire underwriters nor the public will find a materially increased hazard in their use.

The Strowger Automatic Telephone Exchange company of Chicago has been incorporated with a capital of $5,000,000. The scheme which the company proposes to introduce is thus described: "Every Strowger telephone is accompanied by a machine which takes the place of the [illegible] of the switch board and makes the connection automatically. The machines, each of which is con[illegible] are stored together. On the [illegible] a row of keys indicating units, tens, [illegible] and a release key. The subscri[illegible] number on the keyboard which, [illegible] automatic machine, connects the wire [illegible] that of the phone he desire to reach. The connection is made simultaneously with his [illegible] to ring the bell. When through [illegible] key, disconnect the two wires [illegible] other desire [illegible]

CORRESPONDENCE.

New York Notes.

NEW YORK, November 2[illegible].—If the cheerful talk of New York electrical people means anything, there is every prospect for good business this fall. On all sides one hears such expressions as "brisk trade," "business looking up," "our factory is working over-time," etc. Consequently it is but natural to conclude that where there is so much smoke there must at least be a small amount of fire. The electrical societies are doing a brisk business anyway. On Tuesday evening last the American Institute of Electrical Engineers and the New York Electric club held a meeting, a notice of which appeared in my last letter. This joint meeting of the two organizations was held at the club house of the Electric club at 17 East Twenty-second street. There were about 150 members present. Thomas G. Lockwood of Boston presided. The paper of the evening was read by Carl Hering, who illustrated his most interesting lecture with a number of lantern slides of the different buildings and exhibits of the Frankfort exposition.

There was something of a sensation in Newport, R. I., over the assignment of the local Edison Illuminating company. It will be remembered that it was this concern which was having the trouble with Miss Susan Dresser. As was stated not long ago in a New York letter, Miss Dresser brought suit against this lighting company for injuries received in an accident caused by her carriage horses being scared by the engine of the temporary plant erected last summer by the Edison company for the Vanderbilt ball. It has been generally believed for a year or more that the corporation, despite its millionaire stockholders, was virtually bankrupt, and no one was more aware of this fact than the counsel for Miss Dresser. The company has never paid but one dividend, and this was not earned. The stock depreciated rapidly and no bid at any price was made. The stockholders and officers wear smiling faces, and they do not seem to be concerned over the assignment to their treasurer.

That the advantages of the trolley system of electric railways are thoroughly appreciated by street railway men could hardly be more clearly evidenced than by the fact that a number of the Brooklyn surface railroad presidents have sent a communication to the aldermen, asking for a hearing on a petition to change their motive power from the horse to the trolley system. The success of the Brooklyn & Coney Island railroad company in getting the commission to allow it to extend its trolley road into the city proper will be the precedent quoted to further the arguments of these gentlemen desirous of introducing the essentially modern method.

Brooklyn's firemen are in a condition now that might be described as one of righteous indignation. And one cannot blame them for their rage either, for some miscreant has been engaged in the outrageous work of turning on false alarms of fire from street boxes. On Saturday night last, the engine men of the eastern district were kept running all night. It is said that the alarm was turned in ten times.

The Westchester Telephone company and the board of trustees of the village of White Plains are having what some one once described as "a pole cutting bee." The telephone company has a very natural desire to keep its poles standing, but the board of trustees has also the very natural feeling that the poles are useful but by no means ornamental. The condition of affairs at present is that the telephone company has served an injunction to restrain the excitement of the board, and the board is therefore highly enraged, claiming that the telephone company has not lived up to its agreement, and furthermore has cut and ruined many shade trees. The lawyers take their turn next week.

On top of the popular indignation aroused at the thought of the prospect of the Bell Telephone company retaining its highly profitable monopoly for another long term of years, comes the rumor that negotiations are being carried on whereby the American District Telegraph company and the Mutual District Telegraph company should be consolidated. This is given of course as a rumor only, and it must be taken only for what it is worth. It is said, though, that several of the Mutual District stockholders are making a bitter fight against the proposed consolidation. It is stated that they threaten to go into court if necessary, to obtain injunctions restraining the other Mutual District stockholders from selling out to their rival.

Dispatches from Philadelphia state that the warship New York will be launched before or on December 2d. The New York was originally known in the navy as Armored Cruiser No. 2, and its building was authorized by the appropriation in the act of September 7th. The con-

tract for constructing this vessel was awarded to the Wm. Cramp & Sons Ship and Engine building company, Philadelphia. The new cruiser has engines aggregating 18,000 horse power. The navy shows its appreciation of the advantages to be obtained through the use of electricity, by lighting the new cruiser throughout by this ideal system. The plant will not only supply 700 incandescent lights but in addition there will be four search lights and numerous other applications for the current.

Again your correspondent apologizes for his rapid transit paragraph. However, it must be given to keep the record complete. The commission is pushing its work, it is announced, but great bodies move slowly, and this one is no exception. The work of obtaining consents is not progressing as rapidly as it was thought it would. Many property owners are readily signing consents, but the majority, while favorable to the plan of rapid transit, want to know the exact details of construction provided for use in front of their respective properties before they positively commit themselves. Up to this time these details have not been in proper shape for presentation to individual owners, but a pamphlet is preparing which gives the exact profile of the entire structure from end to end of the route. This will be ready for use in a few days.

At the meeting of the commission on the 27th inst., it was stated that Wm. E. Worthen, now well-known for his engineering work in connection with this rapid transit problem, is to become the consulting engineer of the commission. The position of chief engineer is to remain vacant for the time being. There is now no longer any need of the continued services of a chief engineer.

The Western Union company and the New York pool sellers are still having trouble over the race news which they endeavor to keep for their patrons. Several cases have been reported during the week where the company's wires have been tapped to the dismay of the pool men, whose financial losses amount to a considerable sum. W. S. O.

Milwaukee, Wis.

MILWAUKEE, November 28.—Before the common council committee on railroads Henry C. Payne has made an official declaration of the electric street railway extensions that the Villard people propose to build. He began by stating that the company desired to complete its downtown lines first, but would be willing to build to the new city parks as the aldermen had requested, as soon as possible. Eventually the Whitefish Bay dummy line will stop at Park Place, and the Farwell avenue cars will run to that terminus by way of Bradford street and Glen avenue. The Murray avenue line will be extended to the river park. The North avenue line will intercept the north and south lines on the West Side, and afford people living in the northern part of the West Side easy access to Whitefish Bay. A new line is to be built along Cambridge avenue and Brady and Jackson streets, which will connect with the Holton street line. The cars on this line will run along the tracks already laid on Jackson and Martin streets and Broadway. The Mitchell street cars will be switched off the Clinton street track at Lake street, and run over Broadway bridge and up Broadway. The First avenue line and the Hinsey Sixth street line will eventually become one, and extended on the south to Kosciusko Park, east on Lincoln avenue to the Howell Road, and thence to Wilcox Park. The Kintickinna avenue line will be extended to St. Francis. The Hinsey Vliet street line will eventually be extended to the West Side Park. The Winnebago street tracks will be connected with those on Chestnut street, and the cars on Vliet street will run down Chestnut to Third. The Fond du Lac avenue line will be carried out to the Perrigo Park, and the Third street line to Lindeverm. The Eighth street line will probably be abandoned. In the business district the company will put up side poles instead of center poles wherever Chief Foley of the fire department reports that such a change is advisable. An ordinance embodying all the changes proposed by Mr. Payne has been prepared.

The city attorney has decided that the resolution presented by President Hase, directing the Board of Public Works to renew the contract with the Badger Illuminating company for a term of five years, at $112.50 per lamp per year, cannot be legally passed by the common council. It had been claimed that such a contract could be made under the provision of the city charter authorizing the making of contracts with patentees without previous advertising. But the city attorney declares that "Electric light is not patented, and no one thus far has assumed to say that he is the discoverer or inventor of electric light. The various processes by which electricity is utilized are patented; the light is not." The resolution was apparently drawn for the purpose of authorizing a contract with the owners, licensees or assigns of the Thomson-Houston system of lighting, but ready to renew the contract with the Badger Illuminating company. Such a course, according to the city attorney, would release the sureties in the original contract. The resolution attempted to authorize the renewal of an old contract, not the making of a new one, and if the Board of Public Works were directed to enter into a new contract, it would be obliged to enter into a legal contract with ample securities. The city attorney's opinion gives a full explanation of the manner in which contracts for public work should be awarded, and states that there is no reason why a different course should be pursued with regard to electric lights. If bids received in a legal manner are too high, the board is not compelled to accept any of them.

Many improvements have been introduced of late in the Badger plant on Commerce street. This station contains four compound condensing Corliss engines, aggregating 900 horse power, and four boilers of 1,100 horse power. The building is a three-story brick structure, 40x147 feet, and the engines and boilers are in the basement. The dynamo room is 40x72 feet, and contains sixteen 50 light and four 25-light dynamos. The poles used in the aerial system are 45 feet high, and from 150 to 200 feet apart. Four-inch cement pipe is used in the underground system. Brick manholes are placed along the conduits at intervals of between 150 and 200 feet. The conduits are principally in the business district. The company is now furnishing nearly 900 lights of 2,000 candle power, 300 of which are for commercial purposes, the balance being street lamps. The company has 130 miles of aerial wires, and 40 miles of underground wires. Edward C. Wall is president and general manager of the company; S. G. Coleman, superintendent; H. F. Boggis, general accountant and contracting agent, and Henry Corbett chief engineer. During the past twelve months the company used about 750,000 carbons and 5,000 tons of coal. Within five years the whole lighting system will be underground. The cost of burying the wires, Superintendent Coleman estimates, will be $6,000 a mile, or $250,000 for the whole of the present system. The plant is owned by Villard, and will in time be consolidated with the gigantic Edison plant on River street.

On a recent Saturday evening there were no electric cars running on the Farwell and National avenue lines of the Villard system, and the incandescent lights were extinguished for two or three hours. The trouble was due to an accident at the Edison plant. There is a battery of ten very large boilers at the Edison plant, but seven are being set up, leaving only three for use at present. One of these three boilers sprang aleak, and the fire under it was put out. It was thought that the two other boilers, on a pinch, would furnish all the power needed for the street cars and incandescent lights, but early in the evening the grate under one of them broke, and the fire under it had to be put out instantly. With only one boiler to use, it was decided to shut off the electric car circuit, and try to operate the incandescent lights. But after the electric cars had been stopped in transit, just as the people were beginning to start down town in large numbers, the incandescent lights went out, and didn't start again until late in the evening. The street cars ran no more that night. Such an accident will be almost impossible when the plant is complete. As it was, it caused no end of grumbling and annoyance.

The Burton and Carpenter electric heaters are both to be tested on the Farwell avenue line. Two cars are being equipped, one with each system.

The Chicago-Milwaukee elevated electric railway—on paper—has a rival—on paper—in the Barre hydraulic railway. It is the system generally known as the sliding railway. Between the track and the slides is constantly a thin film of water, which is said to reduce the friction to a minimum, and water for motive power is to be furnished by a pipe under the track. It is claimed that a speed of from 100 to 140 miles an hour can be attained. To build a line between Chicago and Milwaukee would cost about $5,000,000, it is estimated. It is proposed to raise $1,000,000 in Milwaukee, a like sum in Chicago, and the balance of $3,000,000 abroad. The territory between Chicago and Milwaukee seems to be a favorite ground for proposed rapid transit enterprises. The elevated electric railway, the Barre hydraulic line and the Edison electric motor line are all being talked of, besides Prof. W. S. Johnson's impulsive railway system. C.

Kansas City, Mo.

KANSAS CITY, Mo., Nov. 28.—The announcement that the Bell company had practically secured another grip on the telephone service was received with lively interest in this city. Many efforts had been made in this state and also in Kansas to bring the telephone people to terms, but [illegible] only remains to be seen if the patent will stand the test of [illegible] been in the same line, or by schemers who take advantage of [illegible] gether for their own benefit.

"It would seem that the Berliner application had been in the patent office long enough, and enough publicity had been given it to [illegible] able claim of priority [illegible]

"After the expiration of the Bell patent in 1893, the telephone question will [illegible] this the Berliner patent must be used. In this day, when electric light and power wires, in all directions, are giving off their inductive radiations, it will be difficult to give first-class service with the magneto telephone alone. I can imagine a tolerable service in the smaller systems by the use of expensive duplex wires without the Berliner transmitter, but the revenue that could be obtained would hardly pay on the investment. In the larger cities, where the service of the telephone system is of great value, the 'survival of the fittest' will be the rule."

"It is highly probable that new companies will spring up in all directions, promising great improvements at lower rates, but so far as the state of the art is known at present they will probably fail because of their inability to successfully make good their promises owing to the inferior appliances at their command. However, the progress of the business has been a succession of surprises, and it would be foolish not to expect others, from the inventive genius which is and will be so largely employed.

"That portion of the public which daily needs telephone service is not clamoring for lower rates but for good, reliable service, and my opinion is that instruments made under the Berliner patent will have to be used to give it."

Denver, Colo.

DENVER, Nov. 28.—The board of aldermen has passed the bill granting a franchise for twenty years to the Denver Consolidated Gas company. The company purchased the plant, franchise and interests of the Denver Gas company for $1,500,000.

This deal was practically concluded some time ago, its consummation depending on the securing of a new franchise as the franchise of the old gas company was about to expire. It is vigorously denied that there is any intention to unite the gas interests with the Consolidated Electric Light company.

The Mountain Electric company, whose bid was $29,975, has been given the contract for the electric plant in the H. C. Brown hotel.

The Tramway company on Sunday began operating the electric line extending from Broadway on Eleventh avenue to Alta street, ten blocks.

A long and bitter electric light contest is on at Telluride. The San Miguel Consolidated company, of which L. L. Nunn is manager, has been at work running several lines from its station in Howard's Gulch, one of which was to furnish light for the city of Telluride. The town board granted a ten years' franchise to the Telluride Electric Light company for lighting the city, the company virtually securing the exclusive right to furnish light inside the corporation. This caused the trouble that resulted a few days ago in the city marshal, by order of the town board, cutting the poles of the San Miguel Consolidated company's line. Much indignation was expressed at the action of the board, and at a mass meeting [illegible] granting of the franchise was [illegible] At the adjournment of the meeting a number of citizens went to where the poles had been cut and [illegible] up. Mr. Nunn kept an armed [illegible] the poles, and two days afterward [illegible] company, through its attorney [illegible] temporary injunction. The San Miguel [illegible] company [illegible] cents per light per month [illegible] The electric light company [illegible]

[illegible] a twenty-five years' franchise by the city council of Santa Fe, N. M., [illegible] electric light plant [illegible]

Work on the railway will begin in the spring. The electric light plant is already in operation.

Colonel Randolph of the City Cable company says that cars will be running over the Seventeenth street line about the middle of December. Work is now progressing satisfactorily, but there has been considerable delay in track work in consequence of the difficulty in securing material from the East. The West Denver line will not be in operation until the first of May. F. C. D.

Cleveland, O.

CLEVELAND, November 28.—The two power houses of the Woodland avenue and West Side Street Railway company are now in the course of erection. The road will be open in the spring. The Woodlawn avenue line will be equipped first.

The Edison Electric Illuminating company at Tiffin has now in operation 4,000 incandescent and fifty are lights.

The local office of the Edison General Electric company has secured the following contracts: Youngstown Bridge company, thirty 2,000 candle power arcs, and twenty-five incandescents; Standard Oil company, Cleveland, 250 incandescents; Collings & Taylor, 200 incandescents; Lake Erie Electric Light & Power company, forty 2,000 candle power arcs; Defiance Machine company, 250 incandescents; Sheriff St. Market & Storage company, sixty 2,000 candle power arcs and 1,040 incandescents.

Owing to a recent fire in its building, the Postal Telegraph company is compelled to look for other quarters. The plant was damaged to the extent of about $300 with no insurance.

The Western Union will shortly remove to its elegant new building recently completed.

The Long Distance Telephone company has petitioned the council to lay its cables underground. B.

PERSONAL.

W. H. Eckert has been appointed general agent for S. A. Day, New York.

Geo. H. Bliss returned to Chicago a day or two since, having spent some time in North Carolina, combining pleasure and business.

Frederick Sargent returned on Wednesday last from a hurried business trip to New York and other eastern points, being absent less than a week.

W. W. Griffin, general manager of the New England Electric company of Bridgeport, Conn., was a visitor at the New York office of the WESTERN ELECTRICIAN last week.

H. W. Hamblin, for several years general manager of the Pawtucket, R. I., Electric company, and recently of Astoria, Ore. has identified himself with H Ward Leonard & Co. His many friends will be pleased to welcome him back to New York.

William Dierman, an electrical engineer of Brussels, Belguim, was in Chicago the last week studying the principal electrical plants in this city. Mr. Dierman is in this country on a mission from his government to investigate the electric development of the United States.

Henry S. Manning of the Thomson-Houston office in Chicago was married to Miss Virginia Hicks on Nov. 25th. The wedding took place at the residence of the bride's parents, Mr. and Mrs. W. Henry Hicks, in Wheatland, Ia. Mr Manning is a widely known member of the electrical fraternity in the West, and he has a host of friends who will extend sincere congratulations.

NEW INCORPORATIONS,

Electric Heat Alarm company, Bangor, Me., capital [illegible] manufacturing and dealing in electric appliances; Laughton, Clergue & Mason, Bangor, Me.

[illegible] company, Portland, Me., capital stock $500,000; generating, applying and in any manner using motive power of all kinds; Clarence Hale, Portland, Me.

[illegible] Light, Heat & Power company, [illegible] capital stock, [illegible]; to [illegible] for light, heat [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

way cars, marine craft and buildings with electricity; to purchase and sell all kinds of electrical and mechanical devices, patents and inventions; F. C. Rutan, 85 Dearborn street, Chicago, Ill.

Electrical Reflector company, Rutherford, N. J.; capital stock, $10,000; manufacturing, vending, introducing and marketing illuminated street and advertising signs and reflectors; Luther Shafer, Rutherford, N. J.

San Francisco Electric Manufacturing company, San Francisco, Cal.; capital stock, $1,000,000; to acquire, use and sell patents and patent rights for railroads, tramways, steamships, etc., deal in real estate, mills, factories, mines, etc.; Suden Otto Tum, San Francisco, Cal.

Torresdale Electric Light & Power company, Philadelphia, Pa ; capital stock, $1,000; supplying light, heat and power by means of electricity to the public in the Thirty-fifth ward, Philadelphia, Pa., and persons adjacent thereto; Henry V. Massey, Philadelphia, Pa.

Electric Ore Reducing company, San Francisco, Cal.; capital stock, $2,000,000; to reduce refractory ores by electric-chemical, treatment under Monroe Thompson's and other patents; to establish plants of machinery and operate same; to acquire mining claims and conduct a general milling business; T. B. Clark, San Francisco, Cal.

ELECTRIC LIGHT.

Efforts are being made to establish an Edison lighting company in Baltimore, with a capital of $1,000,000.

Postmaster McKean of Pittsburg wants the government to introduce electric lights in the postoffice building in that city.

The Rochester, N. Y., Electric Light company has recently added a steam engine of 500 horse power to its plant.

The streets of the capital of the Hawaiian islands are lighted by 92 arc lamps. The private lighting includes 800 incandescent lamps, and 600 more are used in the palace of the queen.

At a recent meeting of the board of trustees of Homer, N. Y., it was voted to give the Hitchcock Manufacturing company of Cortland, a franchise to light the village with electric lights for seven years and six months, the village to discontinue the use of the lights at any time that they should prove unsatisfactory.

A resolution has been introduced in the common council of Cleveland, O., requesting the General Assembly of the state to authorize the city to issue bondsin such sum as may be necessary to establish and maintain a gas and electric light plant. The director of public works was also requested to ascertain the cost of such a plant.

A Chicago inventor exhibits a novel revolving glass globe, in which are placed a number of electric lights. He wants to make a very large globe, place 100 or more lights in it, elevate it on one of the World's Fair buildings and thus supply a powerful illumination for the fair. These revolving globes he says, are particularly adapted for coast lighting.

The Western Electric company has closed a contract with L. Z. Leiter for furnishing dynamos and lamps in the new Leiter building, Chicago, the floor area to be lighted being 596,696 square feet, or nearly fourteen acres. The contract calls for six fifty-light arc machines, two 1,200 light incandescent dynamos and one each of 600 and 400 light capacity, and 200 arc lamps.

Interesting results have been obtained by some experiments made in England in signaling with electric lights turned vertically to the sky. The light of the Eddystone lighthouse can be seen only seventeen and a half miles, and that on a clear night; but a vertical beam of light of far less power is said to be visible just twice as far, with a strong chance of its surmounting an ordinary fog.

The eight-story fireproof building being erected by A. J. Stone at the corner of Madison street and Ogden avenue, Chicago, is to be lighted by electricity. The Chicago Edison company has been awarded the contract for the entire plant, which will consist of two Edison compound wound generators, one 25 kilowatt and one 8.5 kilowatt capacity, driven by an Ideal engine. The building is to be wired for 450 incandescent lights, and there will be ten 2,000 candle power Ward arc lamps distributed on the outside of the building.

The new electric light station of the Citizens' Gas company, of Willimantic, Conn., was opened in a novel manner on the evening of Nov. 12th. The ceremony took the form of a hop, a general invitation to participate in which was issued to the residents by the officers of the company. Many responded to the invitation, and dancing was indulged in till midnight. A feature of the affair was a lunch, which was prepared by the aid of gas stoves. General Boss, president of the company, assisted by Manager Pinney, received the guests.

ELECTRIC RAILWAY.

Electricity is to supersede horses in the street car system of Honolulu, Hawaii. It will be much cheaper, partly on account of the high price of forage.

Each of the 600 employes of the Rochester, N. Y., Railway company were remembered by John N. Beckley, the president of the company, who presented each a Thanksgiving gift. Mr. Beckley is deservedly popular.

The Little Rock, Ark., electric street railway equipment [illegible] some of the cars are now being operated by electricity. The power station is not yet completed. [illegible] horse power in the [illegible]. The Thomson-Houston Electric company [illegible]

The [illegible] company of Chicago

has been incorporated with these officers: President, C. B. Holmes; vice president, Henry P. Daly; secretary, W. S. Garvey; treasurer, W. H. Applegate. This company is organized to exploit the Applegate underground conduit system. By this invention the current is taken from iron contact boxes 32 feet apart on a flexible steel bar 33 feet long propelled with the car.

At Easton, Pa., recently, the brakes on an electric car failed to check the motion of the car, owing to slippery rails and a lack of sand. The car plunged down the track on College Hill for fully a quarter of a mile, gaining headway in its flight, until at a curve it jumped the track, and, at terrific speed, crashed through the iron railings and over the side of the Bushkill bridge, falling into the water, thirty feet below. The car was a total wreck. George Schug, the motor man, remained at his post and sustained a fracture of the leg. The conductor had jumped off at the top of the hill, and escaped without injury. Two passengers were badly bruised by the fall.

The Cicero & Proviso Street Railway company Chicago is building an addition to its present power house on Lake street. The building is of pressed brick, similar in design to the older portion, and is to be two stories in height. A portion of the first floor will be fitted up for office purposes and the rest will be used as a storage room for cars. The second floor is to be entirely for the use of the company's employes. It will have a gymnasium, card and reading rooms, and will be lighted by electricity. The building is to be completed by January 1st, and will be opened with appropriate ceremonies. The company is also putting in two new boilers.

ELECTRIC MINING.

A brief press dispatch from Ishpeming, Mich., announces that the plant established by the owners of the Michigamme mine for the separation of iron ore by electricity has proven a success. The works have so far turned out 30,000 tons of high-grade Bessemer ore.

The H. C. Frick Coke company contemplates operating its larries at Trotter and Leisenring No. 1 by electricity. It is negotiating with the Connellsville, New Haven & Leisenring Street Railway company for the power. The Loyalhanna Coal & Coke company is arranging to light its mines and operate an underground haulage road by electricity.

TELEGRAPH.

The Central & South American Telegraph company has purchased the Transandine Telegraph company, having a mileage of 1,200 and connecting Valparaiso with Buenos Ayres. The purchase price is $600,000. To raise this amount the stock of the American company is increased from $6,000,000 to $6,500,000. The balance of purchase price is to be paid from the surplus of the company.

The daily papers are printing an item to the effect that the Western Union Telegaph company in 1870 had 112,191 miles of wire, 3,972 offices, sent 9,157,646 messages at an expense of $4,910,772 and at a cost to the public of $7,138,738, thus netting $2,227,966 profit. It now has 678,997 miles of wire, 19,382 offices, and last year sent 55,878,762 messages for which it received $22 387,029, at an expense of $15,074,304, with a profit of $7,312,725. The average toll per message was $1.04 in 1868, 78 cents in 1870, 43¾ cents in 1880 and 31¼ cents in 1890.

The Western Union company and the Associated Press are at odds, the trouble having arisen over a disputed bill for tolls. The bill was finally paid, but the Associated is dissatisfied, and will undoubtedly become a customer of the Postal company or find other means to transmit its news. As a result of the row, however, the *New York Tribune* and the *Sun* have formally withdrawn from the Associated Press and organized the National Associated Press, with Charles A. Dana as president. This association will be served by the Western Union. It is claimed that the relations of the Western Associated Press and the Western Union will not be affected by the turn affairs have taken in the East. It is said that Colonel E. F. Shepard of the New York *Mail and Express* caused the trouble by refusing to audit bills except at the rate accorded the United Press.

TELEPHONE.

The Sunset Telephone & Telegraph company of Los Angeles, Cal., has asked permission to place its wires under ground, the work to occupy not over two years and to cost $20,000.

The cruiser Philadelphia is fitted with telephonic communication between the office of the executive officer and yeoman storerooms and between the poop deck and the bridge. The present system is deemed a great improvement over the speaking-tube plan. Aboard large vessels it often happens that the speaking-tubes prove wholly inefficient. This is especially the case with upper deck tubes during use in high winds. The telephone system aboard the Philadelphia is reported as operating successfully under all conditions of weather.

A dispatch from Cleveland says: "Work on the long-distance telephone line between New York and Chicago is going steadily forward through Northern Ohio, and by January it will probably be in operation between Cleveland and New York. The main line passes terough Cuyahoga Falls and Ravenna, where work is now in progress, and a branch will be built from the former point to this city. The line is now in operation as far west as Erie and Newcastle, Pa. It is said that the rate from Cleveland to New York for a five-minutes' talk will be $4. A line between Cleveland and Detroit is projected, to be built next summer."

MISCELLANEOUS.

It is proposed to transmit the power of the Dee and Don rivers in Scotland by electricity.

The number of men now employed at the Thomson-Houston factory at Lynn is about 3,200.

It is said that Atlanta capitalists are considering a proposition to convert 10,000 horse power from Barnett Shoals into electricity, and convey it to Atlanta and Athens, Ga.

Pennington, the air ship man, is in trouble again. All the property of the "Mount Carmel Aeronautic Navigation company" is heavily mortgaged, and the air ship has not yet made its long promised trial trip.

Two young Spanish gentlemen from South America have entered upon the expert course at the Thomson-Houston works at Lynn. Their names are Senor Sangotena, from Ecuador, and Senor Osio, from Venezuela.

At a recent meeting of the Monroe county, N. Y., Homœopathic Medical society Dr. E. J. Bissell declared that where a person had both gold and amalagam filling in his teeth, and the saliva happened to be acid, an electrical current was generated which might cause trouble in other parts of the body.

Two Frenchmen, MM. Guerre and Martin, have produced an electric turning box for the use of instrumentalists, bandmasters, and leaders of orchestras. This box contains a dry pile connected to an electromagnet, This, fixed to a sounding-board, gives the required note on moving a small commutator placed outside the box.

There are 66 draughtsmen employed in the Thomson-Houston works and one draughtswoman. The work of the latter is spoken of as highly satisfactory. The light of the room, after dark, is furnished by arc lampss, and there are so many of them, and they are so well distributed that it is almost impossible to detect a shadow anywhere on the board.

A special committee has been appointed by the electrical section of the London Chamber of Commerce to co operate with the directors of the Crystal Palace company in promoting the success of the exhibition. It consists of R. E. Crompton, chairman; Major S Flood Page and Emile Garcke, vice-chairmen; J. E. H. Gordon, G. Binswanger and Alexander Siemens.

Attention is attracted by the numerous waterfalls in Sweden, which are now looked upon as the source of power that may be economically transmitted by electricity. Several large projects are already being discussed, includiug the supply of power to the towns of Gothenburg and Norrkoping respectively from the Trollhattan fall and a fall on the Motala River.

Cassier's Magazine, a new engineering monthly, has just made its appearance. It is a creditable production, and contains many well-written and handsomely illustrated articles that will prove interesting to all engaged in engineering work. An article on "Electricity Applied to Pumping Machinery," by F. Merriam Wheeler, M. E., appears in the first number.

It is said that 200 requests for space at the Crystal Palace electrical exhibition in London have already been received. The exhibition is to be opened on January 1st. The English electrical papers assert that not only will the most eminent British electrical and engineering firms, with scarcely an exception, be represented, but several of the more important exhibits at the Frankfort exhibition will be transferred to the Crystal Palace.

The Oliver & Roberts Wire company of Pittsburg, one of the largest concerns of its kind in the country, has made a request of its creditors for an extension. The amount of its indebtedness is not known, as the members of the firm refused to give figures, but it is confidently asserted that the creditors will be paid every dollar. The suspension was not wholly unexpected, as it was known that the firm had been closely pressed for several weeks.

A press dispatch from Oregon City says: E. E. Charman was awakened last night by a severe pain in his foot, and found his bed on fire. He seized wraps and finally succeeded in smothering the flames. Mr. Charman was detained in his store later than usual, and upon reaching his home thoughtfully placed the incandescent light under the bed clothes to warm his feet. He went to sleep with his electric bed fellow and was awakened by the blaze.

The Thomson European Electric Welding company has issued a circular to stockholders, in which it is stated that after the payment of the dividend of $25 per share, the company has assets of $80,000 in cash, all of the continental patents and the stock in the British company, which consists of £78,344 common share and £3,760 founders' shares. It is the intention of the directors to sell the patents and stocks in the treasury.

Lightning is the name of a new electrical paper that has made its appearance in London. It sets out to be "popular" in tone, and all technical terms are to be rigorously avoided. So zealous is the editor in his warfare against words of this character that he offers a money prize for each one discovered in the paper, thoughtfully reserving the right, however, to act as judge on the nature of the words brought in question. The first numbers are clearly printed and quite attractive.

It is said that it is now becoming quite the fashion in France to have a tell-tale in the shape of a miniature microphone, enabling persons in a building to listen to any conversation which may be going on in any other room. These "secret telephones" are very small and nicely made. They can be placed out of view in any part of a room, or can be made to form part of a picture or painting, and remain out of sight. It is not likely, however, that these eavesdropping devices will ever become popular in the United States.

The United States Rapid Transit company is a new Chicago corporation which proposes to construct a series of overhead wires or cables for the rapid transmission of mail matter and merchandise, and even passengers, if the latter is practicable. The motive power will be electricity. The wires will be stretched high enough to avoid the tallest buildings, and will radiate from the postoffice to all central distributing points. They will be strong enough to carry ten tons of matter.

One of the engineers employed at the Lauffen generating station met with a fatal accident through touching a wire through which a high-tension current was passing. The deceased, whose name was Rau, was discovered lying dead on the floor of the transformer house by the engineer-in-chief. It appears that Rau, in defiance of the instructions given him, entered the transformer-room to attend to a defective lamp, and coming in contact with a high tension wire, was killed instantly.

A daily newspaper tells of a convict in a Maryland prison who, by working overtime, earned enough money to enable him to purchase over two hundred books. A short time ago, when electric light wires were being placed in the prison, he became interested in electricity and bought some standard works on the subject. The result was the construction of half a dozen different electrical appliances, including a burglar alarm, which he has just completed for the bedroom of the warden of the prison.

St. John V. Day, a member of the Chicago Electric club, has devised a plan for connecting the North and South Side boulevard systems in Chicago by a great bridge over the Chicago river, 1,300 feet long with a roadway 34 feet wide. The central span, 472 feet long, would be 110 feet above the mean level of the river, while the approaches would have very gradual gradients. Mr. Day proposes that an electric railway convey passengers over the bridge, and he estimates the entire cost to be $2,300,000.

It is supposed that the numbness in the fingers and hands of writers known as "scriveners' palsy" is caused by electricity generated by the friction of the steel pen on the paper. To avoid this, it has been suggested that the penholder should be made of paper, which is less a conductor of electricity than wood, and that the clasp which holds the pen should be made very short, so as to come below the touch of the fingers. The device is said to have been successfully employed, rolled paper being used for the holder.

At the commencement of the present year, 731 stationary engines of 38,344 horse power, and 63 portable engines of 1,266 horse power were in use in Germany for driving electric light dynamos. There were also 177 fixed engines of 9,697 horse power, and 12 portables of 212 horse power in operation for actuating dynamos for other purposes. The highest percentage was in Berlin, where 16.07 per cent. of the total was employed. Water power occupies but a very inferior position for electrical purposes in Germany at present.

A Pittsburg paper says that the reorganization committee that has had the affairs of the Westinghouse Electric & Manufacturing company in hand has made an entire success of the undertaking. Recently the work of lifting all paper of the company held by Pittsburg banks was begun. An approximation of the amount thus gathered in could not be given by the officials, but it was stated to be considerable, and it was further stated that within a comparatively short time not a dollar of the company's paper would be held by a Pittsburg bank.

It is proposed to utilize the phonograph to instruct and entertain the blind. There are comparatively few books shat have been reproduced in raised letters, and it is said that the Bible is the only book that has a common circulation among the blind. The idea is to read the contents of a book into the machine, the cylinders being numbered in order and placed at the disposal of blind persons who can enjoy them at pleasure. With larger cylinders and a new receiving needle, it is thought that the number of words that can be taken on a cylinder can be increased from 1,000 or 2,000 to 4,000 or 5,000.

A company with a capital of $10,000 has been organized to operate omnibuses by electricity on the boulevards of Chicago. Harrison B. Meech is at the head of the company. In an interview Mr. Meech said: "We have not made any carriages or omnibuses yet, and for awhile will have them made by carriage manufacturers. We will fit the electrical appliances to them. We make very light and powerful storage batteries, which will be placed under the seats of the carriages. They can be built to carry one or two, or as many people as desired. Eventually we expect to make them so that every one can have his own electrical tricycle. As soon as we get arrangements perfected we will apply to the city council for a franchise to establish regular lines of the buses."

A London telegram tells of a remarkable case of the successful removal of a piece of metal embedded in the retina of the eye, an electro magnet being used. The patient was a Welsh blacksmith, whose eye was injured by a splinter of steel that penetrated through the white coat. Dr. Tatham Thompson reopened the wound and introduced the curved pole of an electro magnet. This was then passed across the vitreous body, as nearly as could be judged, in the direction traversed by the splinter. On the [illegible] fragment of [illegible] tow of the magnet. The sufferer is stated to have since resumed his duties with restored sight.

An [illegible] made [illegible] ure. He [illegible] development through which the spawn passes. A glass cylinder [illegible] support. Into this glass the water containing the spawn is placed. At the bottom is a silvered reflector, the cover forming a parabolic reflector, in the center of which is fixed a small incandescent lamp. The reflectors and the sides of the glass cylinder act in such a way that but few rays of light emerge from the apparatus directly, hence the liquid is suffused with a soft illumination which is admirably suited to the examination of the contents. This little apparatus, or a modification of it, is now being employed in various researches into the life processes of ferments and the culture of microbes, the illumination by the incandescent light being more suitable for the study of these low forms of life than that from other artificial sources.

"Within the next few days," says the *Naval and Military* [illegible] British, "the naval [illegible] possession of an electric launch which has been constructed for the government by Messrs. Thorneycroft and Co. of Chiswick, the well-known torpedo-boat builders. This will be the first electric boat in the royal navy, and is intended for use between the Sheerness and Chatham dockyards in conveying passengers and material. It will have a speed of eight knots an hour, and the battery power will be sufficient to propel the boat at that rate for twelve hours without being recharged. The speed may, of course, be increased at will, but when that is done the motors will be exhausted in a shorter period. It is also claimed for the new boat that she will afford more accommodation for passengers than a steam launch of the same outside measurement, owing to the limited space occupied by the mechanism. During the past few weeks the little craft has been subjected to a series of trials by the builders in the Thames, and has given general satisfaction. If the working of the boat satisfies the admiralty, it is understood that a fleet of electric launches will be ordered for service at dockyard and naval establishments, their constant readiness for use giving them an advantage in this respect over the steam launch now in use."

TRADE NEWS.

The C. & C. Electric Motor company, New York, reports many orders for motors and dynamos.

Holmes, Booth & Haydens, manufacturers of the "K. K." line wire are running their factory at Waterbury, Conn., over time.

The Ball & Wood company, New York, is busy attending to the large number of orders it has booked for the Improved Ball engine.

That mica, as an insulator, is fast becoming more and more appreciated, is shown by the order book of Eugene Munsell & Co., New York,

The Electric Secret Service company of 45 Broadway, New York, states that it has now on hand a large number of orders for its arc light and motor cut outs.

The Phoenix Glass company, New York, is nicely settled in new quarters at 42 Murray street, and can now more conveniently attend to a large number of orders on hand for numerous styles of electric light globes, etc.

The Central Electric company, Chicago, has just issued a circular giving prices on a number of standard articles in the supply line. This circular covers sockets, switches, cut-outs, receptacles, attachment plugs, branch blocks, wire guards, tape, shades, lamps and a number of other articles.

The Hine eliminator is rapidly obtaining a wide-spread popularity. The Hine Eliminator company has received inquiries for the device from St. Petersburg, Russia. Two of the eliminators will go into the laboratory of the State University of Michigan at Ann Arbor, and will be applied to the steam pipes used in that institution for testing purposes.

General Manager L. W. Serrill of the United States Electric Railways company, New York, reports that the business of his company the past year has been far in excess of that for any previous year, and that the outlook is very bright for the future; especially in the West, where there will be a large amount of work.

Bartlett & Co., New York, so well known to the electrical fraternity, announce their removal to new quarters at 21 and 23 Rose street. This concern has added extensive printing facilities to its designing and engraving establishment and is now equipped for executing on the premises every description of printing as well as engraving.

The American Desk & Seating company, Wabash avenue, Chicago, is having an active business in fine office desks, which comprises a large share of its business. Among recent sales was the complete outfit for the Columbian Exposition offices, both in the Rand-McNally building and at Jackson Park. This company has brought out a decided novelty in a curtain desk with the sides hinged.

The Consolidated Electric Manufacturing company, Boston, Mass., is general agent for the New England states for Corthell's adjustable extension for Electric

Lamps This device is said to be a most reliable one. It is neat, light and durable, not liable to get out of order, and thoroughly insulated, so that there is no danger of short circuits. It is especially adapted for use in hotels, offices, factories and private residences where a movable light is required. There is a drum which holds eight feet of extra cord, that can be drawn out to any desired length; and when all out allows the light to be carried to any part of a fifteen foot room.

The Creaghead Engineering company, Cincinnati, has just made a contract with the Crane & Breed Manufacturing company of that city for a very handsome plant for the transmission of power. The generator and motors are to be of the United States pattern, the former of 60 horse power capacity. The exact size and location of the motors has not yet been fully determined, it being necessary to delay the specifications until the machinery has all been located. The motors will average from 2½ to 15 horse power, each one having some particular work to do. This company has also recently completed an isolated lighting plant for Sechler & Co., carriage manufacturers of Cincinnati, having a capacity of 200 incandescent lamps and four Mosher arc lamps for incandescent circuits. The generator used was made by the Card company.

BUSINESS.

George Cutter, Chicago, has taken an order from the Chicago Edison company for 1,000,000 feet of Simplex braided rubber wire.

Whitmore & Robinson, consulting electrical engineers, Boston, Mass., have just issued a neat little pamphlet explaining the wisdom of employing competent electrical engineers.

The Bain voltmeters and ammeters are having a large sale in the hands of the Knapp Electrical Works, Chicago. The simplicity of these instruments is exciting favorable comment.

H. Ward Leonard & Co. announce that they have been retained as consulting electrical engineers for Wm. Sellers & Co., Philadelphia, Otis Bros. & Co., and the Ingersoll-Sergeant Drill company.

"Screw glass insulators and plain glass insulators, battery jars and other jars, globes and globes," is an inscription that would not be out of place on the new catalogue of the Hemingray Glass company, Covington, Ky.

Charles A. Schieren & Co., New York, have just shipped the Franklin Electric company, Franklin, Venango county, Pa., a 20 inch perforated electric double-ply leather belt. When order No. 2 comes in it speaks well for the first shipment.

The Electrical Supply company, corner Randolph street and Michigan avenue, Chicago, reports an increased demand for the Wirt dynamo brush. It is claimed that this brush will almost entirely eliminate "sparking" at the commutator.

The La Boiteaux Electric Fan & Motor company, Cincinnati, will be ready for next season's trade with a large stock of the La Boiteaux revolving and oscillating fans recently illustrated in the WESTERN ELECTRICIAN. This device is a decided novelty.

The Electrical Engineering & Supply company has rented a store room, and Mr. Daigh is putting in a large supply of Packard lamps. The sales by this company alone will exceed fifteen thousand lamps for the month of November, with a much larger business in prospect for December.

The Gleason & Bailey Manufacturing company, 233 Lake street, Chicago, has just issued a new catalogue, illustrating a complete line of supplies for incandescent lighting. This company also manufactures on an extensive scale a large number of electric specialties that are fully described in the new catalogue.

The Electric Supply & Contracting company of Cincinnati, is meeting marked success in the rewinding of street railway armatures. It has several very large orders on hand at the present time. This company has a well arranged and very complete factory, and the outlook for a [illegible] is most flattering.

The Love Electric Traction company has commenced work on the initial plant on the North Side, Chicago. The line will be one and one-half miles in length, connecting [illegible] showing a working [illegible] on the eighth floor of [illegible] the cars will be [illegible]

The [illegible] company, [illegible] West Jackson street, is having an active business in the re cali- [illegible] of voltmeters, ammeters, etc., under contract. This com- [illegible] com- pare favorably with even old established houses in the [illegible]

[illegible]

[illegible]

sion 10,000 horse power, with the dynamo connected directly to the engine shaft. This station is to be known as "Station No. 3," and is to be completed at the earliest possible moment.

The Easton Electric company has recently completed the installation of a fine incandescent plant in the machine shops of M. T. Davidson, located on Keap street, near Kent avenue, Brooklyn, N. Y. The plant consists of one 250-light incandescent dynamo, 130 incandescent lamps of different candle power, and seven Easton "X" arc lamps, burning on the same circuit. The shops are brilliantly illuminated.

Roads in the following places have within the last week been equipped with the Burton electric heaters by the Electric Merchandise company of Chicago: Ottumwa, Ia., Reading, Pa., McKeesport, Pa., Cleveland, O., Lincoln, Neb., Martinsburg, W. Va., Salt Lake City, Utah, Sioux City, Iowa, Marquette, Mich., Wheeling, W. Va., Quincy, Ill., Williamsport, Pa., St. Louis, Mo., Ottawa, Can., Wilkesbarre, Pa., Shamokin, Pa., and Bloomington, Ill.

Foree Bain is having an active demand for the small lighting installations that he has perfected. He is also making a dynamo for printing telegraph circuits that is attracting considerable attention, and for which he has a number of recent orders. In addition to the above work Mr. Bain is turning out a number of new motors to operate mining machinery, to be run at only one hundred revolutions. General business is also reported better than expected at this season of the year.

The Chicago Edison company has closed a contract with the American Express company for the electric light plant for the company's new stables in Chicago The plant is to consist of one 25 kilowatt Edison compound wound dynamo, three hundred incandescent lights and twenty-one arc lamps. The Chicago Edison company has also been awarded the contract for wiring the St. Luke apartment building, corner Fourteenth street and Michigan avenue, Chicago, for 1,250 lamps. The building will be lighted from the Wabash avenue station of the Chicago Edison company. The company has just completed the installation of a 30 kilowatt Edison compound wound dynamo and switch-board at the county poorhouse, Dunning, Ill.

The Central Electric company, Chicago, reports a large increase in lamp business since it has taken the agency for the Swan lamp. The 16-candle power lamp of the Swan make is said to have an efficiency of between 3.3 and 3.4 watts per candle power and an average life of from 600 to 1,000 hours, and also not to blacken even when nearly burned out. The company claims that the demand is for high efficiency and good average life, rather than low efficiency and extra long life. It may be mentioned also that the Central Electric company has just taken the agency for the Washington carbon and will carry a large stock. These carbons are designed for both high and low tension systems. They have a long life, are perfectly straight and uniform. Shipments will be made from stock and at factory rates.

The Toronto Construction and Electrical Supply company, limited, of Toronto, Ont., has been appointed exclusive selling agent for the Dominion of Canada, for the Thomson-Houston International Electric company. The Toronto company has its main offices and showrooms at 63–69 Front street, Toronto, where may be seen a specimen line of apparatus, consisting of dynamos for arc lighting of the Wood system, dynamos and transformers for alternating current lighting, dynamos for direct current lighting, reciprocating rock drills, pumps, and other mining machinery, the Thomson recording watt meter and also a full line of supply material. Frederick Nichols, general manager of the Toronto company, is well known in this country, especially among electric lighting companies, being a member of the National Electric Light association.

Among the trade-marks which have recently appeared, three of the Standard Underground Cable company, Pittsburg, are especially unique. One mark for a brand of weatherproof line wire represents a piece of "Sterling" wire, twisted in the shape of the abbreviation for the pound sterling, the ends showing in detail the wire and its two fibrous coverings. The "Standard" brand of weatherproof line wire is marked with a device formed of wire, bent in the shape of a standard. The most unique trademark of the three is one emblematic of the name given to the highest grade of weatherproof line or house wire made by the Standard company. "Tip Top" wire which is furnished when a strictly first-class product is demanded, is represented by a boy's spinning top ingeniously shaped from a small coil or spiral of insulated wire. The designs must be seen, though, to be fully appreciated.

ELECTRICAL PATENTS.

Issued Nov. 24, 1891.

463,615. Electric Controller for Elevators. William Baxter, Jr., Baltimore, Md.

[illegible]. Brushholder for Electric Motors. James E. Lyons, Cleveland, O.

463,639. Electric Motor Mechanism. Samuel E. Mower, New Haven, Conn.

[illegible]. Armature Core for Dynamo Electric Machines. Elihu Thomson, Lynn, Mass.

[illegible]

463,691. Railway Signal. Edwin J. Samuels and Frank E. Behrendt, Janesville, Wis.

Claim 3 reads:
"In a railway signal apparatus, the combination of a revolving standard of a four-sided lantern, having sign boards on two opposite sides provided with central apertures."

463,693. Electric Motor and Generator. Imley E. Storey, Boulder, Colo.

463,694. Commutator for Electrical Machines. Willis W. Vail, Quakertown, N. Y.

463,704. Electric Motor and Dynamo. Albert L. Parcelle, Boston Mass.

Claim 3 is given:
"The combination of the hub or spider of non magnetic material, the ring armature, the socket in the side of the armature and in the side of the spider, and an iron coupling-bar seated in said sockets."

463,711. Electric Meter. Anthony Reckenzaun, London, Eng.

In this invention two pendulums are employed, which make periodic circuits with electric magnets which lift arms or levers. When said arms or levers fall they impart rotary motion to a rotary mechanism.

463,715. Conductor and Guide for Electric Railway Trolleys. Joseph I Conklin, Brooklyn, N. Y.

463,720. Electric Arc Lamp, William S. Hays, Troy, O.

463,733. Self Lubricating Trolley Wheel. William Duncan, Allegheny, Pa.

463,748. Carbon Brush Clamp for Dynamos. Sherburne Morse, Arkansas City, Kans.

463,754. Electric Cigar Lighter. George N. Engert, Springfield, O.

Claim 2 is given:
"The combination in a cigar lighter, of the outer casing and a normally inactive high resistance conductor and a gravity switch within said casing for bringing said conductor into electric circuit.'

463,756. Wire Hanger. Charles A. Jacobs, Hallowell, Me.

463,760. Electric Conductor for Railways. Charles E. Sargent, Chicago, Ill.

463,761. Section Insulator and Lightning Arrester for Electric Railroads. Elihu Thomson, Swampscott, Mass.

463,762. Electric Arc Interrupter. Elihu Thomson, Swampscott, Mass.

The last claim reads:
"4. The combination, with an electric switch, of a blow out magnet for extinguishing an arc thereat, and a circuit for energizing the magnet directly in or derived from the main circuit and controlled by the switch, the switch contacts being so arranged as to complete a circuit through the magnet when thrown into position, rupturing the main circuit."

463,763. Lamp Socket. Ferdinand Voigt, Bockenheim, near Frankfort-on-the-Main, Germany.

463,764. Multiple Fuse Cut-Out. George K. Wheeler, Chicago, Ill.

463,765. Trolley for Electric Railways. George H. Alton, Lynn, Mass.

463,766. Switch for Electric Railways. Francis O. Blackwell, Boston, Mass.

463,770. Electric Cut-Out. Edwin W. Rice, Jr., Lynn, Mass.

463,773. Means for Suspending Electric Lamps. Thos. H. Brady, New Britain, Conn.

463,785. Electrical Surgical Instrument. Frank L. Connable and Thomas V. Harper, Xenia, O.

463,793 System of Electric Lighting. Edgar J. Hodson and Joel W. Stearns, Jr., Denver, Colo.

The object of this invention is to prevent the burning of the electric lamps in a room in cases where, by inadvertance or mistake, the occupant has left his room without turning off the lamps.

463,802. Electrical Transmission of Power. Harry W. Leonard, New York, N. Y.

463,808. Electric Subway Switch. Louis A. Fehr, New York, N.Y.

463,809. Machine for Covering Conductors. Christopher Klotsbach, Passaic, N. J.

Claim 2 reads:
"In a machine for covering a conductor with an insulating compound, the combination, with rolls for covering the wire with the compound, of a heating surface, over which the compound is led to the rolls."

463 810. Machine for Covering Conductors. Christopher Klotzbach, Passaic. N. J.

463,824. Trolley Wire Hanger. Edward T. Birdsall, New York, N. Y., and Lemuel W. Serrell, Plainfield, N. J.

463,830. Surface Conduit for Buildings. Robert W. Gibson, New York, N. Y.

463,843. Electric Programme Clock. John L. McCaskey, Waynesborough, Pa.

463,852. Synchronous Telegraph. Charles S. Bradley, Yonkers, N. Y.

463,867. Automatic Safety Cut-out for Electrical Conductors Robert A. Morgan, Jr., Boston, and George C. Bosson, Jr., Lawrence, Mass.

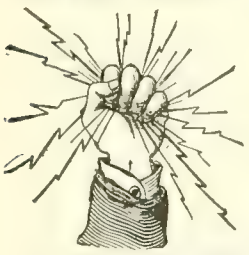
463,879. Separator for the Plates of Secondary Batteries. Charles F. Waldron, Boston, Mass.

463,945. Therapeutic Electric Battery. John A. Crisp, Jefferson, O.

463,955. Electric Wire Insulator Hiram F. Newell, Manchester, Va.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

ESTABLISHED 1864.

HEMINGRAY GLASS CO.,

Offices, Covington, Ky. Factories, Muncie, Ind.

STANDARD SCREW GLASS INSULATORS,

Glass Break Knobs, Floor Insulators, Battery Jars.

ARC LIGHT GLOBES FOR ALL SYSTEMS.

WORK ON SPECIAL DESIGNS SOLICITED.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and will remain flexible in extreme cold weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, and special extra finish, which we have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. Our insulation will prove durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five eighths inch wide, and when wrapped about a joint and pressed firmly it makes a solid mass. **FOR RAILWAY and MOTOR** use, we make all sizes of stranded and flexible cables with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low, if not lower than any other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.
HERBERT H. EUSTIS, President and Electrician.

CHICAGO AGENTS: The Electrical Engineering Co., 320 Dearborn St. TORONTO, ONT. AGENTS: The Toronto Electrical Works.

CHICAGO

The Electrical Construction Co.

43 and 45 Franklin St.

C. A. HARTER, Manager. Telephone, 1718.

WANTED.

A second hand Motor, ½ or 1 H. P., for 110 volt current is wanted. Offer containing price and general condition of Motor received by

G. MONRATH,
1302 Auditorium Bldg., Chicago.

H. T. PAISTE,

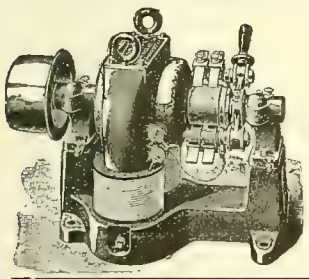
MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill. 10 So. 18th St., Philadelphia, Pa.

See our full page advertisement in issue Sept 12, for illustrations, prices, etc.

THE CROCKER-WHEELER



PERFECTED MOTORS.

Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

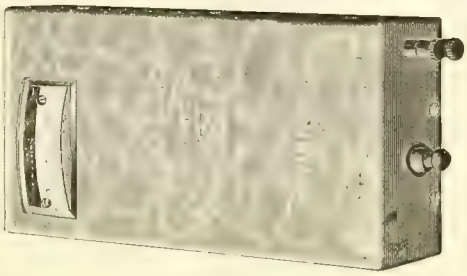
THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK

FOR DIRECT AND ALTERNATING CIRCUITS.

The WAGNER-QUEEN Portable Voltmeter.



Made by QUEEN & CO., PHILA.

Send for Descriptive Circular No. 265.

The Winner of 1890 will win again in 1891. Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,
85 John St., NEW YORK

Binders

FOR THE Western Electrician

$1.00.

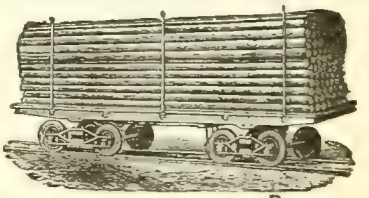
MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,
218 Water St., New York.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light } CROSS ARMS POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES. Room 410 Com'l Bldg., St. Louis, Mo.

HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, Rods, Tubing, Washers, Discs and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.

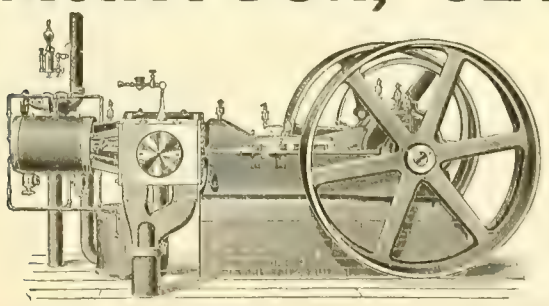
REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

205 and 207 So. Canal St., CHICAGO, ILL.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION.
One	12½x12	80	Edison General Electric Co., Groton, N. Y.
Two	18½x17	100	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rio Janeiro, Brazil.
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 19x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Rollins & Co., Chicago, Ill.
One	15 and 23x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Leeds, England.
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One	11 and 19x15	150	Fritz Wilen, Helsingfors, Finland.
One	16x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	13 and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 26x17	400	Baltimore Electric Redning Co., Baltimore, Md.
One	14½ and 28x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS, 339 Rookery Bldg., CHICAGO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

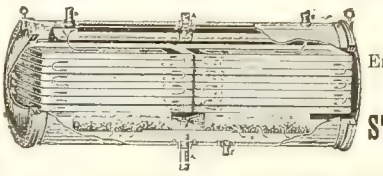
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

KARTAVERT

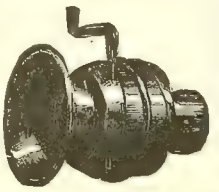
THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞Send for NEW CATALOGUE. Out August 1st.

TO AMERICAN INVENTORS.

Woodhouse & Rawson,

UNITED, LD.,
88 Queen Victoria Street,
LONDON, ENG.,

NEW YORK OFFICE, 36 WALL STREET.

Are Prepared to Negotiate and Introduce Inventions of Merit into Great Britain and all Parts of the World.

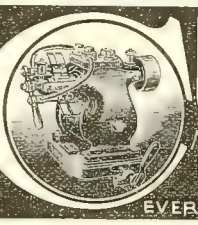
CORRESPONDENCE INVITED.

A GREAT RAILROAD.

By the absorption of the Chicago & Atlantic Railway between Marion and Chicago, the ERIE has at last effected its entrance into Chicago, and now occupies the proud position of being the only line between Chicago and New York entirely under one management

One result of this is the arrangement whereby all the through trains of the Erie are now run solid between Chicago and New York without change. Passengers holding through tickets, whether first or second class, are able to go from Chicago to New York without changing cars.

Pullman's most modern Sleeping Cars are run on all through trains via this line, and on their Vestibule Limited, Pullman's Dining Cars. No extra fare charged on this train. In fact, the rates via the ERIE are lower than via any other route offering equal facilities.



OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.
FITCHBURG, MASS, U.S.A.

MANUFACTURERS OF **DYNAMOS** FOR **LIGHTING, PLATING** AND **EXPERIMENTAL PURPOSES.**
ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

ELECTRIC LIGHT AND BATTERY
CARBONS.

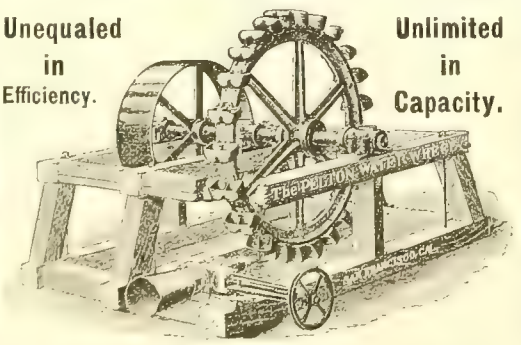
MOTOR BRUSHES.

CLEVELAND, OHIO.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 10 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,
121-123 Main St., San Francisco, Cal., U. S. A.
143 LIBERTY STREET, - - NEW YORK.

☞It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

Manufacturers of OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

HIRLIMANN BATTERIES.

Are Standard.—Only One that is Guaranteed.

SEND FOR CATALOGUE AND PRICE LISTS

C. J. HIRLIMANN, 117 Macdougall St., New York.

AGENTS WANTED.

COPYRIGHTED 1886 BY J.A.J. SHULTZ.

SHULTZ BELTING CO.

Manufacturers of

SHULTZ PATENT FULLED LEATHER BELTING

IT BELTS THE EARTH AND MAKES THE MOON SPIN LIKE A TOP

Shultz PATENT Leather Woven Link Belt

ALL LEATHER
NO IRON ROD OR HINGE OLD STYLE LEATHER LINK AND IRON ROD BELT AND ROPE TRANSMISS ON SUPERSEDED

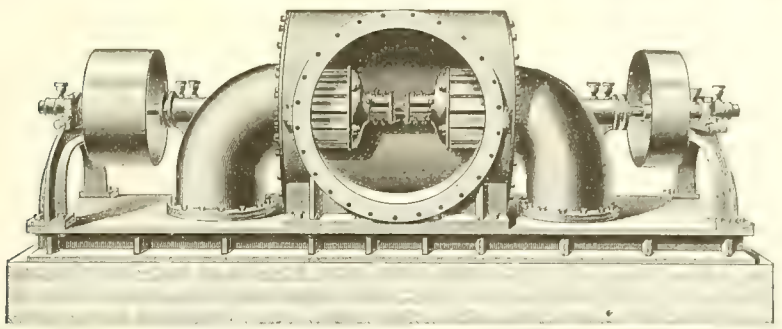
SAVE YOUR POWER. YOUR BELTS. YOUR MONEY.
BY COVERING YOUR PULLEYS WITH SHULTZ PATENT LEATHER PULLEY COVERING.

OUR BELTING IS TANNED ON THE SURFACES ONLY. INTERIOR IS RAWHIDE. THE ONLY PERFECT BELT MADE. NO SLIPPING OR LOST MOTION

RAWHIDE LACE LEATHER AND PICKER LEATHER.

BRANCHES: 164 Summer St., Boston, Mass.; 325 Pearl St., New York City; 139 N. Third St., Philadelphia, Pa.; 40 W. Monroe St. Chicago. | **St. Louis, Mo.**

VICTOR TURBINE WATER WHEEL.



The attention of [illegible] CELEBRATED WATER WHEEL [illegible] on account of its remarkably steady motion, high Speed and great Efficiency, and large Capacity [illegible] diameter, being double the Power [illegible] by a number of the leading [illegible] economical use of water it will [illegible] of useful effect guaranteed.

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" [illegible] and it can be belted directly to [illegible]

The acknowledged [illegible] VICTOR TURBINES [illegible] Tubes, End Bearing for Shaft and Driving [illegible] a cut material cast iron bed plate. [illegible] strictly first class in every particular. [illegible] Turbines, either single or in [illegible] admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO., RAVENNA, OHIO. MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

$22.00

ANTIQUE FINISH DESK,
Four and a half feet long.
Send for complete catalogues of office fittings

AMERICAN DESK AND SEATING CO.
270-272 Wabash Avenue, CHICAGO.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

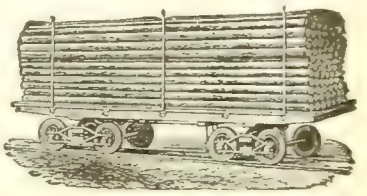
Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.
Will convey all kinds of grain without mixing
Will carry two different kinds of material in opposite directions at the same time
Will convey One Hundred and Fifty Tons of Coal per hour Made of Wrought Iron and Steel. Send for Illustrated Catalogue. BOWDEN & SCHLECK COMPANY 48 and 50 Lake St. Chicago, Ill.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. 136 Liberty St., NEW YORK.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

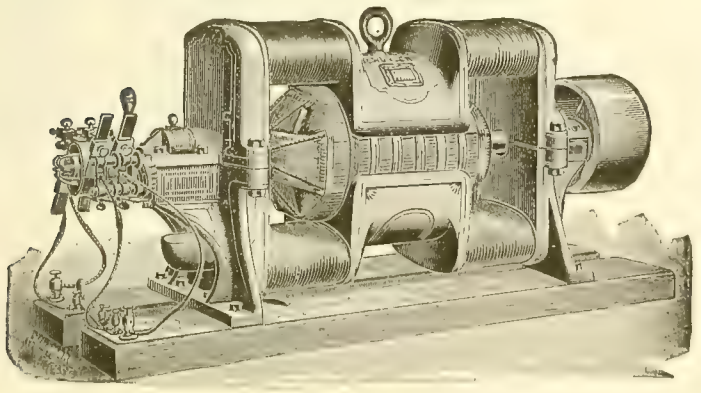
FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES.



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

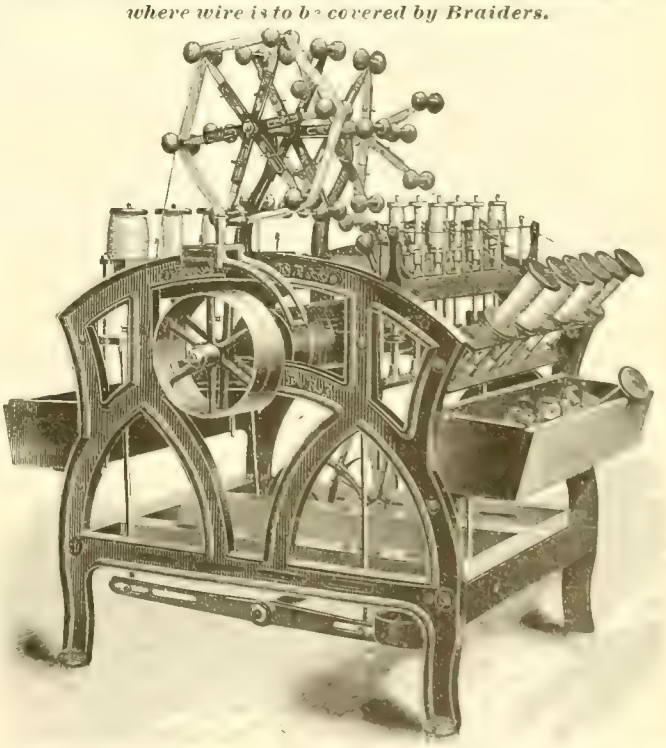
MIDDLETOWN, CONN.

GEORGE W. PAYNE & CO.,

MANUFACTURERS OF

BRAIDER SPOOLERS,

Used in connection with Braiding Machinery for Electrical Work where wire is to be covered by Braiders.



Machines built when required to double two or more ends, with drop motions to stop spindle when end breaks, also when bobbin is full.

Works 102 Broad St., PAWTUCKET, R. I.

C. & C. ELECTRIC MOTORS and DYNAMOS.

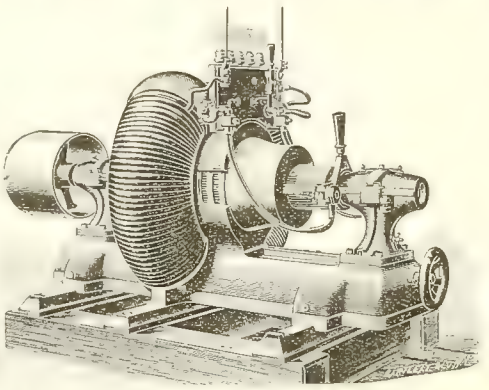
ELECTRIC MOTORS in all standard sizes, up to and including 100 H. P., for operating elevators, pumps, printing presses, and machinery for general manufacturing purposes.

POWER GENERATORS.

ELECTRIC MINING MACHINERY of all kinds, Hoists, Tram Cars, etc.

FAN OUTFITS, Electric Plants for pumping Church Organs.

We call the special attention of Station Superintendents to the fact that our machines are absolutely unsurpassed for economy of electric current.

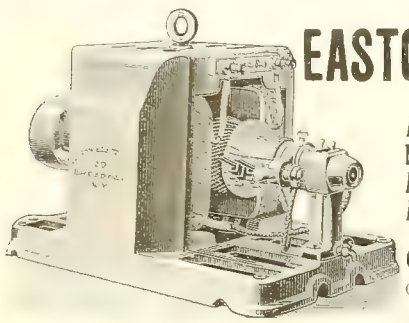


DYNAMOS for isolated plants and the equipment of Mills, Banks and Office Buildings with Electric Lights.

ELECTRIC BLOWERS for ship ventilation. Have equipped 18 U. S. and foreign War Ships with ventilating apparatus.

NEW ENGLAND Office, 63 Oliver St., BOSTON.
PHILADELPHIA Office, 38 S. Fourth St.
CHICAGO Office, - Phenix Building.
SAN FRANCISCO Office, - 35 Market St.
ST. LOUIS Office, - - 421 Olive St.
NEW ORLEANS Office, 78 Customhouse St

THE C. & C. ELECTRIC MOTOR CO., 402-404 Greenwich Street, NEW YORK.



THE EASTON ELECTRIC CO.,

MANUFACTURERS OF

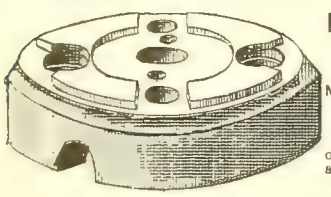
Arc and Incandescent Dynamos, Motors, Generators and Separators And Arc Lamps adapted for use on Arc or Incandescent Circuits.

ADDRESS:

643 Kent Ave., Brooklyn, N. Y.

(Near Roosevelt, Grand and East 23d Street Ferries from N. Y.),

For Circulars, Prices and Information.



EMPIRE CHINA WORKS,

114 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

Goodrich-Coleman Electrical Works,

NEW ELECTRICAL THEORIES DEVELOPED.

Manufacturers of Specialties and Novelties under Contract.

31 South Canal Street, - CHICAGO.

GIVEN AWAY!!

SAMPLE ORDERS OF

Buxton's Packing

At Only 50c. Per Pound.

"The Engineer's Favorite."
All Orders Guaranteed.

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

ESTABLISHED 1882.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

TESTING

OF INSULATED WIRES AND CABLES.

A New Book Just Published.

A Practical Guide to the Testing of Electric Light, Electric Railway, Telephone and Telegraph Wires.

PRICE, POSTAGE PREPAID, $1.00.
SEND IN YOUR ORDER NOW.

ELECTRICIAN PUBLISHING COMPANY,

6 Lakeside Building, CHICAGO.

You can Put It up Yourself.

Lights Are Standard And Full size.

Thoroughly Reliable And Practical.

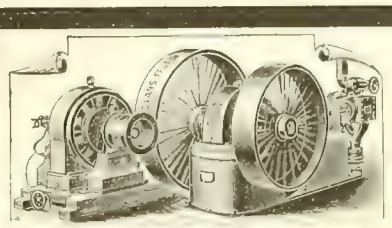
Prices Reasonable.

Send For Illustrated Pamphlet.

BAIN ELECTRIC MANUFACTURING CO.,

47 So. JEFFERSON STREET,

CHICAGO.

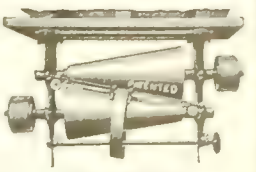


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones, For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | **CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.**

EVERYTHING IN
WIRE—FUSE— STRIPS.

MANUFACTURED BY
The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

56 LIBERTY STREET, NEW YORK.

MANUFACTURED BY
MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

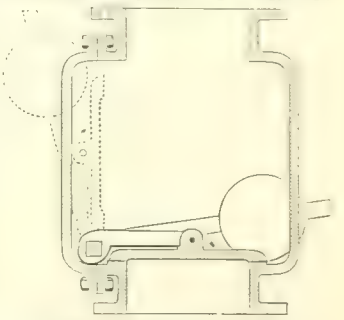
WRITE FOR CIRCULAR AND CATALOGUE.

ELECTRICAL INSTRUMENTS

RECALIBRATED.—REPAIRED.

CHICAGO ELECTRIC MFG. CO., 73 W. Jackson St.

THE EXCELSIOR
Straight-Way Noiseless
Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,
229 S. Franklin St., Chicago.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

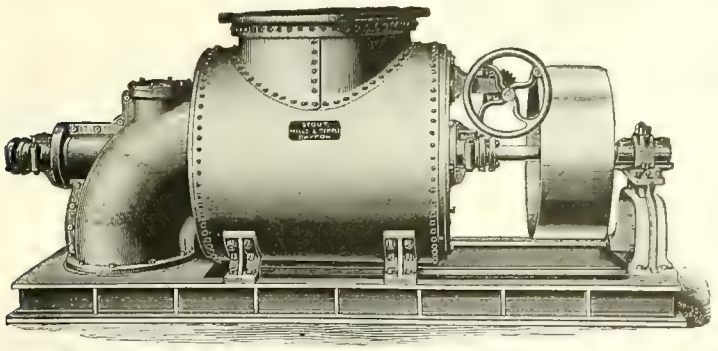
Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS.

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO STOUT, MILLS & TEMPLE, **DAYTON, O.**

INTRODUCING ENTIRELY NEW PRINCIPLES.

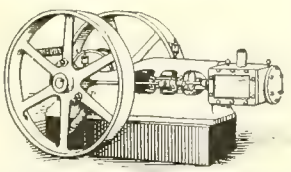
Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.



WILLIAMS AUTOMATIC ENGINE.

For all purposes requiring steady power.

WILLIAMS ENGINE WORKS: No. 417 North street, BALTIMORE, MD.

STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC

HIGH SPEED STEAM ENGINE

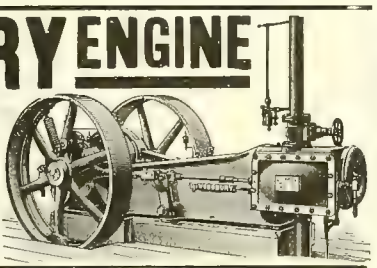
for Electric Lighting and Street Railway Service,

WITH BOILER PLANT COMPLETE.

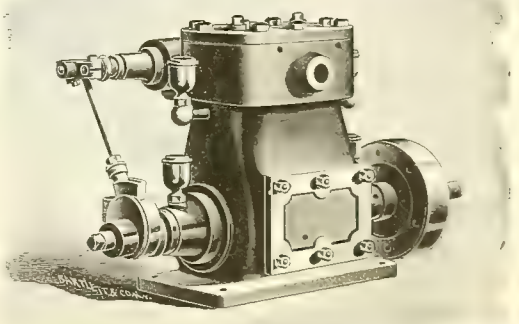
—Catalogue sent on application.—

STEARNS MFG. CO. ERIE, PA.

BRANCH OFFICES { Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



WESTINGHOUSE ENGINES



THE ORIGINAL WESTINGHOUSE ENGINE,

BUILT A. D. 1880.

SIZE 3 x 3. 1,000 REVOLUTIONS.

Now preserved in the Offices of the Company, Pittsburgh, Pa.

THE WESTINGHOUSE MACHINE COMPANY.

PITTSBURGH, PENNA. U.S. OF A.

FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO.

HALF TONE PLATE A SPECIALTY.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

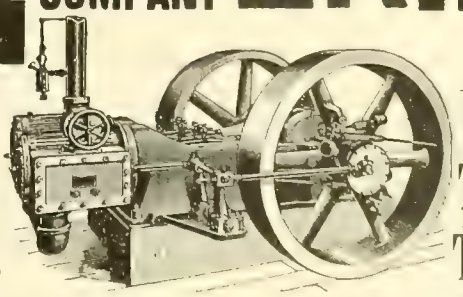
Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,

ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.

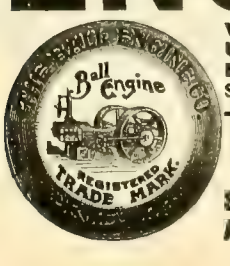


Simple.

Cross Compound.

Triple Expansion.

Tandem Compound



With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 18 Cortlandt St., New York; J. W. PARKER & CO., 38 South Fourth Street Philadelphia, Pa; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY Co., Tacoma, Wash.; CROOK, HORNER & CO., Baltimore, Md.; E. G. GILBERT, Atchison, Kan.; COOLEY & VATER, 224 Washington Ave., South, Minneapolis, Minn.

BRANCH OFFICE, Room 506 Rookery Building, CHICAGO, ILL. ALBERT FISHER, Manager.

DID YOU SEE IT
AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.,

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.

THE

CRESCENT DRY BATTERY.

IT
Is Smaller Than Any Other.
Has Great Strength.
Has Great Durability and Recuperative Powers.
Is Not Subject to Freezing.
Does Not Evaporate.
Is the Best Battery on the Market.

THOUSANDS IN USE.

We want every Bell Hanger and Construction Man to send us his name on a postal card. It will pay him to do so.

Perkins' Incandescent Lamps

Never Dissapoint You.

THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS AND DEALERS,

54 and 56 Franklin Street,

CHICAGO, ILL.

The Wirt Dynamo Brush was designed with the intention of combining the good qualities of CARBON and COPPER brushes. It has accomplished this effectively. *Sparking*, with its attendant wear and damage to the commutator, has been almost entirely eliminated.

The Principle involves the use of a lamination of perfect and imperfect conducting materials, the good conductor being placed between two layers of higher resistance. The result is that the main current is carried away principally by the middle portion with a minimum of heat, while the wasteful currents are partly prevented and in part "wire drawn" to the point where the energy is too small to do mischief. The construction of the brush gives a *CUSHION TOUCH* on the commutator, permitting the use of a very light tension.

The Resistance Metal in these brushes is something new in electrical art, and has a resistance about fifty times that of copper, or three times the resistance of German silver. It is used in sheets as thin as letter paper, the result being great flexibility, producing smooth running, and as the contact on each successive commutator bar is made first with this high resistance metal, and broken also on the high resistance metal, the destructive short circuiting currents which cause the vicious sparking sometimes seen on commutators is almost entirely prevented. At the same time there is sufficient pure copper in the middle of the brush to carry the main current to the brush holder without undue heating.

We invite correspondence from those who have dynamos which are at all troublesome at the brushes. The Wirt Brushes are somewhat higher in first cost than plain copper brushes, but they will pay for themselves many times over in saving of labor and commutator copper.

These brushes are manufactured to order, and can be furnished on short notice. When ordering please give dimensions of brushes in use.

THE WIRT RHEOSTATS.

For many purposes the use of a rheostat or adjustable resistance is indispensable, and consequently the variety of forms in which these are made is very great. The chief difficulty has been to produce a sufficiently gradual increase of resistance and to insure good contact at the successive points, and at the same time have sufficient resistance and ample current capacity within reasonable space.

We are confident that these various points have been well combined in the Wirt Rheostats, two forms of which we illustrate here. We can make these in various sizes adapted to any special purpose for which they may be intended, such as photometric testing, dynamo and stage regulators, etc. They are finished either in hardwood polished, or mounted with marbleized slate. We will be pleased to answer any inquiries relating to these or special instruments.

The Electrical Supply Co.,

WESTERN OFFICE AND WAREHOUSES

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

Eastern Office and Factories
Ansonia, Conn.

Enclose Business Card
for Illustrated Catalogues.

C. R. Huntley,
General Manager.

Buffalo Electric Light & Power Co.

Office No. 5 & 6 Coal & Iron Exchange
257 Washington St.
Buffalo, N.Y. November 2, 1891

Mr W. D. Packard,
New York & Ohio Co.,
Warren, O.

Dear Sir:

We have yours of October 30th. We beg to state that we have used quite a number of your Packard Lamps, and have found them efficient and of remarkably long life. At the present time we are using your lamp with our meter customers to a large extent, finding that they, as well as ourselves, are better satisfied with these lamps than any others that we have used.

Yours very truly,
BUFFALO ELECTRIC LIGHT & POWER CO
C. R. Huntley
Gen'l Manager.

NEW YORK & OHIO CO., - Warren, Ohio.

AGENTS.

J. W. PEALE, 1 Broadway, New York.
THE E. E. & S. CO., 931 Rookery, Chicago; St. Paul and Duluth.
ELECTRIC ENG. & SUPPLY CO., Syracuse, N. Y.
ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

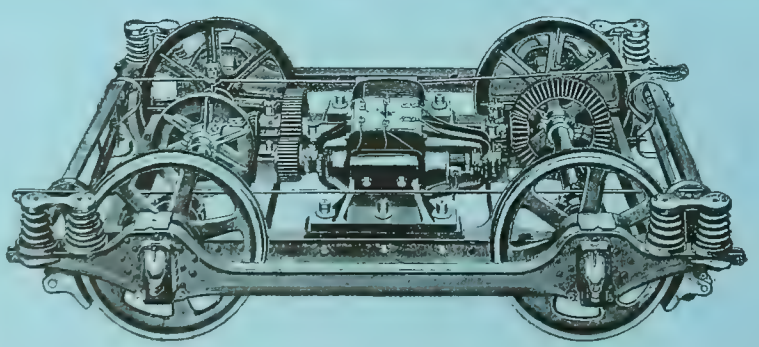
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

ONE MOTOR DRIVING BOTH AXLES

Of a street car, is the same principle as having all driving wheels of a locomotive connected, which is the AMERICAN SYSTEM.

Sizes: 15, 30 and 40 Mechanical Horse Power.



One Heat Proof Motor, Driving Both Axles.

This cut represents the latest construction of our Standard Apparatus equipped with our HEAT PROOF MOTOR. Attention is invited to the work being done by these equipments on the Merrimac Valley Street Railway, Lawrence, Mass.; Consolidated Street Railway Company, Grand Rapids, Mich.; and the People's Electric Street Railway, Springfield, Ill.; where, in each place, the two largest electric companies have put their latest equipments against them, with the result of proving our claims and strengthening the advantages derived from utilizing the full traction of the car, and driving all wheels simultaneously.

PATENTEES AND SOLE MANUFACTURERS:

DETROIT ELECTRICAL WORKS,

DETROIT, MICH., U. S. A.

Also Manufacturers of Electrical Power Machinery, Standard Line Appliances and General Electrical Supplies.

CORRESPONDENCE INVITED.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, DECEMBER 12, 1891. No. 24

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building. - - CHICAGO.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE
Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

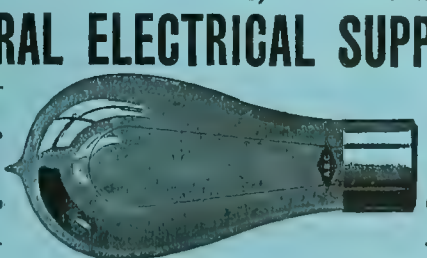
CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

WILLIAM H. ECKERT, Gen'l Agent, 16 Dey St., NEW YORK.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."



WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

See Upper Half of Page ix, and Page xxv.

E. E. KELLER. F. E. DEGENHARDT.
Keller & Degenhardt, ELECTRICAL ENGINEERS.
542 Rookery Bldg., Chicago, Ill.
THE ONLY BUREAU OF ELECTRICAL INFORMATION IN THE WORLD'S FAIR CITY.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
F. CAZENOVE JONES, Manager of Factories.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.

OKONITE TRADE MARK

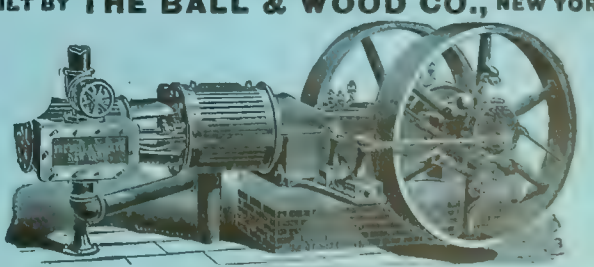
INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

WM. ROTCH, Prest. CHAS. G. WINTER, Treas.
CHAS. E. BIBBER, Gen'l Manager.
DO NOT
Equip your Switch-board with cheap Switches.
BUY THE
C. E. M. Jack-Knife Switch.
It is a Record Breaker and a reliable Circuit Breaker.
Manufactured Solely By
THE CONSOLIDATED ELECTRIC MFG. CO.,
Corner Congress and Franklin Streets, BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS.

IMPROVED BALL ENGINES,
BUILT BY THE BALL & WOOD CO., NEW YORK.



—AGENTS—
W. B. Pearson & Co., Home Insurance Building, Chicago, Ill.
Thos. G. Smith, Jr., 11 Hammond Building, Cincinnati, Ohio.
W. A. Day, 128 Oliver Street, Boston, Mass.
A. M. Morse & Co., St. Louis, Mo.
Cooley & Vater, Minneapolis, Minn.
Mead & Stringham, 321 Hammond Building, Detroit, Mich.

The Thomson-Houston ELECTRIC CO.,

MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co xv
Alexander, Barney & Chapin i
American Desk & Seating Co. ..... —
American Electrical Works xv
Andrews & Co., A. H. xv
Baggot, E xvi
Bain Electric Mfg. Co. xviii
Ball Engine Co. xxi
Ball & Wood Co., The i
Beckerleg, Jas. G. xiv
Beggs, J. E., Mfg. & Supply Co. xvi
Bernstein Electric Co. xvii
Borden & Selleck Co. xvii
Braun Illustrating Co xxi
Brownlee & Co. xiv
Brookfield, Wm. xiv
Brush Electric Co xix
Butler Hard Rubber Co. xi
Buxton, Geo. B xvi
C. B. & Q. R. R. ..... —
C. & E. R. R. xvi
C. & C. Electric Motor Co. xviii
Card E. Motor & Dynamo Co. iv
Central Electric Co. v
Chicago Electric Mfg. Co xix
Chicago Electric Motor Co. ..... —
Chicago Insulated Wire Co xix
Colburn Electric Mfg. Co xvi
Consol. Elec. Mfg. Co., The i
Crocker-Wheeler Elec. Mo. Co. xv
Day's Kerite Insulation i
Dayton Globe Iron Works Co. xxi
Delaware Hard Fibre Co. xv
Detroit Electrical Works xxvi
Densmore Typewriter Co. ..... —
Eastern Electric Cable Co xv
Easton Electric Co. ..... —
Edison General Electric Co. vi
Edison General Electric Co., Cable and Wire Department vi
Electric Construction & Sup. Co ix
Electric Merchandise Co. xii
Electric Secret Service Co. xii
Electrician Pub. Co. iv, xii, xvii, xx
Elec. Construction Co., The xv
Elec. Eng. & Sup. Co., The. ix, xv
Elec. Supply & Contracting Co. xi
Electrical Supply Co., The xxiv
Elektron Mfg. Co. iv
Empire China Works xviii
Evans Friction Cone Co. xix
For Sale xvi
Foster, O. A. ..... —
Fort Wayne Electric Co. xxvi
Gleason & Bailey Mfg. Co. Ltd. iv
Globe Carbon Co. xvii
Great Western Elec. Supply Co. xi
Greeley & Co., The E. S. i
Goodrich-Coleman Elec. Wks. ..... —
Heisler Electric Co. ..... —
Hemingray Glass Co xv
Hill Clutch Works ..... —
Hirlimann, C. J ..... —
Hine Eliminator Co. xiv
Holmes, C. H xv
Holmes, Booth & Haydens x
Hood, Wm. xii
India Rubber & Gutta Percha Insulating Co. ..... —
Interior Conduit & Insulation Co. xii
International Okonite Co. i
Kartavert Mfg. Co. xiv
Keller & Degenhardt i
Knapp Electrical Works xxiii
Law Telephone Co xv
Leonard & Co., H. Ward xix
Loud, H. M. & Sons Lumber Co. xvi
McLaughlin, James ..... —
Milliken Bros. xix
Monitor Electric Co. xii
Mosher Arc Lamp Co. xiv
Munsell & Co., Eugene xv
Murphy, T. J. xvii
National Carbon Co. xvi
National Electric Mfg. Co. viii
N. Y. Belting & Packing Co. xiv
New York Insulated Wire Co xxi
New York & Ohio Co. ..... i, xxv
N. W. Elec. Specialty Co. xvi
Novelty Electric Co. iv
Nuttall Company, R. D i
Ostrander & Co., W. R xvi
Paiste, H. T. xv
Page Belting Co. ..... —
Partrick & Carter Co. xi
Payne & Co., Geo. W ..... —
Pearson & Co., W. B. xxi
Pelton Water Wheel Co xvi
Phoenix Glass Co. ..... —
Pond Engineering Co xxi
Powell Co., The Wm. xi
Queen & Co. xv
Ries Elec. Specialty Co., The xii
Rockford Electric Mfg. Co. ..... —
Royal Electric Co. xiv
Samson Cordage Works. xiv
Sargent & Lundy i
Sawyer-Man Electric Co. xviii
Schawel & Co., Jas. xiv
Schieren & Co. Chas. A. xiv
Schoonmaker, A. O xiv
Schuyler Electric Co. xvii
Short Electric Railway Co xiv
Shultz Belting Co. ..... —
Sperry Elec. Mining Mach. Co. xiv
Standard Underground Cable Co. i
Stanley Electric Mfg. Co. ..... —
Star Electrix Co. xi
Stearns Mfg. Co. xxi
Sterling, W. C. xviii
Stilwell & Bierce Mfg. Co. xvi, xvii
Sunbeam Incand. Lamp Co x
Taussig, S. xi
Temple, J. C. xvii
Thomson-Houston Elec. Co. ii, xxii
Union Electric Mfg. Co., The iv
Union Electric Works. ..... —
Union Hardware Co. xiv
U. S. Electric Lighting Co. ..... —
Van Nuis C. S. ..... —
Vulcanized Fibre Co. xvii
Wasatch Asphaltum Co. xiv
Washington Carbon Co., The vii
Western Electric Co. x
Westinghouse Elec. and Mfg Co. xiii
Westinghouse Machine Co. xxi
Weston Electrical Instrum't Co. ..... —
Williams Engine Works. xxi
Woodbridge & Turner Eng. Co. xvii
Woodhouse & Rawson, Ltd. ..... —
Worthington, Henry R. ..... —

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Goodrich-Coleman Elec. Works

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Samson Cordage Works.

Asphaltum
Wasatch Asphaltum Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Hirlimann, C. J.
Law Telephone Co.
Monitor Electric Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter Co.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
Leonard & Co., H. Ward.
McLaughlin, Jas.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Temple, J. C.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Eas on E ectric Co.
Electrical Engineering Co., The.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng Co.

Electric Wire Gauges.
Novelty Electric Co

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Novelty Electric Co
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co., The
Star Electrix Co.

Electrollers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E., Mfg. & Supply Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electric Construction & Supply Co.
Electrical Supply Co., The
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Novelty Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Gleason & Bailey Mfg. Co. Ltd.
Hemingray Glass Co.
Phœnix Glass Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Novelty Electric Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Wasatch Asphaltum Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Novelty Electric Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Hood, Wm.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene
Schoonmaker, A. O.

Mining Apparatus, Electric
Bain Electric Mfg. Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Sperry Elec. Mining Machine Co.
Stanley Electric Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Bernstein Electric Co.
C. & C. Electric Motor Co.
Card Electric Motor & Dynamo Co.
Colburn Electric Mfg. Co.
Easton Electric Co.
Electrical Engineering Co., The.
Elektron Manufacturing Co.
Fort Wayne Electric Co.
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Goodrich-Coleman Elec. Works

Office Furniture.
American Desk & Seating Co.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors
Woodhouse & Rawson, Ltd.

Packing
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co
Stanley Electric Mfg. Co.
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Type Writer Co.

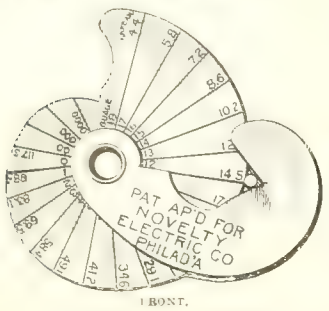
Valves
Barbour, Jas. C.

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

NOVELTY ELECTRIC COMPANY,

50 North 4th Street, Philadelphia, Pa.

NEW ELECTRIC WIRE GAUGE.



FRONT.

This cut represents in full size one side of our recently perfected patented pocket Wire Gauge. It is finely finished, and graduated with extreme accuracy.

IT WILL GIVE:

1st. The American B. & S. gauge of the wire.
2d. The safe current in amperes.
3d. The ohms resistance per foot of copper wire.
4th. The number of lamps wire will carry.

The resistance of German silver and iron wire, and other valuable information can be readily found. Printed instructions with each gauge.

Mailed to any address. Price, $1.00. **Discount to the trade in quantity.**

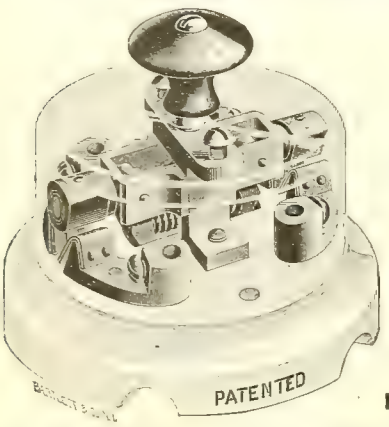
EVERY DESCRIPTION OF ELECTRICAL MATERIAL AND SUPPLIES.

WE ARE HEADQUARTERS IN THE WEST

FOR ELECTRICAL BOOKS.

SEND FOR OUR COMPLETE CATALOGUE.

Electrician Publishing Co., 6 Lakeside Bldg., Chicago, Ill.



OF SOME THINGS ONLY THE BEST!

Three years ago we brought out what was THEN the best switch on the market—now we are doing the same thing again,

BRINGING OUT THE BEST.

THE UNION ELECTRIC MFG. CO.,

BRIDGEPORT, CT.

NEW YORK: Alexander, Barney & Chapin. **BOSTON: Eastern Electrical Supply Co.**

Gleason & Bailey Mfg. Co.,

(LIMITED.)

Manufacturers of, and Dealers in, a line of General

ELECTRICAL MERCHANDISE.

ALSO ELECTRIC AND COMBINATION FIXTURES AND GLASSWARE.

Rubber Covered Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and new catalogue.

The Card Electric Motor and Dynamo Co.,

—CINCINNATI, OHIO.—

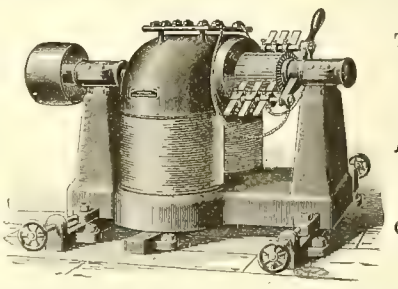
MANUFACTURERS OF

ELECTRIC MOTORS AND DYNAMOS.

Incandescent **Dynamos** from 20 to 350 Lights.

Arc or Incandescent **Motors** from $\frac{1}{8}$ to 30 Horse Power.

Motors for the Arc Circuit a Specialty.



These Motors have the Highest Efficiency, Low Speed and Self-Oiling Bearings.

AUTOMATIC, SIMPLE, DURABLE AND CLEAN.

Correspondence Solicited.

AGENTS.—Boston: The Eastern Electrical Supply and Construction Co., 65 Oliver Street. Chicago: The Thos. L. Johnson Co., 312 Dearborn Street. Milwaukee: Henry Ramien, 641 Third Street. Washington, D. C.: J. Geo. Gardner, 1005 H. Street. St. Louis: Stagl Electrical Engineering Co., 1106 Pine Street. Montgomery, Ala.: W. F. Murphy. Detroit, Mich.: The Michigan Electric Co., 212 and 214 Griswold Street. Minneapolis, Minn.: J. M. Lennon, 22 Loan and Trust Building.

THE PIONEER LOW SPEED HIGH GRADE MACHINES.

PERRET ELECTRIC MOTORS.

ALL SIZES FOR ALL PURPOSES. **THOUSANDS NOW IN USE.**

PERRET - ELECTRIC - LIGHT - SYSTEM.

COMPLETE APPARATUS FOR ISOLATED PLANTS.

THE ELEKTRON MFG. CO., Springfield, Mass.

NEW YORK OFFICE, 89 Liberty Street.

SELLING AGENTS: **Washington, D. C.**, J. L. BURKETT & CO., 1409 N. Y. Avenue. **New Orleans, La.**, GEORGE BAQUIE, 139 Gravier Street. **Chicago, Ill.**, THE ELECTRICAL ENGINEERING CO., 329 Dearborn Street. **St. Paul, Minn.**, E. J. RENZ, 95 East 4th Street. **Philadelphia, Pa.**, PENNSYLVANIA MACHINE CO., 29 North 7th Street.

WHAT'S THE USE OF BUYING SWITCHES?

WE ARE GIVING THEM AWAY.

READ THIS.

We will for 30 days from the date of this notice, give away ten, five ampere, or nine, ten ampere Paiste switches to any one sending us an order for one hundred dollars worth of goods, accompanied by this blank filled in and signed.

CENTRAL ELECTRIC COMPANY,

November 23, 1891. CHICAGO.

Central Electric Company,
CHICAGO.

Please send with accompanying order .....ampere Paiste switches, for which you agree to make no charge.

Signed.....

.....1891.

A DEPARTURE IN CARBONS.

We are selling MOULDED Carbons, Chicago delivery at factory prices for FORCED Carbons.

THIS IS A DEPARTURE IN THE SUPPLY BUSINESS.

EVERY CARBON GUARANTEED

For straightness, brilliancy and life. A full stock of 7-16 and ½ inch plain or coated Carbons will hereafter be kept in our Warerooms, and prompt shipment assured. Save time and money by buying in Chicago instead of at the factories.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison
General
Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

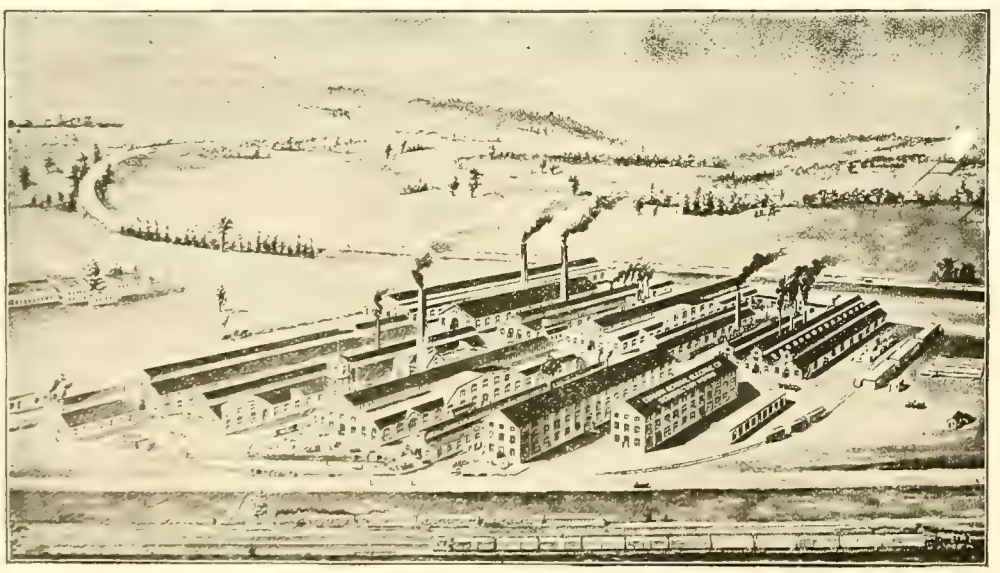
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

The CARBON TRUST'S output is much reduced since the burning of its Factory, at Fremont, Ohio.

WE HAVE A CAPACITY OF

50,000,000 CARBONS

PER YEAR.

We propose to ***continue*** in the front rank of this industry, in spite of the **VIOLENT OPPOSITION OF THE CARBON TRUST**, which is ***now*** endeavoring to monopolize the ***crude product*** of the country, and thus "freeze out" opposing concerns. We have arranged for a supply of raw material for the next two years and are prepared to meet prices, and will guarantee that our carbons are as good, if not better, than the best product of the Trust.

NOTE THE TRUST METHODS:

Companies operating under old Brush licenses are tied up to purchase all supplies from the Brush Company. The Trust bought up the Brush Carbon business because IT could ***squeeze*** these customers. **THEY ARE PAYING MORE THAN ANYBODY ELSE.** The Trust will put the pressure on you in the same way ***if*** IT monopolizes the Carbon Business as IT is trying to do.

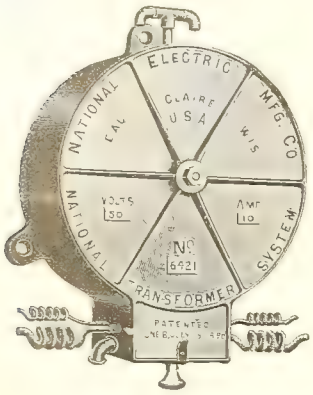
DO YOU PROPOSE TO FOSTER A WOULD-BE MONOPOLY?

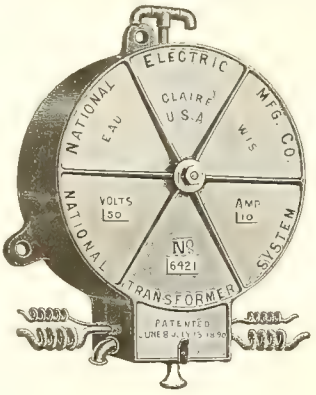
WE ARE NOT IN THE TRUST.
WE ARE NOT GOING INTO THE TRUST.
WE WANT YOUR ORDERS.
WE CAN FILL THEM PROMPTLY.

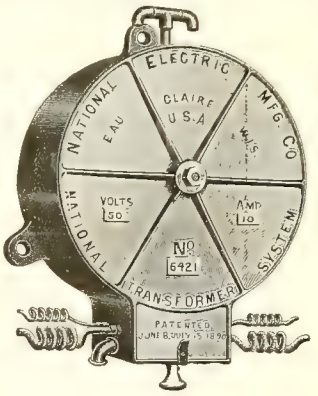
THE WASHINGTON CARBON CO.,

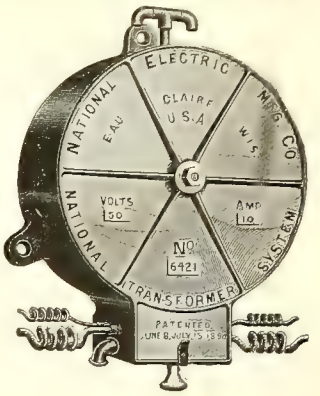
WASHINGTON, PENNSYLVANIA.

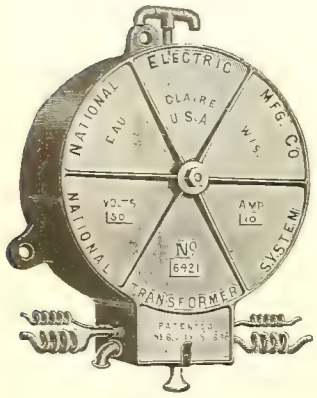
WATCH THIS PAGE NEXT WEEK.
WE SHALL HAVE A GOOD DEAL MORE TO SAY.











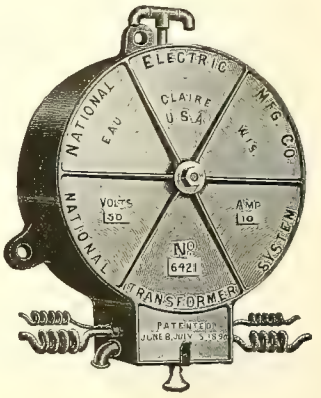
THE

National Transformer System

— OF —

INCANDESCENT LIGHTING.

TRANSFORMERS FOR ANY SYSTEM.

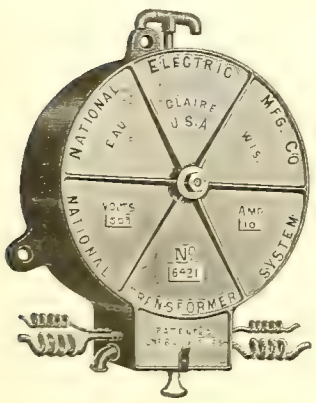


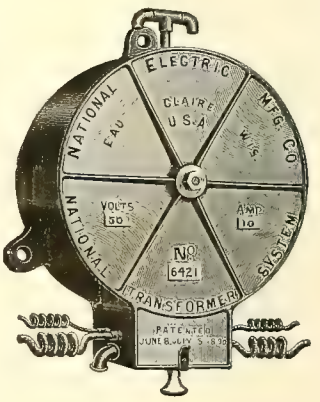
Alternating and Direct Current Dynamos.

MOTORS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.

We are prepared to undertake the construction of Electrical Plants of whatever magnitude. Correspondence solicited.





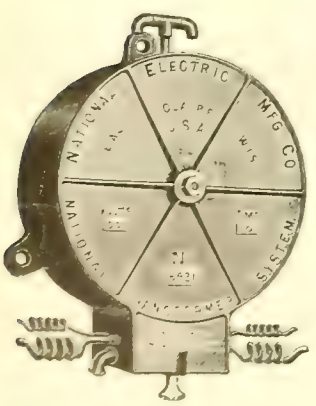
National Electric Mfg. Co.,

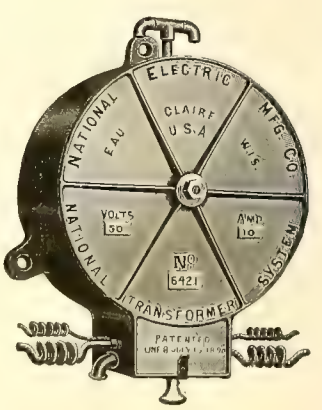
EAU CLAIRE, WIS.

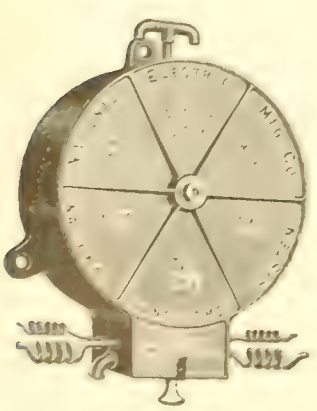
GEO. B. SHAW, Gen'l Manager.

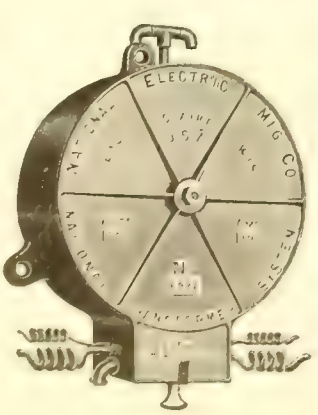
AGENTS:

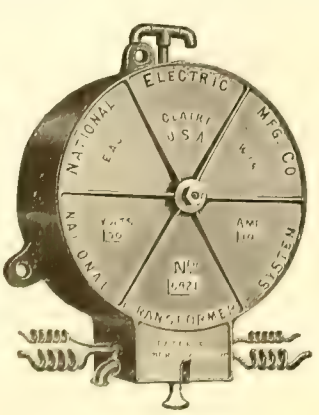
New York, N. Y.—NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Electrical Exchange Bldg.
Buffalo, N. Y.—F. P. LITTLE & CO., 141 East Seneca Street.
Cincinnati, O.—W. N. GRAY, 12 Chamber of Commerce.
Washington, D. C.—L. N. COX, 16 Fifth Street, S. E.
Philadelphia, Pa.—PENNSYLVANIA ELECTRIC ENGINEERING CO.
St. Paul, Minn.—THE ELECTRICAL ENGINEERING AND SUPPLY CO.
Detroit, Mich.—COMMERCIAL ELECTRIC CO.
Denver, Col.—THE MOUNTAIN ELECTRIC CO.
Winnipeg, Man.—SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO.
San Francisco, Cal.—NATIONAL ELECTRIC DEVELOPMENT CO.
Lincoln, Neb—LINCOLN ELECTRICAL MFG. AND SUPPLY CO.
Duluth, Minn.—THE ELECTRICAL ENG. AND SUPPLY CO.
Kansas City, Mo.—THOMAS WOLFE, 515 Main Street.
Seattle, Wash.—CHAS. H. BAKER & CO.
New Orleans, La.—ENTERPRISE CONSTRUCTION AND SUPPLY CO.

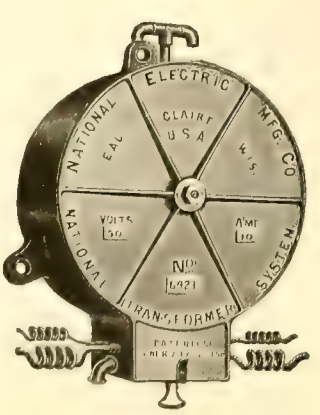












The "Packard" Lamp

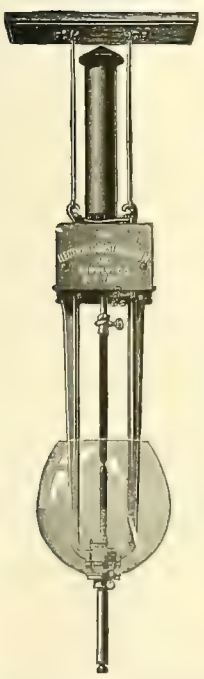
Agency has been transferred to

The Electrical Engineering and Supply Company

931 Rookery - Chicago, Ills.

The exclusive use of a strictly High Grade Lamp only will satisfy both patrons and Stockholders.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

PATENT "K. K." LINE WIRE

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

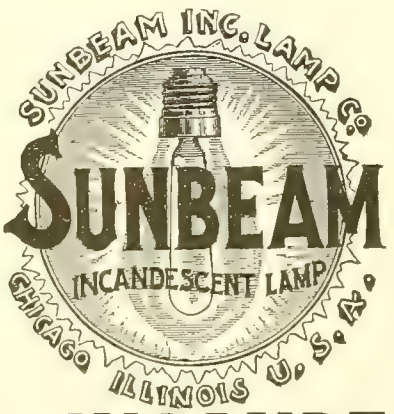
THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.



THE SUNBEAM INCANDESCENT LAMPS

Can be furnished of any desired efficiency or life to suit our customers. We make two standard styles of lamps, as follows:

High efficiency lamps, from 3 to 3 1-3 watts, which maintain their rated candle power from 750 to 1,000 hours.

Long-lived lamps, from 3 6-10 to 4 watts, which maintain their rated candle power from 1,500 to 3,000 hours.

Each style will be found to give more light per dollar expended in current than similar lamps made by other manufacturers.

SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

ESTABLISHED 1867.

FRANKLIN S. CARTER CHARLES M. WILKINS E. WARD WILKINS.

—TRADING AS—

PARTRICK & CARTER CO.,

125 South Second Street, PHILADELPHIA, PA.

SOLE PROPRIETORS OF THE PATENT NEEDLE ANNUNCIATORS.

Manufacturers of and Dealers in all Kinds of

ELECTRICAL SUPPLIES.

—WE MAKE A SPECIALTY OF—

Bells, Disque Leclanche Batteries, Gas Lighting Apparatus, Bronze goods and a full line of supplies for hotel and house work.

Agents for Canada:—The Toronto Construction and Electrical Supply Co., Toronto.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of Application and Business Card.

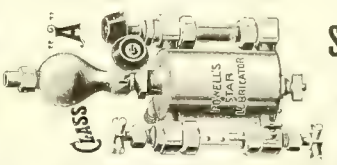
ELECTRICAL AND MECHANICAL ENGINEERING AND SUPPLIES.

REPAIRING

ELECTRICAL MACHINERY

The Electric Supply and Contracting Company,

S. E. Cor. Fifth and Sycamore Sts., (Nevada Building,) CINCINNATI, O.



This cut represents our Class A

STAR SIGHT "UP-FEED" LUBRICATOR.

There are no joints about it. Arms and body cast in **One Piece**, so you won't be annoyed by leaking and it will work to your entire satisfaction. Will let you try it before you buy it.

For sale by Jobbers, or apply to

THE WM. POWELL CO., - CINCINNATI, O.

SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

Write for Prices and Samples. S. TAUSSIG, Agent, 45 River St., CHICAGO

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and have been tested and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

---

25 Ampere Double Pole SWITCHES 75c.

AND LESS!!

STAR ELECTRIX CO., 641 North Broad St., PHILADELPHIA.

SPECIAL NOTICE TO THE TRADE

ON AND AFTER DECEMBER 1ST, 1891,

The Price of our No. 1 Ries Regulating Socket (for lamps 16 to 25 C. P., 50 Volts) will be

$1 27½ EACH —— $3.00 EACH LESS 57½ per cent. DISCOUNT —— Making the NET PRICE $1.27½. —— $1 27½ EACH

THE RIES ELECTRIC SPECIALTY COMPANY,

Baltimore and Eutaw Sts., BALTIMORE, MD.

PATENTEES AND SOLE MANUFACTURERS REGULATING SOCKETS.

FOUR GOOD BOOKS.

DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION Hand-Book.

ELECTRICIAN PUBLISHING CO., 6 Lakeside Building, CHICAGO, ILL.

ONE DOLLAR EACH.

"WINTER SPECIALTIES."

BRAND'S STEEL WIRE TRACK BROOMS,
WARDWELL'S TRACK BROOM HOLDERS,
BURTON ELECTRIC HEATERS,

—AND—

ELECTRIC RAILWAY SUPPLIES

OF EVERY SORT—
FOR ANY SYSTEM.

ELECTRIC MERCHANDISE CO.,

W. R. MASON, Gen'l Mgr. CHICAGO. 11 Adams Street.

THE "JEWEL"

Incandescent Lamp.

The Best Lamp in the Market.

Any Voltage.
Any Socket.
Any Candle Power.

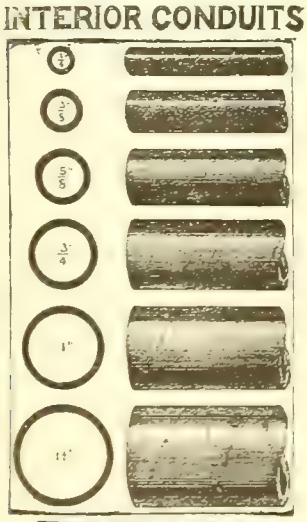
PRICES:

16 C. P. Less than 100 lots, 55 Cents.
" 100 to 1000 " 50 "

Send for Sample Order.

WM. HOOD, Gen'l Agt., 239 LaSalle St., CHICAGO.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding
ELECTRIC CONDUCTORS
Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.
INTERIOR AND UNDERGROUND
CONDUITS
MANUFACTURED BY
INTERIOR
CONDUIT AND INSULATION CO.,
WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,
General Offices: 42 & 44 Broad St., New York.

Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Electrical Eng. Co., 320 Dearborn St., Chicago, Ill.
American Electrical Supply Co., 226 Pearl St. Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 501 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 WABASH AVE., CHICAGO, ILL.
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1820.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords; in fact, every kind of Wire known to the Electrical Trade.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

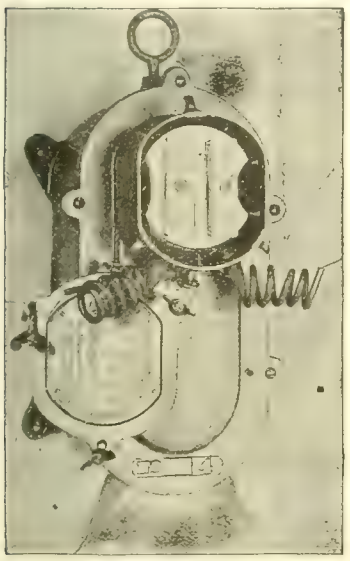
The System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

Westinghouse Electric & Mfg. COMPANY,

Pittsburg, Pa., U. S. A.

☛ Makers of Electric Light and Power Apparatus for all Purposes. ☚

PIONEERS OF THE ALTERNATING SYSTEM.



CONVERTER.

OUR **Converters** COMBINE

HIGHEST EFFICIENCY,
ABSOLUTE SAFETY,
PERFECT REGULATION,
LOW PRICES.

OUR **Meters** ARE

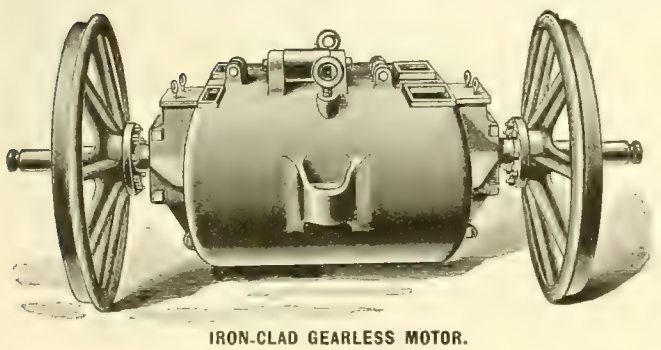
SIMPLE,
ACCURATE,
RELIABLE,
DURABLE.

OVER **700,000** 16 C.P. Lights' Capacity of METERS IN USE.

METER.

The Westinghouse Meter is the only A. C. Meter which has been adopted as standard by the London (England) Board of Trade. Synchronous System for the Long Distance Transmission of Power in large units claims the attention of every one having available Water Power within twenty-five miles of a market.

RAILWAY DEPARTMENT.



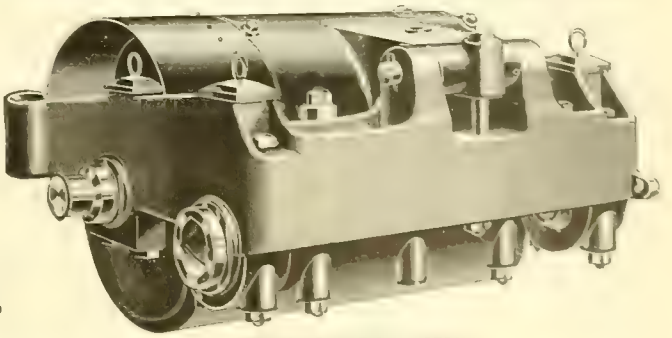
IRON-CLAD GEARLESS MOTOR.

YES, WE MANUFACTURE AND SELL GEARLESS and SINGLE REDUCTION

RAILWAY MOTORS,

MULTIPOLAR AND 2-POLE GENERATORS,

and all Station Appliances for Street Railway Work.



SINGLE REDUCTION MOTOR.

Percentage of increase in roads using our apparatus greater than that of any other company.

Send for Latest Catalogue.

OFFICES IN ALL OF THE LEADING CITIES. Correspondence Solicited.

Address,

WESTINGHOUSE ELECTRIC & MFG. CO.,

Pittsburg, Pa., U. S. A.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

BUY THE BEST!

The Mosher Arc Lamp.

DIRECT OR ALTERNATING INCANDESCENT CIRCUITS.

READ THE FOLLOWING TESTIMONIAL:

NATIONAL ELECTRIC MFG. CO., EAU CLAIRE, WIS., October 5, 1891.

Mosher Arc Lamp Co., Chicago, Ill.

GENTLEMEN:—Replying to your inquiry of the 3d inst. we beg to state that the lamps you sent us some time ago are giving us better satisfaction than any other lamp we have ever tried to burn on an incandescent circuit. We inclose herewith an order for 10 of them to be shipped to Elgin, Ill. Yours very truly,

NATIONAL ELECTRIC MFG. CO.

Noted for Simplicity and Steadiness.

500 to 7,000 candle power, making superior lamp for photo-engraving purposes.

Write for price, circular, and sample lamp.

MOSHER ARC LAMP CO., 125 Ontario St., CHICAGO,

Or to F. P. Little & Co., Buffalo, N. Y.; Creaghead Engineering Co., Cincinnati, O.; Chas. F. Lindner, San Francisco, Cal.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

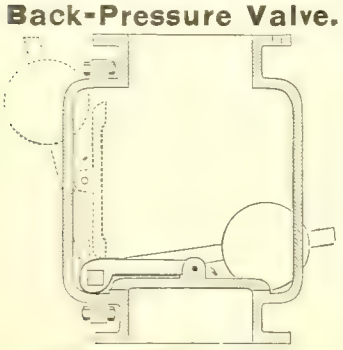
A. O. SCHOONMAKER,

158 William St., NEW YORK.

THE EXCELSIOR

Straight-Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,

229 S. Franklin St., Chicago.

Wasatch Asphaltum

COMPANY.

Proprietors of the largest and richest Asphaltic Limestone mines in the world.

MANUFACTURERS OF

ROCK ASPHALT MASTIC,

For Paving, Roofing, Basements, etc.

ASPHALTINE

(Or Liquid Asphalt),

For Coating Piles, Ties, Poles, etc.,

ALSO SOLE AGENTS FOR

The Salt Lake Gilsonite Co.'s

"Uintaite," "Grahamite,"

OR

PURE GUM ASPHALTUM

For all INSULATING Purposes.

Office, 71 Culmer Block,

SALT LAKE CITY, UTAH.

Correspondence solicited, and samples furnished

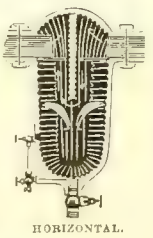
HINE'S ELIMINATOR.

THE ACKNOWLEDGED SUPERIOR OF ALL

Steam Separators and Oil Extractors.

In twelve trials in the "Cornell" Separator test, it averaged 99.9 per cent Dry Steam. Outstripping all competitors.

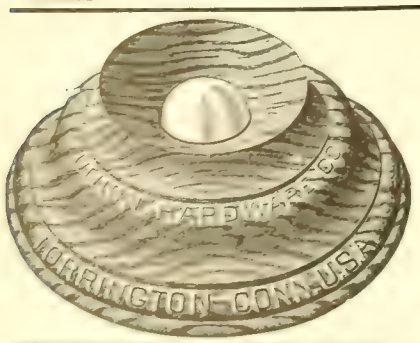
Send for Circular and Cornell test report.



HINE ELIMINATOR CO., 106 Liberty St., NEW YORK.

VERTICAL. HORIZONTAL.

—THE—



UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

Royal Electric Co.,

911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURERS OF

Alternating and Continuous Current Dynamos and Motors,

AND ELECTRIC MACHINERY.

THE MOST CONVENIENT ALTERNATING SYSTEM NOW ON THE MARKET.

Agents Wanted for Exclusive Territory.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia.

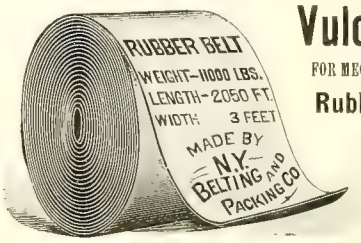
46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.

SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601-1611 17th Street.
CHARLESTON, 160 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 16-20 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

PLATINUM.

JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

THE SHORT DYNAMO.

Efficiency, 92 Per Cent.
From 75 to 500 Horse Power.
Flat Ring Armature.
Multiple Brushes.
Large Commutator. Independent Coils.
Perfect Ventilation.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, DECEMBER 12, 1891. No. 24

The Frankfort-Offenbach Electric Railway.

This railway was built in 1884 by Siemens & Halske of Berlin and is now operated by the Frankfort-Offenbach Trambahn Gesellschaft. From Frankfort the road runs through to Oberrad, a distance of 3.3 kilometers, and thence for about the same distance to Offenbach. Since the last named place is midway along the road, the power station was located there. In this station there are at present four compound wound Siemens & Halske dynamos driven by a new 150 horse power engine, of the Coleman-Steuerung patent built by Schmaltz & Co. of Offenbach. There is also a large double twin cylinder engine built by Robert Kuechen of Bielefeld. This engine may be run with one or both cylinders, developing 120 or 240 horse power at a speed of fifty revolutions per minute. The boilers are three in number, each of 150 horse power. They were built by Berninghaus of Duisburg. Only one, however, is at present in use. The generators give from sixty to seventy amperes at 300 volts, and all are connected in parallel. The four dynamos are in use on Sunday, but only two are in service during the week, as on Sunday eight trains are kept running continually and on other days there are only four trains. A train consists, as a rule, of a motor car and trailer.

The transmission of power to the dynamos is by ropes. Fig. 1. The new engine makes sixty revolutions per minute, the countershaft 200 revolutions per minute, and the dynamo armature 610 revolutions per minute. It is asserted that the generators regulate very closely and but little trouble has been experienced with them. Only three armatures have been burned since the generators were started. During the first year, however, over twenty motor armatures were burned out and twenty-four field coils. The construction at present is much better, and only four armatures have been burned on the cars during the present year. The motors are of the oldest type of Siemens & Halske series car motors and during a recent test gave twenty electrical horse power. When in general use the effective horse power is said to be between ten and twelve horse power for each motor. Each car is equipped with one motor connected by double reduction gearing, the armature making 600 revolutions and the car wheel about ninety revolutions per minute. The car wheels are 750 millimeters in diameter. The maximum speed of the car is twelve kilometers per hour. Regulation is by means of resistance in series, which is thrown in and out by a switch. The motors take about twenty amperes each at 300 volts.

This railway is provided with a snow plow, which, it is claimed, can clear the track from Oberrad to Frankfort in one-half hour when the snow is twenty inches deep.

The most peculiar feature about the entire equipment is the overhead system. The conductors are iron tubes, with a slot cut on the under side, Fig. 2. There are two tubes hung from poles along one side of the track, Fig. 3. Attached by ropes and conductors to the front and rear of a car are a couple of iron rods which slide in the tubes. The tubes are thirty-three millimeters outside and twenty-five millimeters inside diameter. The sliding rods are shaped as indicated in Fig. 2.

Copper feeders six millimeters in diameter covered with an iron wire sheathing, making a total of about fifteen millimeters in diameter, are connected to the tubes along the line. There are incandescent lamps on every sixth or eighth pole for lighting the tracks and roadway. The lighting is accomplished by placing the lamps in series as shown in Fig. 4, so as to take current from the tubes at, say, every sixth pole.

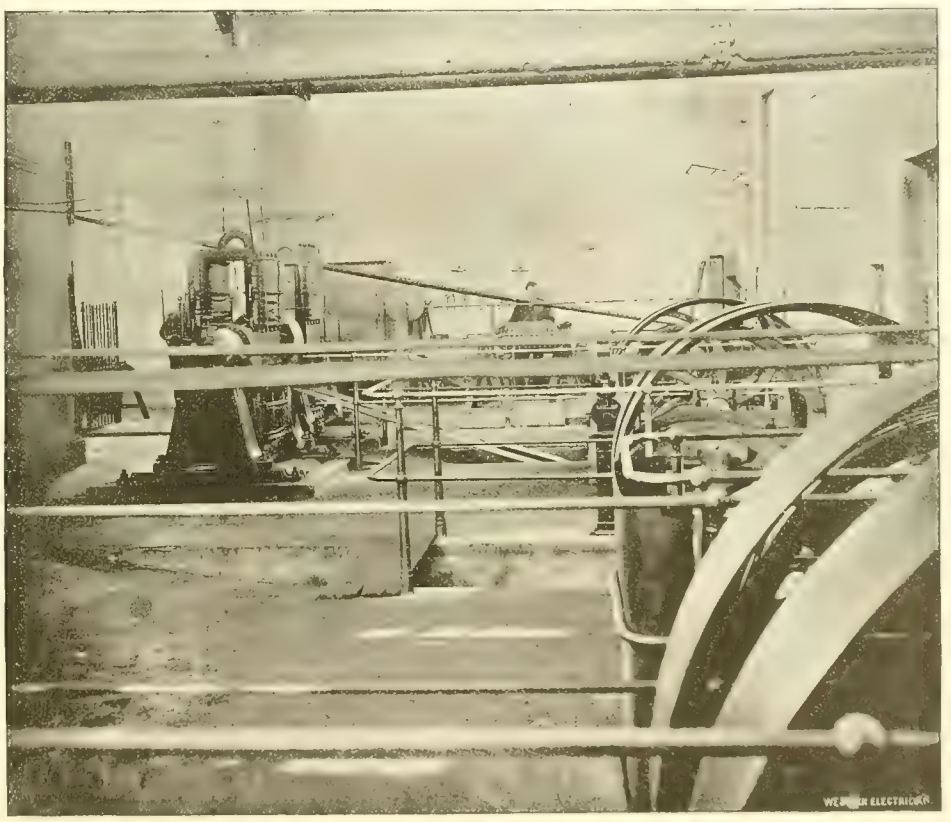


FIG. 1. THE FRANKFORT-OFFENBACH ELECTRIC RAILWAY.

Electricity at the World's Fair.

In speaking of the work on the electricity building at the World's Fair, Mr. Johnson, the principal contractor, told a representative of the WESTERN ELECTRICIAN last week that the work would be pushed as fast as possible. About a hundred and fifteen men are employed on it, and the number will be increased as fast as necessary. Mr. Johnson speaks in terms of great admiration for the building, which he considers the handsomest of those designed for the World's Fair.

A formal application for space in the electrical department that has lately been received by the World's Fair authorities has gladdened the hearts of all the gentlemen interested in the department. It is from Siemens & Halske, the great firm of electrical manufacturers in Berlin, and was received through Herr Wermuth, German commissioner, and the department for foreign affairs. In it Herr Vogel, the managing director, expresses the intention of the house to participate in the exposition, but says that it is impossible to state at present the exact extent of this participation. The German firm seeks the following pre-requisites: Protection for its patents; abrogation of the provisions of the alien labor law so far as its workmen are concerned; permission to send over catalogues, photographs and printed matter free from taxation as to reductions in freight rates and as to free tickets for exhibitors and attendants; cranes and transportation facilities sufficient to transport weights up to 45,000 pounds directly to the place of installation. Storage room for empty packing cases and fire insurance protection are also asked for.

Presuming that these requests can be granted, the firm expresses its intention of occupying about 17,250 square feet of space under cover and about 2,150 square feet out doors. The approximate value of the material to be taken to Chicago is estimated to be between $200,000 and $225,000, and the weight will be about 340 tons. From 1,500 to 2,000 horse power will be needed to operate the firm's machinery. Request is also made for permission to lay wires and cables in the ground for an electric railway, and for the operation of electrically propelled boats on the waterways. Herr Vogel also expresses a wish to take part in the general lighting. The firm intends to exhibit a small model theater to show lighting effects, and asks permission to charge a small admission fee to this display, and also on the railway, merely to regulate the size of the throng. A desire for a special building is also expressed, and it is stated that the staff representing Siemens & Halske at the fair will consist of ten or twelve persons.

Mr. Hornsby is several times mentioned in the letter, and the interest aroused by his visit is apparent. It is stated that a representative of the firm left for Chicago in the latter part of November.

This application is of great importance, not only on account of the standing of the house of Siemens & Halske, but also because the example thus set is tolerably certain to be followed by other European manufacturers of electrical machines and instruments. The request for a special building, which had heretofore been made through Mr. Hornsby, has been acted on unfavorably, and it is doubtful if any exhibitor will be allowed to make any charge for admitting the public to a portion of his display. The idea is that one admission fee —fifty cents—shall admit the visitor to everything to be seen at the World's Fair. With these exceptions, however, there is no doubt that the exposition authorities will do everything that can be reasonably expected of them in the way of cooperating with the great German firm.

Hardly had the formal application of Siemens & Halske been received before the representatives of the firm were themselves on the ground. These gentlemen are Carl Vogel of Charlottenburg, Germany, the managing director of the firm, and Alexander von Babo, who represents the house in New York city. Herr Vogel arrived in Chicago on Tuesday of last week and, with Herr von Babo, is quartered at the Auditorium Hotel. He expects to remain here five or six weeks. On Monday last Herr Vogel had a brief conference with Director-general Davis, but little was done save the process of

getting acquainted, which was speedily accomplished.

When a representative of the WESTERN ELECTRICIAN called on the visitors at their hotel on Monday he found them to be affable and courteous, but rather unwilling to speak about the object of their mission. Herr Vogel explained that the firm could not tell what it would do until its request had been acted upon by the World's Fair authorities. He added that at present the negotiations were in a delicate stage and that it would never do to make any rash assertions as to what Siemens & Halske would do. In reply to a further inquiry Herr von Babo said that no statement of any kind would be proper at this juncture; he could not even say whether Siemens & Halske would make a display if the concessions sought were refused. The gentlemen had no desire to withhold any proper information and assured their hearer that when the matter was settled they would only be too happy to talk about the prospective exhibit. At the time of the interview the foreigners had not visited Jackson Park,

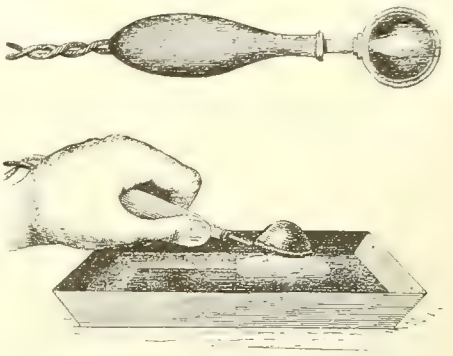
[illegible] ELECTRIC RAILWAY.

[illegible] a day or two. They propose to take things leisurely, and do their work thoroughly. "This business can't be settled in half an hour," remarked Herr Vogel with a smile. The visitor from Charlottenburg, in answer to a question, said that [illegible] electric work in [illegible] Chicago, but that [illegible] before he left.

[illegible] the best known [illegible] of [illegible] in Europe. It has [illegible] at Berlin and Charlottenburg, in Germany; Vienna in Austria, and St. Petersburg in Russia. In all it em-

[illegible] Ernst Fahrig will give a lecture upon the "Electric Production of Oxygen, Chlorine and Ozone for Commercial Purposes." Mr. Fahrig says: "Electro chemistry [illegible] I am thoroughly convinced [illegible] come to be recognized [illegible].

Mr. Terry says: "We are endeavoring to arrange for a series of papers on the electric railway, to be presented in March. We have in mind as subjects, 'The Gearless Motor vs. the Geared Motor,' and 'One Motor vs. Two Motors for Car Equipment,' but possibly may decide on others. We shall have two papers in one evening, taking exactly opposite sides of the same subject, and will try to make the two subjects very interesting. We will also arrange for as extensive a discussion as possible and shall have it understood beforehand on which side each participant is to be engaged. We shall have the discussion



ELECTRICITY IN THE PHOTOGRAPHER'S DARK ROOM.

definitely arranged as to the order of speakers, after which or course, there will be a general discussion."

One of the debates for which the committee is at present arranging will treat of the question: "Is it Economy for a Municipial Corporation to Own a Lighting Plant?" It is arranged for four to take part in the discussion, two on each side, but the selections have not yet been made.

In addition to the subjects already announced papers have been promised by the following named gentlemen, the subjects and dates not being definitely decided upon as yet: Prof. F. B. Badt, Alex. Dow, Elmer A. Sperry, George Cutter, Charles Wirt, Foree Bain, Thos. G. Grier, J. B. Wallace, F. W. Horne, H. L. Bridgman, Dr. Louis Bell, Fred De Land, J. K. Pumpelly.

Mr. Terry announces that he is corresponding with several other gentlemen with fair prospects of securing additional papers on interesting subjects.

Chicago Electric Club.

The literary committee of the Chicago Electric club is endeavoring to make the meetings more interesting. F. S. Terry, the chairman of the committee, has just issued a circular letter to members of the club asking their co operation in the plan proposed by the committee. It is believed that by selecting a few members to lead the discussion on the papers presented before the club the literary meetings may be made more satisfactory.

This plan was tried for the first time at the club meeting Monday evening, when C. C. Haskins presented his paper on "Safety Devices." Messrs. Bain, Sperry, Cutter, and Wirt were selected to lead the discussion, and their remarks, together with Mr. Haskins' paper, are presented elsewhere.

The list of papers for the winter has not yet been fully completed, but Mr. Terry announces that he has secured assurances from several members. On December 21st St. John V. Day will read a paper on "Rapid Transit for Great Cities." This paper in the main will deal with applied mechanics, but at the same time will include some very important electrical features. Mr. Day has given this subject a great deal of study both in this country and in England, and the paper will undoubtedly be of great value.

On January 4th Prof. J. P. Barrett, chief of the department of electricity of the World's Columbian Exposition, will read a paper on "Electrical Exhibits During the World's Columbian Exposition." The club can consider itself very fortunate in obtaining this paper from Prof. Barrett, who will be able to give some information as to the extent of the electrical exhibits, and their benefit to the electrical industry.

An interesting feature of the programme will be presented January 18th, when there will be a debate on "Power Transmission by Direct Current vs. Alternating and Multiphase Current." Alex Dow will present the opening argument for the direct current, and George Cutter will support the claims of the alternating. Prof. Badt will sum up the discussion and give his opinion as

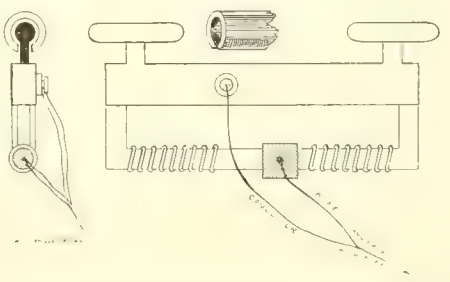


FIG. 2. THE FRANKFORT-OFFENBACHEL ELECTRIC RAILWAY.

to which side has put forth the best argument. Each of these gentlemen is particularly well qualified to take the part assigned to him.

F. W. Parker has promised a paper for February 1st, but has not yet announced the subject. On February 15th C. E. Kammeyer will read a paper on "Fuses." The paper will be illustrated by lantern views, which will show some original effects in photography.

Mr. Terry further announces that he has made arrangements for the following papers; the dates upon which they will be presented however, have not yet been determined:

F. Sargent: "Lighting and Power Transmissions on the World's Fair Grounds."

Geo. H. Bliss: "Undeveloped Uses of Electric Current from Central Stations."

Electricity in the Photographer's Dark Room.

There are now very few of the arts into which electricity has not, in some way or other, worked its way. A useful application of the electric light as an aid to the photographer is described by Geo. M. Hopkins in the *Scientific American*. The method is one for dark room illumination which permits of examining the negative thoroughly during the process of development without unduly exposing the plate. The apparatus employed consists of a two-candle power incandescent lamp attached to a handle and inclosed by a hemispherical reflector closed at the front with a disk of dark ruby glass. When in use the lamp is held near the plate, and all of the light is thrown downward, so that the eye receives only the light reflected from the plate. Furthermore, only a small section of the plate is exposed to the light at any time. When the lamp is not in use in the manner described, it is either laid face down on the table, or suspended so as to light the dark room.

World's Fair Electrical Congress.

A meeting of the advisory committee for the World's Fair electrical congress was held on Tuesday of last week at the rooms of the Chicago Electric club. Prof. Elisha Gray presided. There was some informal discussion, but no action was taken. It is proposed to form an executive committee of three or four members to have general charge of the arrangements until the various sub-committees are appointed. Prof. Gray left for New York on Thursday to discuss the situation with the members of the American Institute of Electrical Engineers.

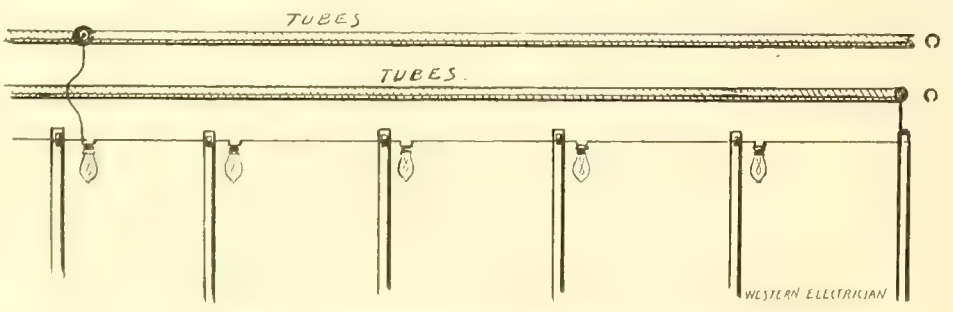


FIG. 3. THE FRANKFORT-OFFENBACHEL ELECTRIC RAILWAY.

Two Central Station Fires in Chicago.

By an unfortunate coincidence Chicago was visited last week by two disastrous fires in electric light stations. On Monday evening, as announced in the last issue of the WESTERN ELECTRICIAN, the large station of the Chicago Arc Light & Power company, at the Washington street bridge, was burned out. More accurate computations of the loss than were then available lower the estimates very materially, however. The loss on stock and machinery is now placed at from $50,000 to $60,000 and that on the building is given at $25,000. Against this there is insurance aggregating $87,500 on the building and $33,500 on the machinery. These sums are divided among a large number of companies, not more than $5,000 being placed with any one concern.

FIG. 1. TWO CENTRAL STATION FIRES AT CHICAGO

The present appearance of the building is indicated by the reproduction of a photograph given in Fig. 1. A careful examination of the structure after the fire revealed the fact that while the top of the building was burned off, the lower portion, protected by a fire-proof floor in the fourth story, was only damaged by water. This accounts for the comparatively small loss, as a large portion of the machinery was uninjured.

The officers of the company went to work with great energy to furnish a temporary service, and by Saturday the wants of a considerable proportion of their customers were being supplied. Current was sent out from a number of stations throughout the city, where steam power could be obtained, including the North Side city station, the Thomson-Houston office at 148 Michigan avenue, the Knight station at 118 Dearborn street, temporary locations at 327 Dearborn street, and at Clinton and Randolph streets, and other points. The Warren Springer building on Canal street has been secured as a temporary station until the company's building can be put in shape for occupancy again.

On Tuesday night the second fire occurred. This time the Fort Wayne Electric company and its local representative, the Central Electric Light company, were the sufferers. Fire broke out in the Adams Express building, on Dearborn street, near Adams, about 11 o'clock, and in two hours the offices and station of the two companies, which are located in the building, were completely gutted. The origin of the fire is not known, but the Fort Wayne people ascribe it to the steam boilers. The fire seemed to concentrate itself on the apartments of the Fort Wayne company, which were on the first floor and in the basement, and the other offices were only injured by smoke and water. An idea of the damage done can be gained by referring to the picture of the ruins of the dynamo room, shown in Fig. 2.

The firemen found great difficulty in locating the flames, owing to the dense smoke that poured from the doors and windows. A hose was carried into the basement from the alley running between the building and the Fair, but one of the firemen was carried out insensible and his companions found it impossible to work longer in the suffocating air. Lines of pipe were carried in from the front and streams turned on through the doors leading from the engine room, but without appreciable effect. The smoke poured up through every opening, and the elevator shafts acted as a funnel to carry the smoke to the upper floors, giving the building the appearance of being on fire throughout. Fireman Henry Callahan of Engine company No. 32 was caught under an upturned dynamo. The heavy iron frame fell across his feet, and it required the services of a half dozen firemen to rescue him from his perilous position. Charles Slausen of Truck Company No. 1 entered the basement under the Jennings Trust company's office during the early part of the fire. Smoke was pouring up from the engine room, and the fireman soon lost his way in the darkness. He fell on the floor and cried for assistance. Two men attempted to reach him through the front entrance, but were driven back by the smoke. Finally a chain was formed of three firemen and a policeman and the man was carried into the open air. He was unconscious for forty minutes. W. J. Buckley, the western manager of the Fort Wayne company, was at the scene of the fire soon after it started, and was active in directing and assisting [illegible] House place until the station could be refitted. This [illegible] company by the Fort Wayne company on October 15th, Mr. Harding [illegible] taken possession of the property up to the time of the fire.

FIG. 2. TWO CENTRAL STATION FIRES AT CHICAGO

Mr. Harding estimated the loss of the Fort Wayne company at $24,000. The plant included three 1,200 light and one 650 light Slattery alternators, one Hamilton-Corliss engine of 300 horse power, one Armington & Sims engine of 50 horse power, shafting, converters, switch-boards and pumps. A quantity of office furniture was also destroyed. The [illegible] by insurance.

The fires caused a greatly increased demand for lights to be thrown on the Adams street station of the Chicago Edison company, and Superintendent Church said that he was compelled to refuse many applications.

Death of W. G. Halm.

The announcement of the death of W. G. Halm at Washington, D. C., Tuesday, Dec. 1st, was received with regret in Chicago, where the deceased was well known. Mr. Halm was a member of the Chicago Electric club and took an active interest in electrical matters. He became interested in the incandescent lamp business about three years ago, and was a stockholder and officer of the Perkins Lamp company, having charge of the entire western business of that concern. Several months ago he suffered a stroke of paralysis, and although he had the best medical attendance, he failed, and at last went to Washington. For a time he entertained hopes of recovery, but these soon disappeared. The remains were removed to Bryan, O., where the funeral took place on Sunday last. At the meeting of the Chicago Electric Club last Monday appropriate resolution were adopted.

Status of the Bell Telephone Suit.

Attorney-general Miller said last week that he had received no intelligence for several weeks from the lawyers who are conducting the government interests before the examiner in the Bell telephone case at Boston, Mass. "My latest information," he continued, "is to the effect that the government is still taking testimony, although its case is pretty near concluded. Should there have been any important newly discovered evidence in the matter, however, I think it quite likely that I would have been notified ere this."

Commissioner Simonds of the Patent Office also returned a negative response to the [illegible] information

concerning new developments in the telephone matter. "Very little attention has been given by me to this subject," he remarked, "for the reason that the time is so close at hand for the expiration of the Bell patent. Its time will be up March 7, 1893, and hence I do not believe that a final decision can be obtained in the courts, for it will be appealed along until it reaches the highest tribunal in the United States. There is no possibility of its being reached in the Supreme Court docket within three years at the outside, and the patent has but a year and three months to run."

Aging Liquors by Electricity.

There is a man in New York city who claims to be able, through the aid of a simple apparatus, to age whisky by electricity. The readers of the WESTERN ELECTRICIAN, generally speaking, cannot of course be expected to be familiar with, or even interested in, the mysterious processes peculiar to the distillery. But owing to the close relationship of process to product, and product to person,

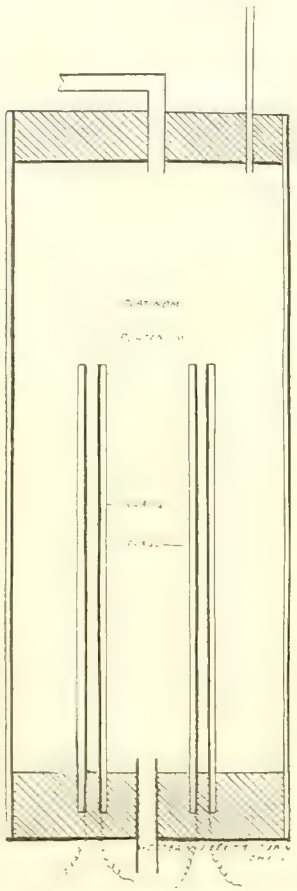


FIG. 2. AGING LIQUORS BY ELECTRICITY.

it may not be amiss to presume that perhaps a few of the electrical fraternity at least might find a knowledge of details to be of service, if only for medicinal purposes.

In January of 1880 a United States patent was granted to one Joseph C. Vetter of New York, for "an alleged new and useful improvement in an apparatus for aging liquors." The inventor claimed that, by means of a series of connected vessels or chambers, in which were inserted a series of electrodes, alcoholic or vinous liquors passed through the same, during the action of the electric current upon the electrodes, will, when caught in the receiving tank, be [illegible] degree corresponding [illegible] the number of vessels employed.

[illegible] with this project, [illegible] patent, was Garland [illegible] Mr. Turell, who is now per[illegible] apparatus manufactured, and to have successfully employed this [illegible]

[illegible] as to require but little explanation. The liquor flows [illegible]

of each jar rises above the level of the fluid in the supply tank, and acts as an escape pipe for the gas formed by the action of the current upon the liquid.

In Fig. 2 is shown a cut of a single receptacle. It consists of a circular glass vessel closed at both ends by water tight wooden plugs. In the upper part of the bottom plug four grooves are cut, and in these are securely inserted the electrodes. The latter consist of thin plates of platinum-coated glass. On one side of each plate, attached to the surface, is an extremely thin coat of platinum, similar to the quicksilver on a mirror. The electrodes are placed close together and connected with the battery, as indicated. In the upper plug there is a supply pipe and an air duct and in the lower a receiving pipe.

Mr. Turell claims that the liquors, if treated in their normal or quiescent state, would be "burned," and receive a fiery flavor by the continued action of the electric current on the same portion of the liquor. By the use of a series of vessels this action he claims, is prevented, and the liquor not acted upon in the first vessel receives the electrical treatment as it passes over the remaining electrodes of the series. According to Mr. Turell, it is thus that the raw product becomes changed so that it has the flavor of liquor two or three years older than it actually is.

German Portable Electric Lighting Plant.

The cuts presented herewith show a portable electric light equipment manufactured by Fein & Co., Stuttgart,

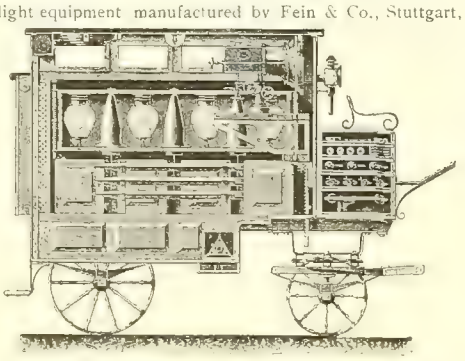


FIG. 2. GERMAN PORTABLE ELECTRIC LIGHTING PLANT.

Germany. This apparatus was on exhibition at the Frankfort exposition. The machine can serve either for operating a single large reflector lamp or several arc lamps of lower candle power. It consists of two carriages, one of which, the machine carriage, carries the boiler with water

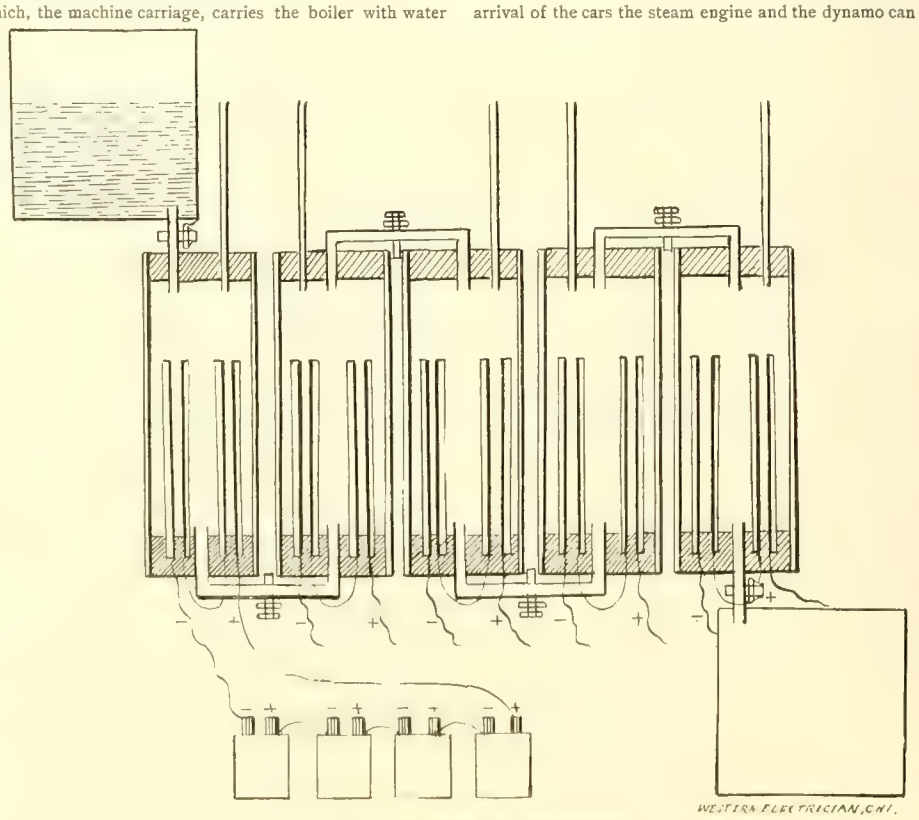


FIG. 1. AGING LIQUORS BY ELECTRICITY.

reservoir and coal box along with the steam engine and the dynamo. The second carriage contains the measuring and [illegible] apparatus, the arc lamps, conducting wires, tools, etc. The capacity of the apparatus is such that it will feed six arc lamps of 600 candles power each, or a single light taking 35 amperes, as well as a number of glow [illegible]

Fig. 1 represents the machinery car. In this the boiler occupies the center of the car, and the coal box and the water reservoir are placed in the bottom.

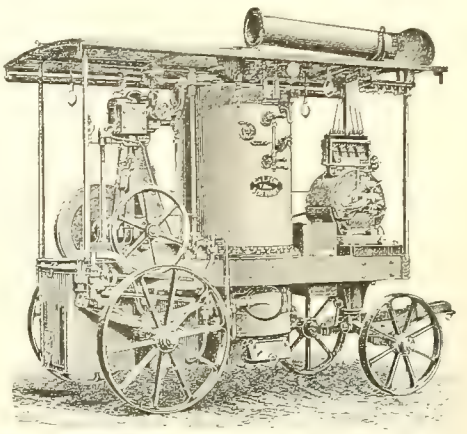


FIG. 1. GERMAN PORTABLE ELECTRIC LIGHTING PLANT.

The supplementary car, shown in Fig. 2, is of very light construction, so that it can easily be drawn by two horses. The light masts and poles for suspension of the wires are arranged on either side of the car. On the right and left of the driver's box are lanterns for night service, and there is room on the box for two men beside the driver. Underneath the seat is a box closed by iron doors containing tools, glow lamps and arc carbons, and behind it is a small platform on which stands the man attending to the reflector. This latter can be hoisted to the roof of the car by a simple contrivance. The six arc lamps are suspended inside the car. There are four wooden boxes on either side of the car closed by doors which can be opened from the outside, and containing the cables, wound on drums, for making connection.

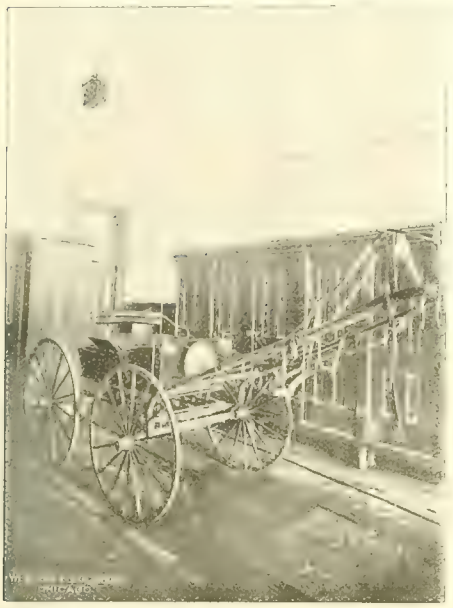
The armature of the dynamo is provided with two windings, by means of which, at the same speed, either a current of 65 volts for the operation of the large reflector, or a current of 120 volts for feeding the six arc lamps, can be obtained. The lamps are arranged in three series of two lamps each. The two armature windings can be arranged in series or in parallel with the electro magnet windings by means of a switch placed on top of the dynamo casing.

It is stated that within ten or fifteen minutes after the arrival of the cars the steam engine and the dynamo can be put in operation and the reflector put into service. The cuts are from London *Electricity*.

Rutherford & Seddon have been awarded the contract to build the electric railroad of the South Baltimore & Curtis Bay Railroad company. The line will be 3½ miles long and cost $100,000. Work is to be commenced immediately.

The Electric Light on a Fire Department Chief's Buggy.

It is fair to presume that many of the readers of the WESTERN ELECTRICIAN have heard of the electrically lighted buggy which for over a year and a half has been driven to Kansas City conflagrations by Chief G. C. Hale, of the fire department of that municipality. There have appeared from time to time brief notices concerning this



THE ELECTRIC LIGHT ON A FIRE DEPARTMENT CHIEF'S BUGGY.

novel application, but the details of the equipment have never before been given. Through the courtesy of Mr. Hale a few points as to the manner in which the vehicle is illuminated are here presented. It may be stated that it is claimed for this vehicle that it is the first one in any fire department to be lighted by electric lamps.

There are in use on this buggy two parabolic reflectors, one on each side of the dash-board, which are 5 inches in diameter and 3½ inches deep. Each reflector is provided with an incandescent lamp of six candle power. The lamps and reflectors are protected by a beveled edge plate of glass about 3-16 of an inch thick. Directly back of the lamps, on the inside of the dash-board, are two switches conveniently located for controlling the lamps, allowing one to be worked independently of the other.

The buggy is wired with okonite wire, which is concealed under moulding. The wires run back from the lamps to the battery in the back part of the buggy. Connections are made to the battery by means of two brass thumb-screws, which clamp to the lugs on the bottom of the battery case. The battery proper consists of six storage cells. The plates are described by Mr. Hale as being of the "planite" type. Each cell is about 4½ inches deep and 4 inches wide. There are eight plates to the cell.

In order to keep the plates apart and help them to resist the shaking up brought about by the rough streets, they are provided with hard rubber combs inserted at short intervals. This arrangement may be better understood by setting several hair combs, so that the teeth point upward, and then placing the plates across and down between the teeth, leaving the back of the comb to form a bridge from the bottom of the cell to the lower edge of the plates. Space is thus secured in which scales and sediment may settle.

The battery is charged through flexible conductors which hang, as shown in the cuts, from a rheostat on the ceiling directly over the rear of the buggy, to the cells. The connection is made with the battery by means of a plug, which draws out as the buggy moves forward. Current is supplied from the Edison lighting system.

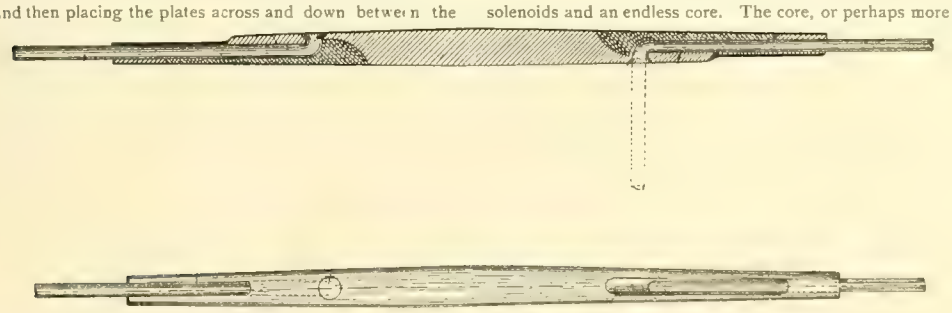
There is a very convenient sealing device on this battery. It consists of a ¼-inch pure rubber plate sufficient in size to blanket the tops of all the cells. On top of this plate there is placed a heavy hard-wood cover strengthened by iron cleats. There are also four slotted lugs which project a sufficient distance from the cover of the battery to receive two tapered steel keys. These keys are driven home by a small mallet so as to press firmly down the rubber blanket over the top of the cells, preventing all leakage. This construction makes the opening and closing the cells most convenient. The battery complete and ready for operation weighs but 32 pounds. It will run the two six candle lamps at full power for about an hour and a half.

Chief Hale writes of his outfit as follows: "This system of lighting was introduced on my buggy August 2, 1890, and since that time it has undergone very severe usage. As you will understand, fire apparatus is driven at a high rate of speed, regardless of rough streets and obstacles, which would have a tendency to disarrange the delicate plates of the battery. It has given fairly good satisfaction, however, and its success has been thoroughly demonstrated. In view of the many new improvements now being made in storage and primary batteries, I am of the opinion that it is only a matter of time until the darkness of night before the drivers of fire apparatus will be dispelled by the glow of electricity. Its value cannot be over-estimated, as past history will show that a great number of fatal accidents have occurred to firemen, and fire apparatus, for want of better illumination of the roads which they are compelled to take. This system of lighting would be a great benefit to the fire fighting fraternity, were it reduced to one large search light for the purpose of penetrating smoke and throwing a light into the fronts of buildings."

This buggy and the lighting apparatus as here shown were manufactured by the Kansas City Fire Department Supply company, Kansas City, Mo.

Splice for Trolley Wires.

This splice is formed of a slender metal piece of a somewhat greater diameter than the conductor. The ends of the splice are provided with longitudinal openings, adapted to receive the ends of the conductor wire, and transoms or holes, through which the ends of the wires are passed, after being bent, and then riveted. A careful study of the cut is necessary to make evident the useful features of this device. It will be noticed that the middle of the bar is about twice the diameter of the conducting wires. From the middle the bar is tapered off to the ends, which are very little larger than the conducting wire, the idea being to make as smooth a path as possible for the trolley. The ends of the bar are milled out, as shown, from each side. A groove is cut in each end, and on the opposite sides of the bar other grooves are milled out. These latter grooves cut through to the first grooves, and make a straight longitudinal hole in each end of the bar for the admission of the wire ends. In this way a small bridge is left at the end of the bar to prevent the springing out of the wire. The end of each wire is hooked, as shown, and passed through the round holes. After being cut off quite close to the bar these ends are riveted to prevent the pulling out of the wires. The whole joint is stiffened by filling in the grooves with solder. This splice is the invention of W. J. Hield of Minneapolis.



SPLICE FOR TROLLEY WIRES.

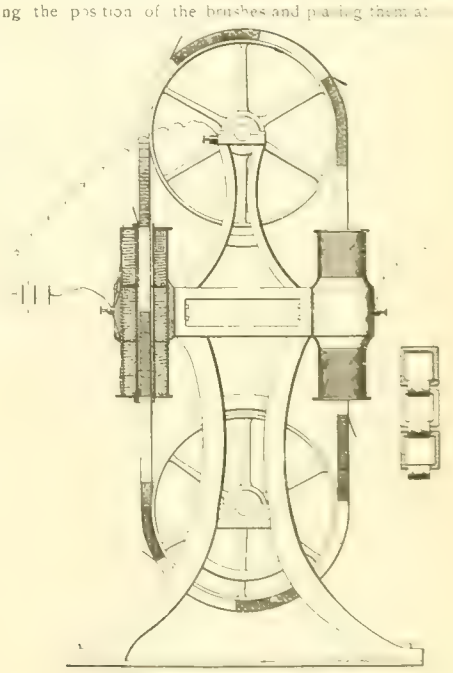
Collom's Motor.

This peculiar-looking motor consists essentially of two solenoids and an endless core. The core, or perhaps more properly the armature, is composed of alternate magnetic and non-magnetic sections and is provided with brushes at proper intervals. These brushes are in electrical connection with a conductor within the core and serve to close the circuit through the solenoid at the right moment. Each solenoid or field is composed of a series of independent sections, or, in other words, each solenoid comprises a number of separate solenoids, which are juxtaposited. One terminal of the wire of the solenoid is in electrical connection with a contact-strip placed within the solenoid.

THE ELECTRIC LIGHT ON A FIRE DEPARTMENT CHIEF'S BUGGY.

solenoid. The core passes over two pulleys, one of which is connected electrically with a pole of the battery or dynamo. The endless core may be made of metallic links after the fashion of any ordinary drive-chain, as shown, the links being assembled to form alternate magnetic and non-magnetic sections. For instance, the links of the magnetic sections are made from iron, and the links of the non magnetic sections are formed from brass.

The operation is manifest. The brushes are so disposed with reference to the solenoid and the core that the circuit is closed through a section about the instant the magnetic section is entering the solenoid. The circuit is interrupted about the time the magnetic section of the core is emerging from the end opposite that at which it entered. The direction of the motor is reversed by changing the position of the brushes and passing them at



opposite end of the magnetic sections. The current is taken from one of the pulleys over which the pulleys are mounted.

M. H. Collom, of Denver, Colo., is the inventor of this somewhat novel mechanism.

It is said that the City Street Car [illegible] Staunton, Va., will be [illegible]

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

J. A. KREIDLER, ... Editor and Publisher
J. P. O'HARA, F. L. PERRY, W. E. KEILY, ... Associate Editors.
J. L. BAKER, ... Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—The WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

	PAGE.
The Frankfort-[illegible]enbach Electric Railway. Illustrated	341, 342
[illegible] at the World's Fair	341, 342
Chicago Electric Club	342
[illegible] in the Photographer's Dark Room. Illustrated	342
World's Fair Electrical Congress	342
Two Central Station Fires in Chicago. Illustrated	343
Death of W. G. Halm	343
Status of the [illegible] Telephone Suit	343, 344
[illegible] by Electricity. Illustrated	344
German Portable Electric Light Plant. Illustrated	344
The Electric Light on a Fire Department Chief's Buggy. Illustrated	345
[illegible] Trolley Wires. Illustrated	345
[illegible] Motor. Illustrated	345
Editorial	346
Canadian Electrical Association	347
Proposed Electric Roads in Chicago	347
[illegible] Men in Council	347
St. Louis Electrical Exchange	347
The Postal Telegraph and Telephone Scheme	347
Underground Electric Railway for Paris	347, 348
Safety Devices, by C. C. Haskins, and Discussion. Illustrated. [illegible]	348, 349, 350
[illegible] Wire Gauge. Illustrated	350
The [illegible] Electrical Company's Midget Battery. Illustrated	350
[illegible]. Illustrated	350
[illegible] Control of the Telegraph	351

DEPARTMENTS.

[illegible]	351, 352
[illegible]	352, 353
[illegible]	353
[illegible]	353
[illegible]	353
[illegible]	353
[illegible]	354, 354
[illegible]	354
[illegible]	354
[illegible]	354

[illegible] financial difficulties, Cyrus W. Field re[illegible] of the American people. [illegible] when it became known that [illegible] by his son, and the sym[illegible] generally was extended [illegible]

[illegible] the attention of Chicagoan[illegible] are under considera[illegible] generally recognize the fact that only in electric [illegible]

[illegible]

vantages of the club. It is not too much to say that the programme is more complete than any other in the club's history. Mr. Terry and his associates deserve the thanks of the members, who should evince their appreciation by a full attendance on the meetings so carefully planned out.

ANOTHER secret execution has been added to the list of mysteries in New York. Murderer Loppy, the last victim, was executed by Warden Brown at Sing Sing, Dec. 7th, and the prison officials succeeded in keeping the details of the execution secret. Warden Brown's "dead line" was once more established around the prison. How long will the people of New York tolerate these outrages? If the scenes of the death chamber are so horrible that they must be kept from the public, even though armed sentinels must be employed, the legislature should put a stop to these proceedings and the law be repealed. The only way the people can be sure that revolting practices are not conducted in their name is by removing the secrecy with which these proceedings are at present enveloped.

CONSIDERABLE prominence was given the romantic story of the first meeting of Lord Russell and his wife, during the recent divorce proceedings which occupied the attention of London society. This story was first printed in the London electrical papers, and was to the effect that "the noble lord" was engaged in superintending some electrical work in the home of Lady Scott, the mother of Lady Russell. It is further claimed that Lord Russell did not disclose his identity until he had won his beautiful bride, but the stories that have been told since the divorce proceedings were commenced show that this is quite improbable. At any rate it is hardly possible that Lord Russell's later experience will tend to encourage young lords and ladies to masquerade while engaged in courting.

DESPITE the repeated statements of our English contemporaries that the overhead trolley system as constructed in this country would not be tolerated in England, there seems to be a tendency even in that country toward the electric railway, overhead wires and all. Yet the pole and line construction has lost none of its so-called unsightly appearance; in fact, the tendency is toward more substantial construction. As soon as English prejudices are overcome there will no doubt be a general substitution of electrical equipments for the present plants. It will be some time before this is done, however, and exploiters of electric railway systems will find it hard work to get English companies to move where a considerable expenditure of money is required.

C. C. HASKINS' paper on "Safety Devices," read before the Chicago Electric club, created an interesting discussion among the members. There was a consensus of opinion that fuses as ordinarily sold to blow at a certain number of amperes of current were liable frequently to disappoint the purchaser. Mr. Haskins related incidents illustrating the carelessness with which the fuse was oftentimes treated by those ignorant of its value as a safety device when properly employed. As a matter of course the magnetic cut-out came in for a share of the discussion. A valuable suggestion was offered indicating a line of construction in fuse blocks that might be carried out to prevent the insertion of fuses too large to afford reliable protection. It was decided by the club to bring the matter of safety devices before the coming electrical congress of the World's Columbian Exposition.

THE formal application of Siemens & Halske of Berlin for about 20,000 square feet of space at the World's Fair is worthy of the serious attention of the exposition authorities. This firm intends to make a large and varied display, including a model theater showing electric lighting effects, an electric railway and electrically propelled boats. In all the firm thinks that it will require from 1,500 to 2,000 horse power, and estimates the weight of its exhibits at 340 tons. Undoubtedly such a display would form one of the most attractive features of the electrical department and would be very popular with the general public. The German firm should be encouraged to do its best by all reasonable and just concessions and privileges on the part of the World's Fair authorities. But some of its requests—as, for instance, those for permission to erect a separate building and for authority to charge a special admission fee to some of its exhibits—will doubtless be denied by the management, as being contrary to the general policy of the exposition, however much the necessity may be regretted in this particular instance. We have no doubt, however, that the representatives of the house who are now in Chicago—Messrs. [illegible] and [illegible] of Halske—will be enabled to arrive at some conclusion with Director-general Davis and the commissioners of the World's Fair that will be satisfactory to both sides. The World's Fair wants Siemens & Halske, and Siemens & Halske want to participate in the World's Fair. With these conditions, the arrangement of the details ought to present no insuperable obstacle.

NOW-A-DAYS one hears so frequently of the "unsightly overhead system" in this country that it is not without some satisfaction that there is presented this week a description of a foreign electric road on which the aerial work merits the designation of, at least in a degree, falling short of being beautiful. It is with no idea of subjecting the work of our German brethren to unkind criticism that we call attention to this line. But as it was in the United States that the overhead electric railway first worked its way into the enviable position it now holds, Americans feel a natural right to point out that there may be one overhead system sightly and another very unsightly.

It is with the electric overhead system as it is with other mechanisms. A line may be so constructed that it is a veritable eye-sore, yet another road, by proper care in building combined with a little taste displayed in the designing of its fixtures, may be made to present a pleasing appearance. There are few of the fraternity who do not remember the appearance of the "cheap" road with its badly set poles and patched-up switches. The electrician, and in fact the layman, is quick to see the bad work. But how often does the good work escape detection on account, perhaps, of its very thoroughness.

THE subject of governmental control of the telegraph is given prominence this week. Elsewhere is printed the opinion of the postmaster-general as presented in his annual report, and there is also given an abstract of Mr. Rosewater's paper before the New York Electric club on the same subject. Both of these gentlemen are enthusiastic advocates of the proposed government telegraph, and Mr. Rosewater has recently given much attention to the subject, studying it in Europe, where it can be seen at its best. His statistics presented elsewhere will no doubt be perused with interest in this country. He believes that the telegraph if placed under the direction of the government would develop and become as commonly employed in commercial affairs as the mails. The charges could be materially lessened with the increased volume of business, no doubt, and if the department were conducted on the same plan as the mail service great extensions could be made, and the advantages of the telegraph placed within the reach of many more persons than at present.

The same line of argument is pursued by Mr. Wanamaker, but the latter gentlemen goes even further and advocates the absorption of the telephone as a part of the postal system. With the expiration of the original patent on the Bell receiver he thinks the government should take hold of the telephone business, and therefore he urges that Congress provide for the absorption of the telephone and the telegraph by passing a bill enabling the government to assume control at once. Mr. Wanamaker evidently does not look for any relief in the solution of the telephone problem from competition. He recognizes the fact that the Bell interests are thoroughly intrenched, and he evidently believes that only by the intervention of the government can its hold be shaken.

It is true that Mr. Wanamaker and Mr. Rosewater present a strong argument in favor of their plan from a financial view, and no doubt the public generally would support them if there were no other considerations. It is a fact, however, that the people generally are jealous of every encroachment in this direction on the part of the government. They do not want governmental interference, so common in the European countries which Mr. Rosewater visited. The reports of the officials of these companies would lead one to believe that they were innocent of any attempt to control the political action of government employes, and that the postal department was not a great political machine. Taking for granted the correctness of this view, it is hardly possible that the advocates of the system would expect the same condition of affairs in this country. In the postal department to-day, as in all others in the federal government, politics reigns supreme. It has been so from the foundation of the government, and it is to be presumed that it will continue as long as human nature remains unchanged.

It is for this reason that there is so much opposition to governmental interference in public institutions in this country. It is not the wish of the people to encourage officialism in any form. It is better, they think, to fight a corporation, however strong, than a powerful government which controls the votes of thousands of employees.

Canadian Electrical Association.

The Canadian electricians who have been discussing the question of forming an electrical association have at last completed the permanent organization, and have decided to maintain an independent existence A meeting was held at Toronto recently, at which the following named representatives of electrical interests were present: J. J. Wright and C. H. Mortimer, Toronto; E. S. Edmonson, Oshawa, W. A. Johnson, Ball Electric Light company, Toronto; T. W. Whiting, manager Bell Telephone company, Guelph; John Yule, manager Gas & Electric Light company, Guelph; James Corbett, electrician, Toronto; Fred Nicholls, manager Incandescent Electric Light company, Toronto; John Galt, M. E., Toronto; H. S. Thornberry, Toronto; A. A. Wright, Renfrew; H. O. Fisk, Peterboro; J. W. Taylor, manager Brooks Manufacturing company, Peterboro; T. Thompson, Electric Light & Power company, Hamilton; Thomas H. Woodland, Bell Telephone company, Hamilton; B. J. Throop, Hamilton; J. Douglas, Kay Electric works, Hamilton; John Carroll, secretary and treasurer Phillips Electric works, Montreal; Hugh Neilson, Toronto; H. J. Dunston, Toronto. Letters of regret were received from C. Harris, manager Bell Telephone company, Halifax; H. Brown, manager St. Thomas Gas & Electric company; W. J. Gilmore, manager Bell Telephone company, Brockville; J. S. McLachlan, Hamilton; S. J. Parker, Owen Sound; G. J. Thomas, manager Bell Telephone company, Essex; W. J. Fraser, Petrolea. All expressed their hearty sympathy with the object of the gathering.

The committee on organization, composed of J. J. Wright, Fred Nichols, D. Thompson, W. A. Johnson, A. B. Smith, H. J. Dunston and John Yule, which was appointed at a meeting shortly after the Montreal convention, presented its report. The proposed constitution and by-laws were adopted, officers were elected and the place of meeting for the first annual convention determined. Hamilton, Ont., was selected, and the second Tuesday in June next was named for this gathering. The election of officers resulted in the choice of the following named gentlemen: President, J. J. Wright; first vice-president, H. J. Dunston; second vice-president, John Carroll; secretary-treasurer, C. H. Mortimer; executive committee, E. S. Edmonson, Oshawa; H. O. Fisk, Peterboro; W. A. Johnson, Toronto; S. J. Parker, Owen Sound; A. B. Smith, Toronto; D. Thompson, Hamilton; Thomas H. Woodland, Hamilton; A. A. Wright, Renfrew; John Yule, Guelph.

All of these gentlemen have been actively engaged in the formation of the new association, and are deeply interested in the organization, which certainly enters upon its existence with the most flattering prospects.

Proposed Electric Roads for Chicago.

Chicago must have improved facilities for rapid transit before the fair, and in order to secure adequate accommodations work must be begun at once, and pushed ahead uninterruptedly until the system is completed. There is no time to be lost, and some of the city officials, at least, appear to recognize this fact. It is proposed to erect elevated structures throughout the city, as it is recognized that the streets are now overcrowded where tracks are laid. The South Side "L" alley scheme seems to meet with the approval of property owners and railroad officials generally. But where it is found impracticable to establish lines in alleys it is proposed to operate them on the same street that the surface roads occupy. For this purpose it is proposed to construct an "L" road on the North Side. In the proposed plan the form of structure is a single track elevated on a row of iron posts as standards. The diameter of the uprights should be twelve inches and they should be made of iron. The base of the iron part is made in the shape of a "Y" inverted; each arm is to rest on a solid stone and concrete foundation, and to be firmly bolted. There are two objects in the forks, which are placed entirely beneath the surface. One is that it prevents the structure after the track is laid and the cars in operation from becoming top-heavy, the width of the ends of the arms being as far apart as the length of the ties and the cross-section supports. The other object is to prevent interference with the sewers. The latter as a rule are laid in the center of the street, and the fork of the upright will pass on each side of the brick arch of the sewer. To the top of the upright is attached an iron girder of sufficient strength at right angles with the line of the road. Upon these the girders supporting the tracks will rest.

The ties will be eight feet or less in length, leaving a projection of two feet on each side of the rail. The only portion of the surface of the street taken up by such a form of structure is that occupied by the posts. The portion of the structure in the air is so narrow and is built of such light material that it does not shut out the light, and has none of the objections of the ordinary elevated structure in this respect.

It is proposed to place a conduit between the rails for carrying the electric wires from which current will be secured. The details of the electrical equipment have not yet been thoroughly worked out. The promoter of the enterprise says he will build the line as a loop to avoid the necessity of double tracks. In building such a road on the North side the cars could come down North Clark street and return on Wells street. Beyond the point where Wells street enters Clark he thinks a double-track line would not be objectionable. It is his purpose to use the Clark and Wells street bridges, but he has a novel plan, the idea being to have the lower end of the loop on Adams or Jackson street. Beginning 200 feet on each side of the bridges he would gradually elevate the structure until it is as high as the top of the bridge. These sections he would operate by a separate circuit, which would be broken if the bridge was moved an inch from its proper place. The fact that the approach to the bridge was an ascending grade and the fact that the opening of the bridge breaks the circuit would prevent all accidents in the nature of a train falling into the river.

Another feature of Mr. Chapman's scheme is to place the stock of the company with the people. He says that no matter what the capital stock of the company is a share should not be over $10 and that the shares should be distributed among the people as patrons of the line. It is also believed to be a good idea to limit the number of shares each person could hold.

It is reported that negotiations are pending for the making of the Lake street "L" road a trunk line and feeding in from proposed West Side electric roads. It is believed that not only the Cicero & Proviso company but the Jefferson Circular Road company as well will be consolidated with the Lake street company. That a system thus organized would be capable of unlimited expansion there is no doubt.

The Calumet Electric company, which is now operating a short line between Burnside and South Chicago, has an ordinance before the council providing for the building of a network of electric lines between Grand Crossing and South Chicago. This will prove one of the most extensive systems in the city if the petitions are granted.

Edison Men in Council.

The first meeting of the district general managers and heads of departments of the Edison General Electric company, under the present organization, was begun at the Auditorium Hotel, in Chicago, on Monday. About twenty gentlemen, including Vice-president Insull and the general managers of the eight districts were present. Henry Villard was not in attendance. Like all the Edison conventions, the meeting was held behind closed doors. Matters of policy and experience, with reference to the conduct of the company's business, were discussed. As outlined on Monday afternoon the further plans of the gentlemen composing the assemblage were as follows: Leaving Chicago at 10:30 A. M. on Tuesday by special train on the Lake Shore, the party will arrive in Schenectady, N. Y., on Wednesday at 8:50 A. M. The entire day will be spent in examining the extensive Edison works at that place, and at midnight the party will leave for New York, arriving there Thursday morning. The works in Gotham will be inspected on Thursday, and on Friday a trip will be taken to the lamp works at East Newark, N. J. Saturday will be spent in the New York office.

Among those present were Samuel Insull, S. Dana Greene, C. D. Shain, John Muir, J. F. Kelly, Mr. Kruesi, John W. Howell, Mr. Page, New York; John I. Beggs, Chicago; M. D. Barr, Toronto; Mr. Glass, San Francisco; Mr. Coster, Denver; Mr. Mitchell, Portland, Ore.; Mr. Reese, Atlanta; S. D. Paine, Boston.

St. Louis Electrical Exchange.

The St. Louis Electrical Exchange, a new organization of the electrical supply firms and the electric light and power companies of that city, has been formed. The objects of the organization are both commercial and social. The association will strive to advance the trade in all the latest discoveries of science appertaining to the practical introduction or the latest improvements in the art; to promote and combine the intelligence and influence of the members for the protection of the trade against imposition; to encourage national and state legislation for the furtherance of the electrical business, and to regulate the system of apprenticeship and employment so as to prevent as far as practicable the evils growing out of deficient training in responsible duties.

The officers of the organization are A. C. Wolfram,

[illegible]

The organization comprises the leading electrical concerns of the city.

The Postal Telegraph and Telephone Scheme.

[illegible] system, showing that it is not only a constitutional privilege, but a duty of Congress to utilize all the modes of modern science for quickening the transmission of intelligence. He says upon this point:

"The one potent agency and the only one that remains beyond our reach is electricity. Its practical value has been known for half a century, but the department stands in relation to it where it stood fifty years ago. The business of the entire world is to-day so dependent upon electricity that its withdrawal would seriously affect almost every interest that exists; yet the chief servant of all the people, the postoffice, which by its equipment is able to make the largest and most beneficent use of it, is so limited in its authority that it can only adopt the slower methods, and a man out of money in San Francisco must stop six days and pay $10 board while he waits on the mail to bring a $20 money order from New York. I want to see the two great servants for the people, the postoffice and the telegraph, reunited, and the telephone brought in to enhance the value of the combination. Public interests, private needs and the popular will call for these agencies to perfect the great postal system of this country. The longer their employment is delayed the greater the aggravation and injustice to the people and the costlier it will be to secure them. Sixty-four millions of people are taxing themselves to-day to the amount of $70,000,000 annually to maintain the postoffice plant, and are denied the right to vitalize this magnificent machinery with the mightiest force which science has given to render that machinery most effective.

"So soon as the postoffice can blend it with its own systems, and use its own forces already under pay, telegraphic rates will be reduced. Most adroit opponents of postal telegraph couple with it a like regulation of the railroads, but the government already employs the railroads as post roads, and the form in which it is proposed to contract with telegraph companies is precisely the same as that by which we have employed railroads ever since they were built. The business of the railroad is to carry freight and passengers, which is foreign to the purposes of a postoffice. This is not true of the telegraph or telephone, both of which by their very nature are limited to the service of cheap and rapid exchange of communication between the people, and this is what the postoffice was founded for.

"A year from next March the telephone patent expires, and unless Congress acts promptly to authorize its adoption for communication among the people, it requires no stretch of imagination to believe that in the next two years one immense syndicate will unite and control all the hundreds of telephone plants of the country as the telegraph is now controlled, or the two will be united, and then for the next twenty years the most astute attorneys will be legitimately earning large salaries in indignantly opposing the so-called attacks of future postmasters general upon defenseless vested rights. It is not chimerical to expect a 5 cent telephone rate; the possibilities of cheapening the management of these new facilities are very great. The system recommended would not forbid private telephones or telephone exchanges in cities any more than it would exclude the use of the telegraph by railroads having their own lines. The plan contemplates only the convenience of the people in the use in common of their own postoffice as the neighborhood station for telephoning and telegraphing.

"The rapid transmission of correspondence is a part of the business and proper duty of the Postoffice Department, and it does not fulfill its functions or perform its full duty until it operates the telegraph, the most rapid means of transmission of intelligence. The press is more deeply interested in the union than the people, because it is dependent in large measure for telegraphic news. A system capable of such extension should surely be tried. I therefore respectfully request that authority be given to the postmaster-general to contract for the lease of wires for the transmission of correspondence by telegraph or telephone, and connect postoffices with telegraph and telephone offices, and that an appropriation of $500,000 be made toward this end; the rates to be charged for such correspondence to be fixed from time to time by the postmaster-general, subject to the approval of Congress."

Underground Electric Railway for Paris.

The municipal government of Paris, encouraged by the City and South London railway, proposes to establish an underground electric road from the Bois de Boulogne to the Bois de Vincennes. The system adopted is that presented by M. J. B. Berlier. The concession includes an underground tunnel nearly following the course of the Seine, and traversing Paris at its greatest breadth. There are te be six stations, and a generating station at the end of the line. The following is M. Berlier's arrangement for the position of the conductors. The transverse sleepers of [illegible] on these run two parallel ways formed of rails 30 kiles to the running metre. In the middle of each line of metals is placed a central rail insulated by rubber plates from the sleepers to which it is fastened. The conductor, thus insulated and perfectly sheltered, is protected against all loss due to atmospheric causes, which are always present in aerial lines. The motor carriage carries under its framework two metres [illegible]

[illegible] which are directly attached [illegible] the wheels of the vehicle. The motors are each of 25 horse power, and will be regulated for proportionate speeds and for stoppages by a rheostat, while the reversing of the machinery will be effected by a special commutator. A similar arrangement [illegible] be adopted for the interior lighting of the carriages; in addition to which, during the journey, all the doors will be closed by an electric bolt under the charge of the engine driver. On arriving at a station they will be released, and will open automatically.

Safety Devices.[1]

BY C. C. HASKINS.

The law of Ohm, that multiplication table of practical as well as theoretical electricity, tells us, as you all know, that with a given source of electricity the current that will traverse any conductor is regulated by the resistance of that conductor, and it is also well known to you that resistance or opposition to the flow of current results in the development of heat.

These two factors are made available to furnish the equivalent of the safety valve for a steam engine, or, better perhaps, the soft-plug in a boiler, to stop the strain; in the one to prevent an explosion and in the other to forestall a conflagration.

Various metals having different electrical carrying capacity, must necessarily be variously affected thermally; and as some of these fuse at a much lower temperature than others it is readily seen that protection from abnormal heat in an electrical conductor is readily arrived at by the use of the fusible strip, which, placed in direct line with the passing current, will, before undue heating of the conductor proper takes place, melt, and thus break the continuity of the conductor.

Such, briefly stated, is the usual method of protection from abnormal currents.

Let us look at this subject for a brief time, and see if in practice this is as reliable as theory would indicate.

The material from which these devices are constructed may be either a simple metal or an alloy of two or more metals in combination. A curious fact in this connection is that an alloy may be made of two metals which has a lower melting point than either of the metals of which it is made.

The metals which are more commonly used are tin, bismuth and lead.

The melting point of tin is .... 451° F.
" " " of bismuth is .... 512° F.
" " " of lead... .... 620° F.

Authorities differ two or three degrees on these melting points, but that is a matter of small consequence for the purpose of this paper.

Now, different combinations of these metals will give us widely different results. Equal parts of tin, which fuses at 451° and lead, which fuses at 620,° will give us an alloy which will fuse at 385°. Tin and bismuth in similar proportions will fuse at 250°. One of tin, one of lead and four of bismuth will melt at 200°. Lead 5, tin 3 and bismuth 8 forms a combination which melts at 212°. Other combinations will give us an upward range far above the necessities of the case, and the admixture of other metals will give any desired melting point.

W. H. Preece has furnished us with the results of a long list of experiments in his fuse table. This table gives the sizes of pure wire which will fuse by a current of from 1 to 5 amperes up to 80, by steps of 10 amperes to 100, and by steps of 20 amperes to 200 amperes. These figures are given for tin, lead, copper and iron.

In the matter of safe carrying capacity of copper wire there seems to be considerable diversity of opinion.

This appears to be one of the rough spots in the highway of success. There are several tables purporting each to be the best, so that it is rather difficult to decide between them, and as the safe carrying of the copper has something to say as to the capacity of the fuse, the doctors are not all in perfect harmony over the case.

We are told that a 0000 wire B. & S. gauge is good for 312 amperes by one authority; a second says 229 amperes, while a third says 300 amperes, and the last speaker says 175 amperes. Number 6 is given at 65.2, [illegible] and [illegible] amperes. Number 14 is given 16.2, 11, 22 and 10. These various figures come now from the Board of Trade of Great Britain, from Boston, from New York and from Montreal. How nearly great minds arrive at [illegible]

[illegible] for selection it would certainly seem possible that a perfectly reliable fuse should be read[illegible] for [illegible] requirement, and yet with such a disagreement of authorities as are given above it is [illegible] should occasion[illegible] the other.

[illegible] of the West [illegible] has [illegible] kindly [illegible] facts which are in[illegible]

[illegible] for conductors [illegible] for telegraphy, [illegible] confined to those of quite small capacity. He says in [illegible]

His experiments led him to believe that the fuse wire known as of one-light capacity would require an average of about 2⅛ amperes to rupture the circuit.

German silver was tried by Mr. Summers, the wire being drawn down to 36 and 38 B. & S. gauge. This wire fused with from ¾ to 1 ampere and proved quite constant. But the fineness and delicacy of wire of that diameter unfitted it for general use.

Other persons beside Mr. Summers have given this matter much thought and time, and some of the results are even more remarkable. Among these are the recorded experiments of one investigator with a lot of fuses marked 15, which stood up nobly until melted by 30 amperes. This mark 15 may have meant 15 lamps, but it is charitable to believe it should read amperes.

Looking retrospectively over the steps we have so far traced, we can readily see that there is a very wide latitude, a broad path of glorious uncertainty in all this matter of protection by fuses; so wide, indeed, that I sometimes wonder we accomplish as much as we do, and disturb Chief Swenie's slumbers as little as we do, in the still small hours of the morning.

Not only is the moderately expert electrician allowed abundant choice in the selection and dimensions of his so-called safety strips, but the deplorably ignorant operator can, and sometimes does, impose upon himself, even to the substitution of 97 per cent. copper in place of fusible metal, as he says "because they last better," rather than remove the difficulty which renders the better conductor necessary.

There is perhaps a grain of consolation in the fact that the professional inventor-electrician has his eyes open to the needs of the hour. One of these recently patented an automatic combination by which, if a fuse burned out, a wire of greater capacity would be instantly substituted. It is unfortunate that his idea had not progressed a few steps farther. A series of such substitutions ending with a bus bar would have made the invention complete. An inspector would then be superfluous, and the grounds would take care of the plant.

In close proximity to the safety strip matter is another to which I call your attention because of the possible danger which may at any time be drawn from its lurking-place through the ignorance of the general public of electrical laws. The electric motor is marching boldly to the front with a double quick movement—a sort of Yankee Doodle alacrity—and ensconsing itself on the shelf, or the counter, under the table, or over the cupboard, never twice consecutively in a similar locality, hardly twice consecutively to labor for the same accomplishment. A mere infant, it turns a mimic windmill over the desk of a bank cashier or railroad official, grown a trifle larger it takes charge of and moves the foul air of a kitchen or a beer cellar, and arrived at maturity it grapples fearlessly with the passenger or freight elevator, or cheerfully manipulates the printing press, either class of labor being apparently recreation to the little giant, who never turns a hair, and seldom dampens its collar by the exertion.

But while all this is accomplished to the perfect satisfaction of those who are using electricity for such and similar purposes, of course there must be somewhere a safety valve, a blow-off system or check rein, by which to control the giant when a tug strap breaks or a thill drops down. "Of course," I think I hear some one say, "there is the rheostat, and the ampere strip." Yes; but like the strips and wires we have been examining, these are assumed to be constructed of proper alloy, made the proper size, with no flaw in their attachments, but cases have been known where the ampere strip probably by accident, or through color blindness—was of 97 per cent. copper.

For the sake of the discussion, we will assume that the safety device possesses all the necessary qualifications, and yet, under certain circumstances very deplorable results may develop when least anticipated.

The motor switch, as often constructed, has now and then the uncomfortable habit of stopping at an intermediate point between off and on, thus leaving a portion of the resistance in circuit, and of course a part of the current flowing through it. This current may or may not be sufficient to move the machine, and the switch may be left in that position intentionally or accidentally. When the quitting time arrives there are few employes in many an establishment who are not ready to rush for the door. It is very easy to stop a machine by throwing the switch lever part way over in the haste of quitting time, and had we nothing better than theory to base the statement upon, it might be hard to prove that such an act of carelessness was ever committed.

Let me give you two dissimilar cases which I assure you are authentic. There are more where these come from.

A fan in a restaurant was run by a motor, and doing excellent work during extremely hot weather. The weather changed suddenly, and the economical proprietor thought to save some current, and run his motor slower by turning in part of the rheostat. He knew just enough of electricity for that, and his little learning proved a dangerous thing. You have anticipated the result. It didn't melt out the safety plug, but it heated the Fire Department and warmed the underwriters.

In another case a small motor was used to run a light piece of experimental machinery, in a dark corner of one of Chicago's sky scraper buildings. It required all the current to run the fake whatever it was, and when the schemer left the room at night he turned the switch just far enough to stop the motor, locked up and went home. The department extinguished the blaze about two o'clock the next morning, and the fuse was not injured.

[illegible] these two cases show that under some circumstances the [illegible] of soft strips may be thoroughly valueless.

I [illegible] the mouth of every motor man present to remark, "That was not *our* motor." You are all right, [illegible] the other fellow's motor, [illegible] but it did the work [illegible] as well as a better one might have done it.

Seriously, this state of things has existed, and does exis to some extent to-day, and yet the remedy for this class of danger seems to me simple and easy of accomplishment.

If the stationary motor switch is so made that it can never be left between full on and full off, it can never be so left. That which cannot be, never is.

But the soft strip conundrum is not so readily answered. There are several points to be considered.

1st. When the ordinary dynamo man requires a wire or strip of a certain capacity he must perforce take on trust the article given him. He has no means of verifying the purchased article, and may or may not get what he requires. And more than that. High authority has advised that all soft strips should be made of sufficient carrying capacity to allow a surplus of 25, 50, or even a larger per cent. excess over the marked capacity. As in many instances there is no mark on the fuse it is not beyond the range of possibilities that the salesman may err in supplying the purchaser, or that the latter may mistake in replacing a fuse

2d. The fuse wire may change its carrying capacity by exposure. Oxidation has that effect. If it is firmly fixed when first placed, unless it has a hard metal terminal the constant pressure tends to flatten the contact, and thus loosen the connection—possibly setting up an arc at that point. The constant vibration of a building may be readily shown with a glass of water, placed upon a table. This constant agitation tends to loosen any but the most firmly set screw, so that here are two evils to be avoided.

3d. There is no means at hand for effectually preventing the user from endangering not only his own, but his neighbor's property, by substituting other than fusible metal in the cut-outs. Some of these substitutes are truly wonderful, not to describe them by any more expressive epithet. I have seen an Edison plug, the melted fuse of which had been replaced by casting the space full of lead; and some type-metal slugs which I once found in a plant would certainly have frightened a conscientious or timid dynamo man. I once found the largest fuses—those at the dynamo—had been removed, and half a dozen strips brush copper (more than the equivalent of the wire) substituted.

For these several difficulties there should, it seems to me, be found reasonable and simple remedies. It was once customary to designate the limit permitted upon a wire by the number of lamps. This is no longer practical. There is such a variety of lamps, so many different voltages, and hence so many differing rates of current absorption, that our only standard of allowance is the ampere. It seems to me that the device, whatever shape it may assume, should be so arranged that its actual capacity at a certain temperature can be known at a glance. The cut-out block should be so constructed that only the strip for which it is marked can be used with it. A 10 ampere block should not be made capable of holding a 20 or 40 ampere strip.

With a given alloy the manufacturer would be able to make his strips uniform, so that the carrying capacity would be easily verified by a wire gauge or micrometer, —so many millimeters wide, so many thick, so many amperes capacity, and no more.

I make these suggestions as a possible solution of a difficulty which is growing formidable, and in the hope that by drawing attention to the existing necessity, the matter may be thoroughly sifted and proper remedies applied.

It is so easy to go wrong in such matters, and so difficult at times to go right. I sometimes almost feel inclined to think good, pious, Dr. Watts' lines a proper comment on the how-not-to-do-it class of electrical users:

> Broad is the road that leads to death,
> And thousands walk together there;
> But wisdom shows a narrow path,
> With here and there a traveler.

DISCUSSION.

GEORGE CUTTER: It appears to me that Mr. Haskins' discussion of the importance of safety devices that can be relied upon, is an effort in the direction that needs considerable attention at present. I had hoped that the matter would be handled a little more vigorously, and that our friend, the inspector, would have given some of the instances found in practice, to show the danger of the so-called fuse boxes as at present constructed. We all of us have met cases—yes, many cases—where the fuse has been replaced by copper wires, chunks of triangular solder, and such make-shift devices, which would easily carry a large current in excess of the safe current of the wires they were supposed to protect.

Mr. Haskins has hinted at something that I have had in mind for a long time as the proper course to pursue; that is, the construction of safety boxes to admit of only a certain peculiarly constructed safety strip. These strips should be made up in such a manner that there could be no question or doubt of their opening the circuit at the current for which they were built. In this way a 10 ampere fuse box would not accommodate anything except one of these peculiarly shaped strips made for 10 amperes. It is easy enough for supply dealers to procure such boxes if they are demanded by the proper authorities.

I think it would be well for the electric lighting business if a movement were started to secure safety devices to prevent putting in cut-outs that would not thoroughly protect, according to the original plan of the installation. I see no reason why a certain size cannot be made for such purposes, and in such a manner that people entirely ignorant of the uses of fuses and cut outs could not make mistakes in replacing the same.

For the protection of generators and important machinery, I do not believe in a fuse strip of any kind. I am firmly convinced that they cannot be made sufficiently reliable for this class of work, and therefore some electro magnetic device which will always open the circuit at the same current strength should be used in such a place.

Another part of Mr. Haskins' paper interested me very much and that was the subject of motor rheostats. Having spent considerable time and money experimenting in

this line, I feel pleased, of course, to notice that Mr. Haskins agrees with me as to the danger of the present motor rheostat. There is no question but that these rheostats are a source of danger as at present constructed, and it is time that a simple series of wire coils with an equally simple rheostat switch, to throw them into the circuit of the motor should be abandoned. Having devised a rheostat for motor work, it is difficult for me to enlarge on this important question in this discussion without simply "blowing my own horn," so to speak. I agree with Mr. Haskins most heartily in condemning motor rheostats which could be left anywhere between full off and full on, and which could heat to a dangerous point whenever stopping or starting a motor. There is, of course, no doubt whatever, but that all such rheostats should be built in non-combustible boxes, and they should be installed with proper consideration of the fact that they are sources of heat.

CHARLES WIRT: The title of the paper which we have listened to is a very broad one—a great deal too broad to follow out in detail within a limited time. I shall, therefore, confine my remarks to the matter of "Fusible Cut outs," having had more experience with that branch of the subject than with some others. Nobody will disagree with me when I say that a perfect material for fusible strips has not yet found its way into the market. The choice of materials ordinarily obtainable is quite limited. The characterlstics of a good material for fusible strips can be very briefly stated. They are: First, low resistance; second, a low fusing point; third, permanency under normal conditions; fourth, tenacity; fifth, if used as very many of the fuses are used to-day, the quality of making and keeping a good contact under a screw head or clamp; sixth, a high temperature co-efficient of resistance.

The first characteristic, low resistance, is often overlooked, although it is a very important one. A fuse when called upon to act cannot act too quickly. The promptness with which it will act depends upon the energy expended, its mass, specific heat, surface and rate of radiation. This appears rather complex, but it practically means that a low resistence material will be of small cross-section and consequently light weight and small surface, the result being that with a given energy expended it will be raised to a given melting point much more quickly than a fuse of corresponding ampere capacity made of high resistance material which will call for an increased cross-section, weight and surface. No mention is made here of the fact that the fuse of lower specific resistance will have a lower actual resistance and save a very small amouut of energy continually wasted;—energy, which, though small in the individual, is worth considering in the aggregate of a large instalation.

The second characteristic, low fusing point, is less important than commonly believed. It is usuully quoted on account of the fact that wooden fuse blocks are still used to a small extent, but the difficulty of setting fire to a wooden block by means of a fuse wire with any fusing point lower than that of silver, can hardly be appreciated until one has tried it. Low specific resistance and low fusing point in the same material, comparatively speaking, cannot be had. Pure tin probably comes the nearest to possessing both characteristics of any material commercially obtainable. Tin, however, has bad qualities of its own which fully offset its good qualities. It is very well known that a fuse of pure tin when heated to near the melting point forms a tough skin of oxide, which acts as a sac to hold the melted metal and will sometimes prevent the rupture of the fuse indefinitely. Other materials show the same tendency to a less extent. Further than this, for low specific resistance a pure metal would be chosen which will also give us the fifth desideratum—a high temperature coefficient. For a low fusing point on the other hand, an alloy would certainly be chosen. Regarding the third point, permanence, little need be said, as the ordinary material for fuses suffers little with time except when exposed to chemical action in contact with other metals.

The fourth polnt, tenacity, is important, as fuses are subjected to rough handling before being put up and are liable to be strained when screwed or otherwise fastened into place.

The fifth point, good contact, is the sore point of most fusible cut-outs. We all know that these should be provided invariably with copper terminals for perfect contact under the screw head. We also know equally well that often this is not done. Lead, tin, or lead-tin alloy, if bright at the start and fairly secured under the head of a binding screw, will do very well for a while, but differential expansion, corrosion, vibration, and in the case of alternating currents some subtle effects, due possibly to the alternation, will get in their work, and after a time the fuse blows from poor contact. In many cases the final result is just such an approximation to the copper bus bar mentioned by Mr. Haskins, as the circumstances may seem to require.

The sixth point, a high temperature coefficient, is a very desirable condition, as can be seen by a little reflection. If the resistance of the material increases rapidly with the temperature, the energy expended in the fuse will increase rapidly with an increase of current. The margin which is required in a fuse is really a margin of temperature. We do not wish to work our fuse above the temperature at which it will be safe and staple. If we require a margin of, say, 100 or 200 degrees between the normal current and the fusing current, we can get this with a large current variation in the case of an alloy having a small temperature coefficient and with a small current variation in a pure metal having a large temperature coefficient. Out of a large amount of experimental work which I have done on fuses, about the only piece which seemed entirely successful and satisfactory was a fuse designed to be made of two iron wires tinned together the entire length and each wire cut, with a certain linear distance between the cuts, thus leaving a section between the cuts joined by the tin only. This fuse was designed to protect the lamps in a series circuit in case of a cross in a line, which accident generally resulted in the burning out of all the lamps inside the cross. By the use of this fuse, having pure iron wires drawn to an even gauge and tinned together uniformly with pure tin, it was found possible to cut down the margin to 10 per cent. or less, the fuse acting so quickly as to save the lamps in circuit in case of any sudden cutting out of a portion of the circuit. This arrangement could not be considered practical for ordinary low tension work, which is the condition for which fuses are used mostly. I am glad Mr. Haskins mentioned the matter of extremely fine fuses, as that is a question I happen to have in hand at the present time. That these are urgently demanded is amply attested by the amount of effort recently spent on such fuses. The extremely rapid dissipation of energy from wires of small diameter pointed out first, I think, by Mr. Preece, is a great difficulty in securing accurate fuses of small capacity. I have been fortunate enough to secure help on this from as skillful a metallurgist as Thomas Wallace, who has sent a number of samples to test for the purpose, and promises to send more. Some of these give very interesting results, both good and bad. One sample, tested lately, was reported by my assistant as being suitable, perhaps, for incandescent lamp filaments, but not suitable at all for the purpose required. So far iron has seemed to me the best material for the purpose if tinned to prevent slow corrosion. The rapid oxidation of the iron at a red heat insures prompt fusing. We are emerging from chaos in this matter, and the prospect is more hopeful than the retrospect would lead one to anticipate. Fuse wire can be had to-day prepared and rated with an amount of pains that is all that can be desired. Current use has improved and will contiuue to improve. Users of electrical apparatus grow more critical every year. The "dynamo tough" must go, and his place will be taken by the man who does not know it all but who reads and thinks and mingles the little he may know with a refreshing portion of common sense.

FOREE BAIN: "Safety Devices" for electric circuits is a subject in which I am very much interested. Mr. Haskins' timely paper will, I hope, call special attention to this seemingly insignificant, but in fact very important portion of every electric circuit. The devices which have been used to protect electric instruments of all kinds from an overburden of current have been so simple, it is probable that their importance has, on this account, been lost sight of. I do not urge more complication, but I do insist that they should not be wholly neglected and left to take care of themselves. A safety device should, however, take care of itself, and I believe that a good one will do so every time. Should we let this matter rest until we have found such a device? I think not.

More than a year ago I suggested to Mr. Haskins the subject of his paper and asked that he then present his ideas and experience to the club. I was induced to do this after having made several experiments with so called fuse wire. I selected several samples from as many different makes and found from a few crude experiments that I then made, that a fuse wire composed of alloys was simply a guess and often a very poor guess at that. At the time I found that the various samples would not fuse with the current for which they were designed; in fact, I found from actual experiment that I could increase the carrying capacity of any alloy or pure metal wire, to a point very far beyond its expected, and to me, known capacity. I will relate an experiment to illustrate. I first selected a fuse marked ten amperes, then put a good and correct ampere meter in circuit with it and found the fuse did not let go until the instrument indicated twenty-nine amperes. I took another sample of the same wire and increased the current passing through it, until forty-two amperes were indicated. I repeated these experiments and found, to my surprise, that I could approximately control the carrying capacity of my fuse by the manner and suddenness of introducing the current it was called upon to carry. I then put in a fuse and suddenly threw current on, so arranged that it could not rise above ten amperes and it "let go" everytime. I think this illustrates that the sudden introduction of the load tends to heat the wire to a very much greater extent than when the current comes on gradually, or it may be explained in this way: It is known that a remarkable molecular change sometimes takes place in metals without their undergoing any alteration from a solid to a liquid state. Brass, silver, lead and several other metals when first cast or rolled, possess a great degree of toughness without any apparent crystalline structure. If these metals are subjected to sudden and repeated strains they become weak and lose their toughness, a condition known as the fatigue of metal. A similar effect is produced by repeated heatings and coolings, and from this they often become so brittle as to snap apart upon the application of a very slight degree of force. The surface of the fracture then exhibits a distinctly crystalline appearance. This effect does not seem to alter the conductivity of the metal or to decrease its normal carrying capatity, nor does it seem to alter the melting point of the metal. It occurred to me that this effect was more reliable then to depend solely upon the melting point, as I believe that the crystallizing effect always precedes the melting point when electricity fuses a wire. I therefore, arranged a fuse in such a way that it was constantly under strain from a spring from gravity or otherwise in such a manner that it would be pulled asunder when its molecular structure was weakened by the over burden of current. A sudden blow will frequently crystalize and destroy the toughness or strength of a piece of metal, when an equal force applied in a steady pull, or strain, will not affect its molecular structure. Again, when a current is applied gradually to a fuse, it has time in which to radiate or conduct away the resulting heat. Its structural molecules are not so violently affected and its own resistance for these reasons is not so great. The spring or weight, which I have suggested, acts in a way to agitate

[illegible] very much above the surrounding atmosphere. This stretch-

[illegible] bearing on the case: Water, for example, in a still atmosphere [illegible] eight or ten degrees below freezing point and yet remain liquid, but the slightest vibration or any extraneous pressure or agitation causes sudden crystalization of a portion of the liquid into ice, which is rapidly communicated to the entire mass. If [illegible] strain, [illegible] ment or agitation be made to occur at the critical point when crystalization is about to take place, it will hasten this action and cause the process to be more positively effected. In the case of the fuse, the metal will rapidly lose strength the moment crystalization begins, and the spring will force it apart and thus open the circuit. I believe that pure metal is better adapted to use than alloy, for the reason that a very slight change in the proportion of metal in an alloys will make very great difference in its action when used as a fuse. A pure metal is more uniform in its action. I like a pure tin wire for this reason. Another reason is that the coefficient of resistance due to heat is greater in pure wire than alloy. I like tin because its melting point is lower than any other pure cheap metal, except lead. It does not oxidize so readily as many others and it does not crush like lead. It is not so good a conductor of heat or electricity as copper.

Referring to Mr. Haskins' paper where he speaks of fuses for telegraph and telephone circuits, I will describe a safety device which I made ten or twelve years ago to protect gas lighting circuits, or in other words it opened the circuits to prevent polarization of the batteries. It consisted of a small hard rubber rod about three inches long and one eighth of an inch in diameter. Around this I wound ten or more turns of number thirty German silver wire over its entire length which was included in this main circuit. One end of this rod and the wire were rigidly attached to a brass pillar, the other end of the rod was provided with a brass disk to which the remaining end of the German silver wire was attached. The disk was set to bear upon a metal terminal so that the circuit would be complete through the disk, German silver wire, and the pillar. A certain strain on the rod was necessary to make contact between the disk and the terminal, and against this strain was arranged a spring. The operation of the device was as follows: A current greater than that designed for the apparatus would heat the wire, the heat would soften the rubber and the differential spring would push it and the disk off the contact with the terminal, and thus break the circuit. When the rubber rod became cold again it would regain its elasticity and be once more ready for action. To set the device it was only necessary to turn it one half revolution when the disk, being eccentric in position, would make contact again with the terminal and close the circuit. This is admirably adapted for circuits carrying small currents such as telegraph, telephone, bell, gas lighting, etc., and a modification of it might be used very satisfactorily for much heavier circuits.

I have seen protecting devices in which a resistance wire was used to melt a chunk of tallow which held contacts together. Electro magnetic devices are sometimes successfully used, and are in a great measure reliable. Objection may be offered on account of moving portions, which present more or less mechanical resistance by stiff rusted or corroded joints or pivots. Another objection when used for heavy currents is based upon the feature of contacts which must be pressure contacts and not frictional contacts. These become corroded, easily heated, and they interpose useless resistance. The act of breaking the current produces an arc. This intensifies the oxygen in the surrounding atmosphere or produces ozone which quickly coats the contacts with a high resistance film, so that when they go together again, if they are not cleaned, they are liable to heat. We all know from experience that the inanimate persistence of matter in all devices is eternally tending to go wrong. We must not, therefore, increase the duties of the so-called attendant by introducing anything that would ruffle the easy tenor of his everyday life.

ELMER A. SPERRY: The eminent utility of safety devices and the certainty with which such devices should act, has led many to work upon various forms and constructions with a view of increasing such certainty, and also to decreasing the time element in their operation. At an early date I was impressed with the fact that "grounds," so called, were the source of a large percentage of the troubles calling for the use of safety devices of the ordinary construction. Looking to the removal of the source of trouble I devised at that time a junction box for branch circuits containing an automatically operating switch which served instantly to disconnect both leads of the branch upon the appearance of a ground therein, providing at the same time for the continuity of the circuit in case of constant currents. A number of specimens of this device have successfully performed this function for a number of years, and for some purposes; such, for instance, as operating groups of incandescent lights from constant current circuits, I know of no better form of safety device. For purposes of ordinary constant-pressure distribution the evident simplicity, directness of action, and general fitness of the fuse has led to its almost universal adoption. In adapting the fuse to certain special purposes requiring more than [illegible] operation, I was at an early date brought face to face with certain evident [illegible] the manufacturer and the actual performance, and at once set myself to the task of remedying the trouble. I first undertook to classify [illegible] legion. My task can easily be magnified [illegible]

[illegible] experience that this method of investigation is far from satisfactory, especially when compared with the work that followed, which will now be briefly described.

I first encountered difficulty with alloys. I found that many, some of which have been mentioned by Mr. Haskins, could not be depended upon as being stable, that is "batches" of carefully weighed and compounded elements would not be alike. One of the metals would seem to vaporize in compounding more at one time than another, and again the alloy was not found to be homogeneous throughout. Wire or strips drawn from the same batch would show marked difference when the same alloy was used. The softer alloys with low melting point have been found to be preferable to the harder ones; the terminal will make better contact with a softer wire than with a hard—and furthermore the tendency to crystallization upon frequent bending renders the harder fuse wire less desirable. I have found some alloys which, though apparently quite soft, will show quite deep fractures or cracks upon being once bent around its own diameter. The matter of softness, however, may be carried to an extreme. But the character of the metal or alloy will be found to be responsible for most of the variations in this particular.

At last a material was found that seemed to be perfectly uniform and homogeneous when in the hand of the kind of workman ordinarily set upon a task of this kind. It was next found by careful testing that the die for forming the shapes would soon change, even when made of superior steel and hardened. Then again the metal itself being soft, is easily indented and thrown out of true form by particles of foreign substance and "stoge" which often "foul" the die. Right here a peculiar fact was noticed. The pieces of wire drawn though the same die, one with cylindrical section; the other with a periphery scratched or indented enough in fact to cause considerable diminution in the weight of a unit length in fusing showed considerable increase of carrying capacity for the smaller wire. This is doubtless traceable to the increase in superficial area for dissipation of the heat. The results in this way often become very perplexing, the reports of the tests leading sometimes to wrong conclusions, causing changes in the alloy, etc., which were really in no way resp nsible for the result. It will readily be seen that a wire of this character under the micrometer will register sufficiently near to be pronounced accurate in size by the average technical observer. I could not exactly agree with the paper on the point of sizing by the micrometer where accuracy is required. The face of the micrometer having only a line of tangency with the soft wire will be forced into the material compressing the same more or less, depending on the delicacy of the manipulation, decreasing thereby the reliability of measurements taken in this way.

One result of my experience is, that the fuse as a safety device may be made perfectly reliable, and may be depended upon absolutely as to performance, providing always that "unit fuse" being a cylindrical fuse wire 10 diameters in length measured along the path of the current between the terminal blocks; also "unit terminal" being a terminal block including screw or other clamp, and that part of the main conductor which was in contact therewith, all of which, taken together, having a weight 10 times that of the unit fuse. The denomination of the fuse wire was the safe carrying capacity in amperes. The mean fusing point is usually placed at a point 40 per cent. above the carrying capacity. The per cent. may be varied to suit the requirements, and is usually greater in small sizes than in large. This accurately gauging the fuse to meet the exact requirements as to range of current and time, giving at the same time certainty of action, I consider a matter of growing importance, looking not only to placing within the reach of the electrical engineer a reliable safety device of the utmost utility and simplicity, but increasing at the same time the usefulness and desirability of all electrical appliances. As to curves, Fig. 1 shows between what points the difference in lengths of fuse wire affects the fusing point, and this with different terminals, curve No. 1 being with "unit terminal;" curve No. 2 being with three unit terminals and curve No. 3 with five unit terminals, all being carefully drawn fuse wires of the same capacity and uniform character; duration of fusing current 30 seconds.

As to curve No. 4 the current was run up to the fusing point instantaneously. In this curve different length fuse wires were taken the same as in the case of the other three curves, and also different terminal blocks were used, from 1 unit to 10 unit terminals. It will therefore be seen that curve No. 4 really represents 10 different curves which fall so nearly in the same path as to be represented in a single line. By comparing curve No. 4 with the other three curves, the effect of the time element will be noticed on the absorption of the heat by the terminals in different length wires, as well as with terminals of different sizes.

Fig. 2 shows the relation of safe carrying capacity with with fusing points with constant length wire and constant terminals with uniform increase in diameter to the right. The curvature is owing to the decrease in the ratio of the superficial area or radiating surface to the sectional area or carrying capacity, cylindrical wire being used. In this case uniform terminals were used and uniform absolute lengths of fuse wire were used. Curve No 1 being for one inch lengths, curve No. 2 for five inch lengths, in all capacities. Curve No. 3 is safe carrying capacity. The terminal used in this case was a ten unit terminal for 100 ampere fuse wire; duration of fusing current 30 seconds.

Fig. 3 shows the effect of using different sized terminals from one unit to ten units in conjunction with the same fuse wire as to capacity and length in all cases, that used in this case being a five unit fuse; duration of fusing current 30 seconds.

The following is suggested as the equation of the curves in Fig. 1, being correct for all practical purposes: The addition of two or three constants would doubtless render it correct to a mathematical degree of refinement. The heat generated is proportional to $C^2 Rt$, but if the length of time is the same in a series of tests, C and R are the only variables. R varies directly as the length L, therefore the amount of heat generated depends upon $C^2 L$. An increase in L necessitates a decrease in C^2 if the heat developed is to remain constant; therefore, C^2 varies inversely as

$$L \text{ or } C^2 = \frac{1}{L} K,$$

where K is a constant depending upon the cross section and specific resistance of the fuse wire. In increasing L the amount of fusible metal present to absorb the heat as well as the surface of the same to radiate it is increased in the same proportion, therefore to produce the same temperature the current must be multiplied by

$$L \text{ or } C = L K$$

The final effect of increasing L is to increase the resistance to the flow of heat from the center of the fuse to the terminals, and this increase of resistance is directly proportional to L, therefore the current required must be divided by

$$L \text{ or } C = \frac{K}{L}$$

and this may be considered the final equation of the curve. [illegible] that this equation holds only in cases where the terminal blocks are large enough to [illegible]

FIGS. 1, 2 and 3. SAFETY DEVICES.

Novelty Electric Wire Gauge.

In the accompanying cut is shown the wire gauge just placed on the market by the Novelty Electric company of Philadelphia.

As will be seen, the wire is placed in the V-shaped opening between the movable arm and the edge of the gauge. The arm is then moved around until the wire is tightly bound between it and the gauge, when the radial line from the short square shoulder of the arm will indicate the B. &. S. gauge of the wire, the safe current it

NOVELTY ELECTRIC WIRE GAUGE.

will carry in amperes, and the resistance per foot of copper wire in ohms. With this information, the size of wire required to carry any number of lamps any distance with any loss can readily be calculated by means of the formula stamped on the arm.

New Porcelain Insulator.

The accompanying cut illustrates a new porcelain insulator placed on the market by the Security Insulator company of New York. The device obviates the necessity of using a tie wire, the wire being pressed into a groove by a cap, which by a cam movement, is made to grasp and hold the wire securely. By this arrangement wires of varying sizes can be used, the cam motion allowing a variation of one-quarter of an inch. The time consumed in running wire by the use of this insulator, it is claimed, is reduced materially.

The Nassau Electrical Company's Midget Battery.

Of thenumerous electrical inventions that have been put on the market by the Nassau Electrical company, New York, none has attracted more attention than the Midget battery. This apparatus was designed especially for the medical fraternity. The size of the battery is one of its most important features. It is only 2½x4x2 inches. The battery requires little or no attention. The electrodes are within the box and the battery proper, which is in the form of a capsule, can be taken out and replaced by lifting the cover. The strength of the current can be varied over quite a considerable range by pulling out the lever which is located on the outside of the box.

Third Edition of the "Incandescent Wiring Hand-book"

The third edition of the "Incandescent Wiring Hand book" by Lieut. F. B. Badt, has just been issued by the Electrician Publishing company, Chicago. The fact that

THE MIDGET BATTERY.

this little book was much needed is shown by the large sale which it has had, 8,000 copies having already been issued.

The Milwaukee Street Railway company has finally secured the privilege of building tracks on Michigan street bridge, and will soon extend its Farwell avenue line to the Union depot, via that bridge, and tear up its Huron-Clybourn street tracks.

A press dispatch from Cleveland says that the city officials are seriously considering the question of establishing a municipal lighting plant. The present quality of illuminating gas is poor and costly and it has been ascertained that an electric plant could be purchased and operated at a cost at least one third less than the city has paid in the past for street lighting purposes.

Governmental Control of the Telegraph.

The New York Electric club held an interesting meeting on December 3d, at which the subject of governmental control of the telegraph was discussed. E. Rosewater, editor of the *Omaha Bee*, and an old time telegrapher, opened the evening's proceedings by reading a paper on "The Government Telegraphs of Europe." Mr. Rosewater entertains decided opinions upon the subject and as he has recently visited countries in which the telegraph is fostered by the government his views were very interesting. An abstract of his paper follows:

"Our postal system cannot attain its full measure of usefulness and efficiency until the electric telegraph and long distance telephone have been made an integral part of our postal facilities, with the pneumatic tube post as an auxiliary for conveying letters and messages in our great population centers. The American government helped to build many of our early telegraph lines, and it should have operated them from the first. Our telegraph companies work on inflated capital, and supply a lack of facilities at small cities and towns.

"Nothing has impressed upon me more forcibly the dangerous tendencies of telegraph inflation and over-capitalization than the comparative exhibit of the world's telegraph system submitted to Congress last winter by the president of the Western Union Telegraph company. According to Dr. Norvin Green this country has 185,000 miles of telegraph pole line, as against 375,000 miles possessed by all other countries of the world. There are 673,000 miles of wire in the United States, as against 1,111,968 miles in all other countries, and there are in America 18,000 telegraph stations, against 53,000 in all other countries. As a matter of fact, the aggregate number of telegrams handled in European countries alone, computed officially for the year 1889, is 204,935,055. With one-half of the world's telegraph line mileage, American telegraph companies should have handled one-half of the business. Instead of handling 102,000,000 telegrams, they only handled 60,000,000. With one-half of the world's telegraph lines in a country that boasts two-thirds of the railway mileage of the world, America should have her full quota of the world's telegraph stations, but out of 53,000 we only have 18,000, including railroad offices, which comprise nearly three-fourths of our telegraph stations. On the other hand, Great Britain, with less than one-third of the wire mileage of the United States, handled 62,403,399 telegrams in 1889.

"The first step toward merging the telegraph system of Great Britain with the postal service was taken in 1868, when Parliament passed an act authorizing the purchase or leasing of all lines operated by private companies. In 1870-71 the number of messages handled by the British postal telegraph was 9,850,177. In 1874-5 the number had increased to 19,253,120. In 1880 81 the number of telegrams handled was 29 411,982, an increase of 55 per cent. in five years, and in 1885 the number of messages handled had reached 39,146,283. By the act of October, 1885, the rate on telegrams to all parts of Great Britain was reduced to 6d. (12 cents) for a message of 12 words, including address and signature, and ½d. (1 cent) for each additional word. This reduction was followed by an enormous increase of business. In the year 1886–7 the number of telegrams handled was 50,243,639, and in the year 1890–91, 62,403,399.

"In London the city messages are transmitted exclusively by postal pneumatic tube. The pneumatic tube department in the great central telegraph station handles the bulk of the letters, dispatches and cards that are delivered within the city of London. Outside of the London Exchange, which is supplied with an independent system of direct commercial wires, all communications within the city of London proper are dispatched by pneumatic tube. Thousands of dispatches, letters and postal cards are shot by air pressure every hour of the day from the twenty postal-tube stations established at points most accessible into the central telegraph station, and there they are redistributed and fired back to other stations, delivered by carrier, or forwarded by telegraph or telephone to points outside of London.

"In New York or Chicago a city message of ten words or less costs you 20 cents. In London, you can send as many words as you can write on the blank card, which varies from 100 to 1,000 words, for 6d. (12 cents.) By the tube system, no copying is done—the original message is delivered to the person to whom it is directed unless it is to go by telegraph or telephone to points beyond London.

"While London was the first city to utilize pneumatic tubes for the rapid transmission of mail matter and telegrams, the cities of Paris, Vienna, and Berlin have for years been served by pneumatic tube post. During the year of 1889 the pneumatic tube post of Vienna handled 2,692,752 letters, telegrams and postal cards. Of this number 1,541,647 were telegrams. But the city of Berlin can truthfully boast of the most perfect and best-served system of postal pneumatic tubes in the world. While London has only twenty pneumatic tube stations, Berlin now has fifty-one distributed, not merely over the entire area of the German capital, but reaching out into the suburbs. You may deposit your message in one of the pneumatic tube stations and it will reach any point within the radius of ten miles within six minutes, including a transfer at the central tube station. For 6½ cents your message or letter, inclosed in one of the red Rohr post envelopes, will be fired through the tubes from Berlin to Charlottenburg and delivered by postal carrier."

"The postmaster general of Great Britain was empowered by the act of 1868, which authorized the acquisition of the telegraph lines, to facilitate the collection and transmission of dispatches by designating places for depository telegrams in letter boxes and other depositories, and telegrams deposited therein are, if written on stamped paper of proper value, conveyed by letter carriers to offices of transmission by wire or to the tube stations free of charge. This is a convenience that we cannot secure so long as our telegraph lines remain under corporate ownership.

"But the postal telegraph facilities in London, even without this special convenience, could scarcely be improved on. At the present time there are 538 stations in London from which telegrams may be forwarded. Of this number 451 are branch postoffices and 87 are railway station offices. Inasmuch as the telegraph tolls are uniform throughout Great Britain, people simply purchase stamps covering the cost of any message, and the stamped blank is rushed through the tube to the central station, and thence transmitted by wire to its destination. A telegram with the proper stamp attached, dropped into a post-office box in any city in Great Britain, will be wired from the nearest telegraph station just the same as if the sender had gone through the tedious formality of handing it directly to the receiving clerk at the telegraph office. For the accommodation of business men and other patrons who use the telegraph frequently, stamped telegraph blanks are supplied at a trifling extra charge for paper. Similar conveniences are enjoyed by the people of France, Germany, Austria and other countries of Europe.

"The impression has prevailed in this country that the postal telegraph service of Europe does not afford as good facilities and cheap rates to the press as do the telegraph lines of America. This I have found to be erroneous. Press dispatches may be duplicated to any number of papers. Computed for a service of 1,000 words a night, a special dispatch directed to one paper would cost $2.50; the same dispatch transmitted in the day to one paper would cost $3.33. But to a press association of twenty-five papers then the cost of 1,000 words in the night would be $12 10, and transmitted in the day, $14.85. This is less than 1¼ cents per word for night work, and 1½ cents for day work, delivered to twenty five papers.

"The rate charged for leased wires in Great Britain is £500 per annum for a line extending to any distance within the United Kingdom, the service beginning at 6 P. M. and terminating at 9 P. M., for six nights in the week. The government furnishes the operators and instruments. Leased-wire messages are delivered free at newspaper offices at a distance of one mile from the main office. In this country the wire rental is computed at $10 per mile.

"The press service receives special care at the Paris central office, and the leased-wire service is even more liberally arranged in France than in England. You can lease a wire for an hour, or even for five minutes. The rate for one hour over a wire extending any distance within the republic of France is 30 f., including operators' service at both ends, or 2½ f., or fifty cents, for five minutes. The French Postal Telegraph grants a rebate to the press for the time during which a leased press wire is in use for commercial purposes.

"In Austria, the bulk of all press dispatches is transmitted by long distance telephone, which is part of the postal telegraph plant in that country. This is also true of Germany. All the press dispatches between Vienna and Prague, a distance of nearly 300 miles, are transmitted by telephone at rates computed according to the time consumed.

"The salaries of postal telegraph employes in Great Britain will compare favorably with those paid for the same class of operators in this country, barring perhaps a dozen officials of the highest rank. By the telegraph purchase act of 1868 all telegraph employes who had been in the service of the companies twenty years or more prior to the purchase and who failed to secure re-employment in the postal telegraph service were to receive annuities equal to two-thirds of their salary, and if less than twenty years the annuity was to be reduced one twentieth for every year under twenty, but no annuity was granted to any employe who had served less than five years in the telegraph companies' employment. The same policy is pursued in France, Austria and Germany. In the last named country postal telegraph employes share with all other government employes the benefits of the system of life insurance and annuities after a long term of service.

"Now a word about the political influence of the postal telegraph. My investigations were confined to four countries—England, France, Austria and Germany. France is a republic like ours, and party feeling is more intense there than in America; England is a constitutional monarchy, governed by party, that holds its supremacy through electoral majorities; Germany and Austria are limited monarchies. In all these countries the uniform response to my inquiries concerning political interference with telegraph employes or abuse of power in tampering with messages was uniformly the same. In Paris, M. Magne, director-general of telegraphs, expressed great surprise at my question about political interference with postal telegraph men. 'We all exercise our rights as citizens untrammeled,' said he. 'Postal telegraph men are not allowed an active part in campaigns or in public meetings, but all vote as they please. Such a thing as trying to delay a political message or tamper with it, or divulge its contents, has never been heard of in France. The attempt if made, would cause a revolt and overthrow the party that was in power at the next election.'

"The director-general of German telegraphs was equally emphatic. He said: 'There are quite a number of Social Democrats in the telegraph service. These men are virtually committed against our form of government, but we cannot interfere with them so long as they do not conduct themselves treasonably.'

"In all European countries the laws against delaying or destroying telegraphic dispatches are much more severe than they are in this country."

The statement has been made that the now unused line of the Union Cable Railway company in Kansas City will be converted into an electric line, and run in connection with the northeast electric line. This cable line was built on the Terry shallow conduit system, but, owing to a lack of money and various legal complications, has never been operated. The line runs from Fourth and Oak streets east to Third and Highland.

CORRESPONDENCE.

New York Notes.

[illegible] that those most affected by calamity were men identified in some way or other with electrical interests. Russell Sage's startling explosion was, of course, an exception, but with Cyrus W. Field's sad experiences and Frank J. Sprague's [illegible] numerous minor incidents, the happenings of the week may at least be entitled "newsy."

Mr Sprague [illegible] to protect his interests. On the day of the failure of Field, Lindley, Wiechers [illegible] the sale of certain [illegible] with this concern as [illegible] $25,000. Mr. Sprague [illegible] months' loan from November 4th. At this time the stock was worth 98 to 99. It is charged that on the same day in which the loan was made, the collateral of 300 shares of Edison stock was sold by Field, Lindley, Wiechers & Co. It is asserted that the shares were exchanged for an amount nearly $5,000 in excess of the loan for which they stood. Mr. Sprague was also submitting to a call for additional margin, which he unsuspectingly deposited in the shape of fifty more shares of Edison General stock. It was not until the failure of the firm that he was apprised of the fact that the stocks had been disposed of. The injunction is the result of an investigation by his attorneys, who discovered that 200 shares of the stock still stand in the name of the transferee, Broker E. M. Hussey. One hundred shares were disposed of to other persons in small quantities and another fifty shares still stand in the name of Field, Lindley, Wiechers & Co.

Chas. S. Frisbie, who has been engaged as superintendent of the pay stations of the Metropolitan Telephone & Telegraph company, is charged with embezzling the funds of his company. It is claimed that Frisbie altered the reports of operators stationed at public telephones by erasing cash entries and inserting the word "house" or "pass," and then pocketing the difference.

The offices of the W. T. Curtis Electric Manufacturing company and the Pierce & Thomas Engine Supplies company were damaged last week to a considerable extent by water, which leaked from the third floor of 42 Cortlandt street. These two concerns, together with another firm, estimate their damages at $1,500.

Last week mention was made of a pole cutting bee which was in session at White Plains, Westchester county. Now the Westchester Telephone & Electric Light company of White Plains has placed notices on the poles warning against interference. This action was brought about on account of the threatened position of the village trustees and board of supervisors, who have an antipathy to some of the newly erected poles.

For the last four months Baltimore, Md., has been agitating the telephone question with a view to obtaining lower rentals. On November 28th the secretary of the Telephone Subscribers' Protective asssociation notified the telephone company that the subscribers had agreed that $60 was enough rental for one wire—$120 is the present rate. It is stated that if the $60 rate is not agreed to two hundred instruments will be ordered out next week. The fight will be carried to the legislature in January.

The Electric Accumulator company has been restrained by a permanent injunction issued on December 2d in the United States Circuit Court, from making storage batteries in infringement of the patents of Chas. F. Brush, now owned by the Consolidated Electric Storage company, successor to the Julien Electric company.

There is an electric light fight going on in Plainfield, N. J., between the city fathers and the lighting company. The Plainfield Gas & Electric Light company has had a monopoly, owning both gas and electric light plants. This company has had a contract for the city street lighting. There have been of late, however, some startling disclosures. Secret investigations have been conducted by the common council committee on lights. This committee states that the street light circuits have been examined by experts, who have discovered that [illegible] payment of $10,000 the city has been getting [illegible] service paid for. Twenty-five candle power lamps, they assert, gave only from twelve to seventeen candle power, and after eleven o'clock the electric current, and consequently the light, was diminished even more. The councilmen make some very pointed accusations against the company. It is said that the Edison Light company of North Plainfield is to be given the privilege of extending its service into Plainfield City. Of course in such cases as this, where politics enter into the [illegible]

who is in the right or what will be the outcome of all the [illegible]

[illegible] heard of a fighting parson on the stage, but Orange, N. J., is to be congratulated on its being the home of a minister of the gospel who is manly enough to give a practical illustration that there is such a thing as justifiable anger. Any one who has had to do with the aggressive electric railway lineman will sympathize with the Rev. Father Kirwan, rector of St. Mary's Catholic church, East Orange. It seems that the linemen knew that the reverend gentleman did not propose to have any poles in front of his church if he could help it. For this reason it was decided to steal a march in the night on the priest. So at midnight the squad of pole setters appeared and went to work. The hole had been dug, but too much noise was made, and Father Kirwan was aroused. "Now stop that work at once, or I will shoot!" came from the bedroom window, but as priests do not usually carry pistols, the words did not cause the loss of very much time. When, however, a pistol ball whizzed in among the gang there was something of a scattering. Several of the men returned to work, but the priest shot twice more. An altercation then ensued with the usual result—the pole planted just where it was intended. It is said that the priest fired into the air and not at the men.

The New Yorkers have at last awakened to the fact that the World's Columbian Exposition is going to be a success whether they take part in it or not. So to help the fair there is going to be a great public dinner at Delmonico's. The spread is to occur on December 21st. Covers will be laid for fifty persons, and the gentleman who proposes to give this dinner is J. Seaver Page, secretary of the Union League club. Mr. Page says that New York is not inimical to the Fair but merely sluggish and indifferent. The dinner is simply to arouse public interest in the Fair. It is intended to be absolutely devoid of political significance and invitations are to be extended to representative men of all parties. Perhaps it is hardly worth while to mention that Mr. Depew will preside. A suggestion here will not be amiss. It might be a good idea for Mr. Page to strike a little nearer home. There ought to be an elegantly decorated and heavily laden table set to one side for several prominent New York editors. Perhaps, then, with the aid of a little Chicago pork done to a turn and flavored with a little of Mr. Depew's kindly eloquence, together with other and more invigorating sauces, an impression might be made on a class of men who have apparently done all in their power to hinder the work of the Fair pioneer. The newspapers are supposed to be mouth-pieces of the people. But if the New Yorkers, as Mr. Page says, are not inimical, then the New York press failed most signally to represent correctly [illegible] sentiment.

The Hudson River Telephone company, to accommodate those in Amsterdam, N. Y., who are not subscribers, is perfecting arrangements to establish a number of telephone stations at convenient points in that city. The long distance telephones will be placed in these stations.

Friday's storm played havoc with the possessions of the New York Electric Light company and it would seem that they were this time caught foul, so to speak, in so far as the conduit question is concerned. The loss to the Manhattan, the Brush, the East River, and United States Electric Light companies, it is said, will aggregate $120,000, and it is doubtful, too, if the fallen poles will ever be replaced. General Manager E. A. Leslie of the Manhattan Electric Light company, Eightieth street and East River, visited the Board of Electrical Control to get a permit to put up poles, but he was not successful. The board told Mr. [illegible] working order, and [illegible] a good opportu- [illegible] needless to say [illegible] and declare that [illegible] necessary [illegible] in [illegible] of [illegible]

details. Dr. Ward of Albany, who was one of the witnesses, said: "I, as well as the other witnesses, am pledged to maintain the strictest secrecy in regard to the execution. I will say, however, that in my opinion it was a success. I do not believe that Loppy felt any pain. He was calm and composed when he was being led to the execution room and when strapped to the death chair. I believe that electrocution is the most successful capital punishment. It is far preferable to hanging. I do not see why reporters should be excluded from the death-chamber during the execution. I believe that one of the earliest acts of the next legislature will be to amend that portion of the law which excludes newspaper men."

W. F. O.

Pittsburg, Pa.

PITTSBURG, Pa., December 5.—The week has seen the practical closing of the preliminaries in the affairs of the Westinghouse company. A representative of the company said: "The completion of the plan of reorganization adopted by the board of directors April 14, 1891, and by the stockholders July 15, 1891, is announced. The stockholders have responded with substantial unanimity to the call for the surrender of 40 per cent. of their holdings for the use of the company. Of the stock at the disposal of the company, $4,000,000 has been converted into 7 per cent. preferential cumulative stock, and the balance into 'assenting stock' entitled, after the preferred stock, to a 7 per cent. annual preference. Provision has been made for the company's debt and working capital by the sale at par of $3,000,000 of the preferred stock, for which payment in full has been received. The company has acquired almost all of the stock of the United States Electric Lighting company and the Consolidated Electric Light company (commonly referred to as the 'leased companies'), so that the fixed charges formerly incident to the leases of these companies are now substantially obliterated, and the consolidation of interests thus effected has rendered possible a great reduction in general expenses. The saving in interest upon debt, rentals, and other fixed charges thus effected by the reorganization amounts to more than $400,000 per year. All this has been accomplished without increasing the company's capital stock The reorganization has been effected without litigation and without interruption to the business, its three factories having been kept in continuous operation."

The $3,000,000 of preferred stock referred to was bought by August Belmont & Co., Brayton Ives, and Lee, Higginson & Co.

G.

Milwaukee, Wis.

MILWAUKEE, December 5.—Milwaukee may adopt the municipal lighting system, but it won't be for some years yet. The contract with the Badger Illuminating company will undoubtedly be renewed for four years. Up to a short time ago President Wall insisted upon a five years' contract at $112.50 per lamp per year, and declared that his company would not accept any less favorable terms. The council committee on street lights insisted upon the price per lamp being reduced to $110. For some time President Wall held out for a seven years' contract at that figure, but he and the committee finally compromised upon a contract for four years. The report was submitted to the common council last Monday evening. Alderman Ziegler, the chairman of the committee, which had been the foremost advocate of the muncipal lighting system, explained that the city could probably produce its own light cheaper, but it had no funds at the present for any such purpose. Anyway, he said, it would be wise to follow the advice of Prof. Barrett, the Chicago electrician, and wait until after the World's Fair, when electric light machinery would be much cheaper. Competition was a good thing, he said, but he said that he was satisfied that there could be none in electric lighting. He had assisted the Milwaukee Electric & Power company in its efforts to compete with the Badger company, but that company would not take a step toward getting ready to light the streets until it became certain of the city contract. Alderman Dewerth said that the Electric Light & Power company had confessed to having no money with which to enter into competition with the Badger company and to its desire to sell out. Alderman Lorenz accused President Wall of having taken advantage of the law and courts in order to place the city at his mercy. The reduction of $2.50 per lamp [illegible] return to gas unless a [illegible] Alderman Hanke and Hazelton thought that the cheapness of the municipal lighting was [illegible] of the question. Ald. Braun remarked that the committee acted as though its members had stock in the Badger company. Alderman [illegible] Badger contract for [illegible] The amendment [illegible] defeated. The matter was then laid over until the next meeting, a week from next Monday. The present contract will expire on December 15th and there is no doubt of its being renewed for four years at $110 per lamp per year at the coming meeting. The project of a municipal lighting system may be realized before the new contract expires. There is quite a strong public sentiment in favor of the plan, and it seems to be growing in favor. The advocates of the system will watch the situation very closely and be prepared for a fight when the time comes.

The common council got into a fight over the Western Union Telegraph company's aerial cable scheme. Alderman Ziegler said that the telephone company and the city were putting their wires underground, and that it was not fair to make an exception in favor of the telegraph company. Alderman Smith said that the question as to whether overhead wires were a nuisance would have to be fought out in the courts, which would take several years, during which time the wires would remain above ground; while by allowing the supension of aerial cables the city would gain some advantage at once without losing anything. A motion to indefinitely postpone the aerial cable ordinance was lost, and final action was postponed for two weeks.

Julius Andrae has secured the contract to do all the electrical work on the imposing new residence of T. D. Stimson, Los Angeles, Cal. The house will be thoroughly fitted with all the latest electrical conveniences. William Becker, Mr. Andrae's chief electrician, has gone to Los Angeles to take charge of the work.

C.

PERSONAL.

Charles L. Pullman returned to Chicago on Tuesday after an extended eastern trip.

J. H. McGraw of the *Street Railway Journal*, New York, was in Chicago last week.

G M. Mumford, treasurer of the C. & C. Motor company, New York, visited Chicago last week,

H. K. Gilman, of the Great Western Electric Supply company, is in New York and expects to be absent ten days.

Dan Hemingray, of the Hemingray Glass Works, Covington, Ky., has been in Chicago the past week attending a meeting of the glass manufacturers.

A. F. Davis, chief operator of the Western Union Telegraph company, at Providence, R. I., has retired from his position after occupying it fifteen years Mr. Davis was a veteran operator.

J. W. Godfrey, general manager of the New York Insulated Wire company, is in Chicago. Mr. Godfrey is on his way east from an extended business trip to San Francisco and other points on the coast.

Thomas Lowry, the Minneapolis and St. Paul street railway magnate, was in Chicago on December 5th. Mr. Lowry is as enthusiastic in his support of the electric railway as ever. He expresses the belief that he has the best system in the country.

C. H. Goodrich, vice-presidest and superintendent of the electric railway system at Minneapolis, was in Chicago last week. He has recently made an extensive tour investigating the methods of transportation in other large cities, and he says he found nowhere a system to compare with that at Minneapolis.

W. A. Stadelman, manager of the Equitable Engineering & Construction company, Philadelphia, has returned from an extensive southern and western business trip. He brings back a number of important contracts and reports the outlook for business in those portions of the South and west which he visited as being unusually good. Mr. Stadelman predicts a large trade in the electrical line in '92.

NEW INCORPORATIONS.

Metropolitan Street Lighting company, Omaha, Neb.; capital stock, $25,000; street lighting by gasoline and electricity in its various forms.

Beatrice Light and Power company, Beatrice, Neb.; capital stock, $250,000; to furnish gas, electricity and supplies for light, heat and power.

Bowling Green Electric Light & Power company, Bowling Green, O.; capital stock, $50,000; furnishing electric light and power; E. H. McKnight, Troy, O.

Southern Improvement company, Dallas, Tex.; capital stock, $60,000; electric light, heat and power, and supply of water to the public; W. J. Williams, Dallas, Texas.

New England Heat Regulator & Electric company, Portland, Me.; capital stock, $50,000; to manufacture, use and deal in all kinds of electrical appliances; George C. Hopkins, Portland, Me.

Electro-Medical Appliance company, Chicago, Ill.; capital stock, $50,000; the manufacture and sale of electro-medical appliances, Frank D. Thomason, Room 18, 142 Dearborn street, Chicago, Ill.

San Diego Electric Railway company, San Diego, Cal.; capital stock, $250,000; to construct and operate a street railroad, to purchase rights and franchises owned by the San Diego Street Car company; Works, Gibson & Titus, San Diego, Cal.

Shaver Telephone company of Central New York, Syracuse or Watertown, N. Y.; capital stock, $30,000; to

construct and use a line or lines of electric telegraph and telephone through counties of Onondaga, Oneida, Oswego, Lewis and Jefferson.

Home Electric company, New Brighton, Beaver county, Pa.; capital stock, $10,000; supplying light, heat and power by means of electricity at the borough of New Brighton and other boroughs adjacent thereto, etc.; Stiffy & Calhoun, New Brighton, Pa.

Morelton Electric Light & Power company, Korresdale Mills, Pa.; capital stock, $1,000; supplying light, heat and power, or any of them, by means of electricity to the public in Bensalem township, Bucks county, Pa.; Henry V. Massey, 505 Chestnut street, Philadelphia, Pa.

Electric Railway Development company, San Francisco, Cal.; capital stock, $500,000; to acquire and dispose of patent rights and inventions for building electric railways; to manufacture and deal in electrical machinery and to build railroads; also to deal in real estate; John F. Boone, San Francisco, Cal.

ELECTRIC LIGHTING.

An electric light plant is to be erected at Bryson City, N. C.

An electric light company has been incorporated at Point Pleasant, W. Va.

The Dallas, Tex. Electric Light company has increased its capital stock to $400,000.

The Fernandina, Fla., Light & Power company contemplates an enlargement of its plant.

The government of the Cape Colony, it is stated, will shortly have all of its trains lighted by electricity.

It is said that secondary batteries are used in storing current for about 70,000 incandescent lamps tn Paris.

The Westinghouse company is building an alternating current dynamo to have a capacity of 10,000 16 candle power lights.

The Weston Electric Light, Power & Water company has increased its capital stock to $15,000, and will put in new machinery.

The Chattanooga Electric Light company is making arrangements to extend its system in order to supply private dwellings with electric lights.

English brewing journals urge the introduction of electric lights in breweries owing to the non-pollution of the atmosphere, which is of especial advantage in brewing.

According to a recent report there were at the end of last year 434 electric light installations in Switzerland, in which 68,368 incandescent and 1,068 arc lamps were used.

The Ashland, Ky., Electric Light & Power company has increased its capital stock from $25,000 to $100,000, and will put in new motors to furnish power to small manufacturers.

It is stated that a syndicate of Belgian financiers has obtained a concession from the Persian government for the monopoly of electric lighting in Persia. The office of the company will probably be at Brussels.

The San Angelo, Tex., Electric Light, Power & Irrigation company has been organized for the purpose of erecting an electric light plant and developing a water power of 250 horse power capacity from the Concho river.

A Baltimore man is investigating what is known as the McCrea mill property at Ellicott City, Md., with a view of purchasing it and utilizing the water power for the production of electricity to supply Ellicott City with light.

The town of Milton, Ore., has bought an electric light plant for fifteen arc and two hundred incandescent lights, at a cost of $4,025. The Edison system will be used, and water power from the Walla Walla river will be utilized.

The Marietta, Ga., Electric Light company, at a recent stockholders' meeting, voted to increase its Capital stock $10,000, and put in an incandescent electric light plant. Campbell Wallace, Jr., will be the manager of the plant in the future.

The property of the Des Moines Water Power company, which utilizes the Des Moines river water power to generate electricity for light and power purposes, was sold to the Des Moines Water Power & Electric company for $450,000 on December 5th.

The Congaree Gas & Electric Light company and the Columbia Electric Street & Suburban Railway company of Columbia, S. C., will consolidate, and the electric light plant of the former company will be enlarged and the capacity increased. Bonds for $100,000 will be issued to pay for the improvements.

J. W. and A. E. Carlson of Portland, Ore., have been granted a franchise by the city council of Marshfield, Ore., to erect and maintain an electric light plant having a capacity of at least 25 arc lights of not less than 2000 candle power each, and not less than 500 incandescent lights of 16 candle power each.

Cicero, a suburb of Chicago, has granted an ordinance to Edward L. Jeffreys, giving him a thirty-year contract to light the territory between Chicago avenue and Madison street and Austin avenue and West Fifty-second street with arc lights at $50 a year each, and the territories in Clyde and Hawthorne with incandescent lights at eight-tenths of a cent an hour each. The ordinance carries with it permission to construct the necessary lines, erecting poles and laying conduits. The ordinance must be accepted in ninety days and a $5,000 bond be given by Jeffreys.

A Chicago merchant is quoted by one of the daily papers as authority for the statement that he had been asked to put up screens on electric lights in the stores to shade them. "At first I thought nothing about the complaint," he said, "but I am satisfied that the time is at hand when something will have to be done. I made some inquiries the other day of one of the young women, and she informed me that the trouble lay in the fact—she called it a fact—that the electric light brings out all the imperfections of the face. This compels the women to use more of the rouge or resort to other methods of covering up their crow-feet, or whatever the facial imperfections may be. If the objection was based on anything else there would be some hope of remedying the same, but when a woman concludes that anything is liable to make her age apparent she will move the mountains to accomplish her aim in getting the detector out of the way."

ELECTRIC RAILWAYS.

An electric railway from Portsmouth to Port Norfolk, Va., is projected.

It is reported that the Corsicana, Tex., street railway is to be operated by electricity.

The Velasco & Surf Side Railway company of Velasco, Tex., will build a street railway from Velasco to Surf Side. It will be operated by electricity.

It is stated that negotiations are pending for the changing of the motive power for passenger trains on the Chattanooga Union Railway to electricity.

The Ashland & Catlettsburg Street Railway company of Ashland, Ky., will extend its road to Catlettsburg and change from animal to electric power.

The city council of Newbern, N. C., has granted a franchise to build and operate an electrical street railroad to William C. Clarke of Wakefield, R. I.

The Jacksonville, Fla., Street Railway company has applied to the city council for permission to operate its lines by electricity, using the storage battery system.

An ordinance has been introduced in the city council of New Orleans authorizing the New Orleans & Carrollton Railroad company to operate its street railway by the overhead electric system.

Work has been commenced on the Washington & Arlington railway at Washington, D. C., and work on the bridge over the Potomac will be begun as soon as the plans are approved by the secretary of war.

It is said that a New York syndicate contemplates the purchase of the Highlandtown & Point Breeze street railway of Baltimore. If the sale is made the road will probably be operated by cable through the city and electricity in the suburbs.

The West End Street Railway company of Boston is reported to have contracted last month for the purchase from the Thomson-Houston company of electrical equipment for 250 cars, which includes 500 street railway motors, but not the car trucks or car bodies.

The South Galveston & Gulf Shore Railroad company will build an electric railroad from Galveston down the island to South Galveston, a distance of about thirteen miles. The company expects to commence work at once and build the line as speedily as possible.

Work is being pushed on the new electric railway between Buffalo and Tonawanda. The cars can be thrown open as observation cars in summer or closed in winter and heated by electricity. Johnson girder rails are being used, and the construction work is in the hands of Woodbridge & Turner of New York.

The motors of the Westinghouse type that were removed from the ruins of the fire in the Second avenue Passenger Railway company's headquarters at Pittsburg were found to be uninjured and they will be placed in service again. The Westinghouse company announces that it has secured from the Second avenue company an order for a complete equipment of its lines.

All the motor men and conductors of the street car lines of Terre Haute, Ind., went on a strike November 21st. The conducters asked for an advance from eleven to fifteen cents an hour, and the motor men from twelve and a half to fifteen cents an hour, twelve hours a day. The company claims that the books do not show the earnings to be so good as when the men were led to believe that the wages would be increased.

Ordinances have been introduced in the common council of Baltimore authorizing the Central Railway company and the North Baltimore Passenger Railway company to use electricity as a motive power, and granting permission to the latter company to extend its tracks; also authorizing the Rapid Transit Railway company to construct a street railway to be operated by cable, pneumatic power, animal power, electricity or other method.

A writer in the *St. Louis Globe Democrat* has prepared a table showing the number of miles of street railroads operated by electricity in the principal cities of the country. According to his statement, St. Louis has more miles of electric railroads than any other city in the world. A total of 380 motor cars and 327 trailer cars forms the equipment of the seven roads which operate in that city. The table credits the following named cities with the largest equipments in the order named: (1) St. Louis, Mo., 154 miles; (2) Minneapolis, Minn., 138 miles; (3) Richmond, Va., 128 miles; (4) Cincinnati, O., 121 miles; (5) Cleveland, O., 103 miles; (6) Denver, Colo., 98 miles; (7) Newark, N. J., 87 miles; (8) St. Paul, Minn., 82 miles; (9) Los Angeles, Cal.,

TELEPHONE.

Long-[illegible] tralia, conversation having been held between Melbourne and [illegible] was carried on, [illegible] were distinctly heard in Melbourne, and vice versa. The instruments used at Melbourne were the Hunning, Berthon, Perliner [illegible] most effective."

TELEGRAPH.

According to a writer in the New York *Sun* Cyrus Field is one of the few Americans who have a standing acquaintance with Queen Victoria. Mr. Field's part in the laying of the early Atlantic cables obtained for him a presentation to the queen that meant rather more than such things usually mean [illegible] years ago has been kept up by occasional meetings and communications of one kind or another.

South American politics has caused many disappointments in commercial projects during the last year, including several of an electrical character. Commenting on this fact the New York *Sun* says: "Last year when the Brazilian republic seemed to be firmly established and when novel enterprises of all kinds were numerous there, a grand project was set up in Rio de Janeiro for the laying of a submarine cable across the South Atlantic ocean between the eastern coast of Brazil and the southwestern coast of Africa, to be followed by lines of commercial steamers between the ports of the two continents. But the many troubles of the new republic during the present year have caused this enterprise as well as many others to drop out of sight."

Mrs. Matilda Gragg, of St. Louis, has began a $5,000 damage suit in the Circuit Court against the Western Union Telegraph company, on account of alleged mental anguish undergone while awaiting the arrival of a delayed message. It appears that on October 5th last she received a telegram from Jonesboro, Ark., announcing that her son had been severely injured at that place in an accident. She states that she wired for additional information relative to his condition, but although a response was placed in the hands of the Western Union officials at Jonesboro on the 5th of October, it was not forwarded to her until the next day. In the meantime, she alleges that the suspense and disappointment that affected her was of such a character that it has permanently impaired her mind.

MISCELLANEOUS.

The *Age of Steel* of St. Louis is an excellent technical journal, and in its new dress it is now one of the handsomest in the country.

The city of Houston, Texas, is seeking bids for a complete electric fire alarm system to comprise 75 to 100 boxes. The bids are to be opened December 14th. Bidders are required to furnish their own specifications, and to have such rights to the use of the telegraph poles as the city may have. The work is to be done in six months.

Charles J. Hallywell of Red Wing, Minn., who recently announced the discovery on his farm of "a great natural storehouse of electricity," is credited by the daily papers throughout the country with several accounts of this "wonderful find" which bear striking evidence of romancing. Mr. Hallywell says that he was digging for water when he "struck" electricity. He had two professional well diggers drilling his well. They had bored about 150 feet down when their tools dropped and a great force of air came from the hole. The men said the hole was bottomless, but after awhile began to fish for their rod and drill. Fresh rods dropped into the hole, and the men claimed that they were violently shaken, and one man who took hold of a rod was knocked down.

At the annual meeting of the stockholders of the Pullman Palace Car company the issue of 50,000 shares of additional stock was authorized, thus increasing the capital stock 20 per cent. The additional stock is to be offered at par and stockholders will have the option to subscribe to an extent not exceeding one-fifth of their holdings of record on November 2d. The old board of directors and officers was re elected. The usual quarterly dividend of 2 per cent. was declared. The statement of the company for the fiscal year ending July 31st showed a gross revenue, $9,772,324, disbursements, $[illegible] surplus, $2[illegible] 223. Total assests of the company are $[illegible], total liabilities, $26,261,370. The output of the manufacturing department during the year amounted to $11,906,077; increase $2,890,544. The total number of persons in the employment of the company is 13,885 and the wages paid during the year amounted to $[illegible].

Statistics collected by the German government tend to prove, it is claimed, that the iron ships of to-day are not damaged so frequently by lightning as are wooden ships. The reason assigned by the commission which has had charge of the official investigation of the subject is that wire rope is used for rigging purposes and that the vessels are constructed of either iron or steel. In this way it is believed that the whole ship becomes a continuous conductor, leading the lightning to the sea before it can do much damage. The commission reports that no case has been recorded of a ship rigged with wire rope sustaining

damage from lightning except in a few instances where a continuous connection has not been made with the hull. Wooden ships, on the contrary, will show the same percentage of casualties as formerly when they are not fitted up with lightning rods.

TRADE NEWS.

The Warfield Manufacturing company, Baltimore, Md., is completing tests upon a new line of motors of higher power than it is at present manufacturing.

The Automatic Switch company, Baltimore, Md., is preparing a number of novelties which are to be placed on the market about January 1st. This concern states that southern trade is active.

The Ries Electric Specialty company, Baltimore, Md., found recently that it would be compelled to hire extra help and run the factory overtime in order to meet the demand for its specialty.

The Crocker-Wheeler Motor company on November 15th paid the stockholders a dividend of 5 per cent. A reserve fund was at the same time created, and the balance of the profits was set aside for this fund.

The Central Electric company, Chicago, has just received a large importation of steel pliers of standard sizes. The company has also received direct from Germany an importation of sal ammoniac.

The Baxter Electric Motor company, Baltimore, Md., has a number of large contracts on hand for street railway work. The outlook in this line of construction is unusually encouraging, especially in the vicinity of Baltimore.

The Chesapeake Belting company, Baltimore, Md., will be represented at Chicago, hereafter, by the Western Rubber & Belting company, 205 Lake street. G. H. Phillips has recently returned from an extended trip through the West.

The Imperial Electric company, 1222 Filbert street, Philadelphia, on account of the demand for its various supplies, has been obliged to largely increase the force at the factory. A number of novel articles will be put on the market in the near future.

The Viaduct Manufacturing company, Baltimore, Md., has recently placed on the market a new standard magneto bell which possesses many improvements over those previously manufactured by this company. The factory is now running overtime to keep up with orders.

Wright & Starr, Philadelphia, southern agents for the Waddell-Entz Electric company, report that the month's test of their storage batteries at Chester, Pa., has been most successful. Present indications point strongly toward the adoption of this system by the city railway company of Chester.

The Williams Engine Works, Baltimore, Md., are obliged, on account of the large increase in business, to move to a place where they will have more extended facilities for manufacturing. They have several locations in view, and expects to make a change by the first of the year.

W. L. Schloss, New York representative of T. H. Dallett & Co., Philadelphia, has received a contract from the New York Biscuit company for a 100 horse power Bilberg motor, a dynamo, and one standard double compound Triumph engine. This plant is to be equipped with the Hunter clutch couplings. The wiring will be for 1,000 lights.

Clay, Pepper & Register, electrical engineers, Philadelphia, have completed their line of new "C. P. & R" motors in sizes up to 5 horse power. Although none of these new machines have been offered for sale as yet, it is stated that a number of orders have been already received for them. They are now at work upon motors of larger capacity, which they will soon offer to the trade. They have received also a large number of contracts for their compound marine engine, which is still employed in connection with their patent boiler for use on yachts where the fuel is oil. This concern is now at work upon a 40 horse power engine, together with boiler for oil, to be sent to Jacksonville, Fla.

W. Le Conte Stevens, writing to Edward Weston, vice-president of the Weston Electrical Instrument company, [illegible] Weston standard voltmeter is held in very high esteem in Germany. At a lecture recently attended by him at the Polytechnic school in [illegible] a member of the testing commission at the recent Frankfort electrical exhibition, [illegible] Weston voltmeter to various [illegible] highest degree satisfactory. As [illegible] the magnet employed, [illegible] were not affected more [illegible] And to them [illegible]

[illegible]

foundry facings, gear grease, etc., and is rapidly building up a large trade. W. G. Wilmot has charge of the sales department.

BUSINESS.

The Electrical Construction company of Chicago has closed a contract for the complete electric light plant in the new Lexington hotel. The plant will consist of four 1,000 light machines.

J. L. Somoff, of 1 Ann street, New York, is introducing a number of novelties in the way of electrical scarfpins, cuff buttons, bracelets, etc., and has at present all the orders he can attend to. He is preparing a unique exhibit for the World's Fair.

Dougall & Cummings, 623 Phœnix building, Chicago, western representatives of the Electric Construction & Supply company, New York, report a large and increasing trade in "Ward" arc lamps. This firm represents the C. & C. Motor company, New York, and is making some fine sales of this motor.

Chas. E. Lee, manager of the western office of the Electric Gas Lighting company of 195 Devonshire street, Boston, reports a fine business in the Porter electric motor. This motor, although very small, is highly efficient and will operate small dental lathes, fans, egg beaters, music boxes, etc., with one cell of acid battery. Its rated power is about 1-32 horse power.

The Shultz Belting company of St. Louis, Mo. has just sold two woven leather link belts to the Citizens Electric Railway company of Decatur, Ill. It has also recently furnished fifteen in the state of Montana, five in the state of Washington, one flat belt, 48-inch double, to the Municipal Electric Light & Power company of St. Louis, which has been using one of the Shultz 48 inch double belts 19 months. The company also shipped one double belt to Clinton, Mass., 30 inches wide and 175 feet long, and one 36 inches wide and 210 feet long.

The Central Electric company, Chicago, has again added to its quarters, being obliged to secure increased storage capacity for its stock. The large line this company handles, which includes appliances for all kinds of electrical work, necessitates carrying a very large stock, and the business has increased very handsomely during what has been called "dull times." This company, which is always in the front rank of progress, has recently put in a large stock of electric light carbons. The sales of okonite wire have been larger than ever before, and the Swan incandescent lamp, for which this company is general western agent, has obtained a popularity that is also deserving of mention. The branch houses of this company, viz.: Southern Electrical Supply company of St. Louis; Gate City Electric company of Kansas City; Western Electrical Supply company of Omaha and the Electric Power Transmission company of Denver, are doing a thriving business.

Through the courtesy of J. C. English, secretary of the Bridgeport Electric Light company, a representative of the WESTERN ELECTRICIAN was recently permitted to inspect the company's model station. That this concern has pleased a community as exacting as Bridgeport is known to be, shows that it has fulfilled the original promises in regard to maintaining a first-class plant. The company is, at present, making several changes in its building to provide additional accommodations. The company now has in mind a number of important ventures for the coming year, and the dividends show that it can afford to consider improvements. As the company was not fully satisfied with the switches, sockets, etc., which it had in use, a company was formed, known as the Union Electric Manufacturing company, with Mr. English as secretary and general manager. But it was not anticipated that the business would grow to the proportions it has now attained in so short a time. The company has a large number of orders for future delivery and the indications are that it will have to increase its facilities in order to supply the increasing demand.

ELECTRICAL PATENTS.

Issued Dec. 1, 1891.

464,001. Telegraph Repeater. Richard L. Atkinson, Delaware Township, N. J.

464,002. Electric Brake. La Motte C. Atwood, St. Louis, Mo.

464,005. Treating Filaments for Incandescent Electric Lamps. James Bradley, Massillon, Ohio.

464,022. Splice for Electric Conductors. Willard J. Hield, Minneapolis, Minn.

464,025. Potential Indicator. Carl E. Kammeyer, Eau Claire, Wis.

[illegible] quoted:
"[illegible] combination of an electric generator with translating [illegible] with each other, a circuit closer, and connect[illegible] either one of them may be short-circuited, and [illegible] change in the current delivered."

[illegible] Transformer and Armature Core. Carl E. Kammeyer, Eau Claire, Wis.

[illegible]
[illegible] core, consisting of a [illegible] of plates, said [illegible] permanently flexible insulating coat of [illegible] applied permanently to the plates, which [illegible]

[illegible] Field Magnet for Dynamos or Motors. Carl E. Kammeyer, Eau Claire, Wis.

[illegible] Lineman's [illegible] John McIsaac, Malden, Mass.

[illegible] Electric Heater. Parvin Wright, Denver, Colo.

464,063. Electric Motor. Martin H. Collom, Denver, Colo.

464,067. Automatic Salesman. Matthew H. Foster, Haverhill, Mass.

464,090. Electric Apparatus for Use on Railway Trains. Rufus A. Wilder, Cressona, Pa.

464,096. Apparatus for Obtaining Metals of the Alkalies from Molten Chloride. Ludwig Gradau, Hanover, Germany.

464,125. Method of Testing Insulated Wires. Richard Varley, Jr., Englewood, N. J.

464,129. Crossing for Trolley Wires. Robert M. Jones, Salt Lake City, Utah.

464,132. Electric Arc Lamp. William A. Nicholson, New York, N. Y.

464,133. Relay. Richard Varley, Jr., Englewood, N. J.

464,134. Electric Circuit Closer. Richard Varley, Jr., Englewood, N. J.

464,136. Electric Regulator. Charles W. Holtzer and George E. Cabot, Brookline, Mass.

464,152. Electric Transmitting Telephone. Rudolf Eickemeyer, Yonkers, N. Y.

464,156. Electrical Generator. Victor Hirbec, Paris, France.

464,198. Electro Magnet. Olof E. Lundstedt, Brooklyn N. Y.

This invention consists of an encircling frame of soft iron, centrally pivoted to allow the end plates of the frame to swing in unison from opposite directions over the poles of the magnet.

464,216. Armature for Dynamos and Electric Motors. St. John V. Day, St Louis, Mo.

This invention consists of an armature so mounted upon a shaft that one end is fast and the other loose, thus permitting longitudinal expansion and contraction.

464,231. Electric Motor. John R. Robinson, Salem, Mass.

464,244. Electric Fire Engine. Mark W. Dewey, Syracuse, N. Y.

464,245. Electric Hose Carriage. Mark W. Dewey, Syracuse, N. Y.

464,246. Electrically Propelled Vehicle. Mark W. Dewey, Syracuse, N. Y.

464,247. Electric Heating Apparatus. Mark W. Dewey, Syracuse, N. Y.

464,248. Electrically Propelled Vehicle. Mark W. Dewey, Syracuse, N. Y.

464,253. Car Truck. Edgar Peckham, Kingston, N. Y.

464,256. Watchman's Electric Recorder. Harvey Redding, Everett, Mass.

464,298. Electric Wire Support. Richard Ellison, Cincinnati, O.

464,299. Electric Motor. Herman A. Florian, Detroit, Mich.

464,342. Method of and Apparatus for the Propulsion of Trains. John B. Mahana, Freewater, Ore.

The method described of generating and storing electricity consists in generating electricity by the rotation of the car wheels on the down grade, storing such electricity and overcoming the resistance to the forward motion by using the power of a prime motor in addition to the momentum of the train on the down grade.

464,347. Magneto Electric Igniter for Combustible Vapor Engines. Leonidas G. Woolley, Grand Rapids, Mich.

464,367. Insulating Composition. Smith W. Kimble, Denver, Colo.

This invention is a compound of pulverized mica, silicate of soda and a mineral substance, as talc free from lime, combined and moulded under pressure.

464,368. Insulating Support for Electrical Apparatus. Smith W. Kimble, Denver, Colo.

464,369. Composition of Matter for Insulating Purposes, etc. Smith W. Kimble, Denver, Colo.

464,370. Trolley Wheel for Electric Railways. Smith W. Kimble, Denver, Colo.

464,371. Trolley Wire Hanger. Smith W. Kimble, Denver, Colo.

464,411. Hanger for Trolley Wires. Thomas E. Adams, Cleveland, O.

Claim sixteen reads:
"In an insulator, the combination, with a metallic shell and a shank therein, and insulated therefrom, of a canopy removably secured in said shell."

464,452. Controller for Elevators. John H. Clark, Boston, Mass.

464,470. Electric Elevator. William Baxter, Jr., Baltimore, Md.

464,475. Joint for Electric Conductors. Henry W. Fisher, Pittsburg, Pa.

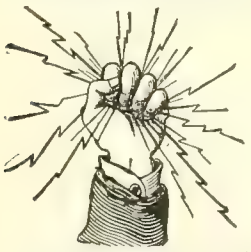
The joint for uniting the adjacent ends of metal-armored conductors is made by casting around the ends a hollow metal joint, the metal of the joint fusing and igniting with the metal armor of the conductors and forming an integral part with the adjacent sections.

Re-issue. 11,207. Open Circuit Battery. John F. Wollensak and William E. Gill, Chicago, Ill.

The first claim reads:
"In open circuit batteries the combination of a cup having holes through its sides, a carbon stick having a hole in a position and direction to be brought into a line with the holes in the cup and a pin passing through the holes in the cup and stick.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS.



PROVIDENCE, R. I.

Manufacturers of Patent Finished

ELECTRIC LIGHT WIRE,

Magnet Wire, Office and Annunciator Wire, Rubber Covered Wire, Lead Encased Wire, Telephone and Incandescent Cords.

FARADAY CABLES.

New York Office, 10 Cortlandt Street,

P. C. ACKERMAN, Agent.

ESTABLISHED 1848.

HEMINGRAY GLASS CO.,

Offices, Covington, Ky. Factories, Muncie, Ind.

STANDARD SCREW GLASS INSULATORS,

Glass Break Knobs, Floor Insulators, Battery Jars.

ARC LIGHT GLOBES FOR ALL SYSTEMS.

WORK ON SPECIAL DESIGNS SOLICITED.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack [illegible] weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, [illegible] have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very [illegible] durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made [illegible] to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, [illegible] and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE. and our [illegible] other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.

HERBERT H. EUSTIS, President and Electrician.

43 and 45 Franklin St. — CHICAGO.

For Sale Cheap, Second-hand Machinery, Arc and Incandescent. Also Motors. All Apparatus Guaranteed.

The Electrical Construction Co.

OFFICE DESKS,

"Gem" and "Rugby" Folding Beds. Brass and Wire Work.

A. H. Andrews & Co., 215 Wabash Ave., Chicago.

H. T. PAISTE,

MANUFACTURER OF

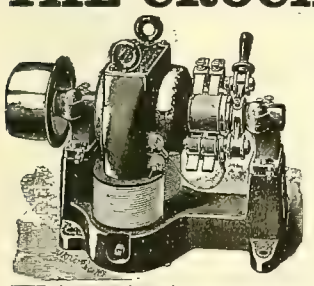
SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill — 10 So. 18th St., Philadelphia, Pa.

See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

Acknowledged by the Leading Manufacturing Companies to be

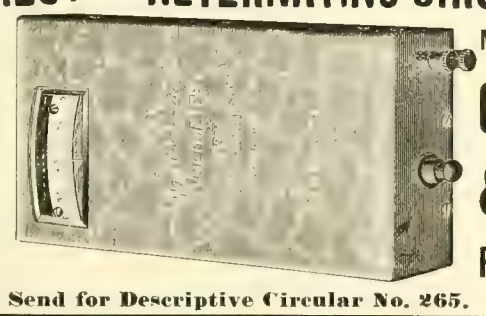
THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK

FOR DIRECT AND ALTERNATING CIRCUITS.

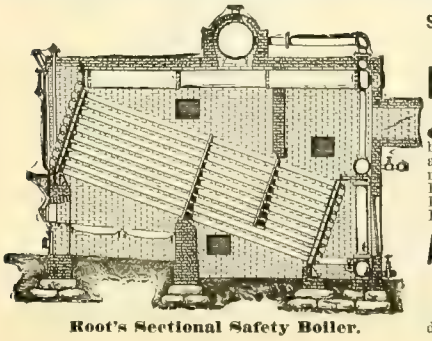
The WAGNER-QUEEN Portable Voltmeter.



Made by QUEEN & CO., PHILA.

Send for Descriptive Circular No. 265.

ROOT'S WATER-TUBE BOILER.



Root's Sectional Safety Boiler.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

Electric Plant Boiler.

Adopted by the **Electric Light Companies** of Detroit, St. Paul, Columbus, Cincinnati, Louisville, Jersey City and a great many others; also by the Armington & Sims Engine Co., Providence, R. I.; the Lynn Belt Line Street Ry. Co., Lynn, Mass. and the Thomson-Houston Electric Co., Lynn, Mass.

Abendroth & Root Mfg. Co.,

28 Cliff St., New York.

BRANCHES: Chicago, Boston, Philadelphia, Dallas, Rochester.

The Winner of 1890 will win again in 1891 Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY.

85 John St., NEW YORK

BINDERS

For the WESTERN ELECTRICIAN,

—$1.00—

MICA

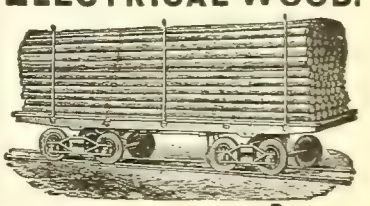
ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,

218 Water St., New York.

ELECTRICAL WOOD.



Telegraph, Telephone, Electric Light — CROSS ARMS — POLES

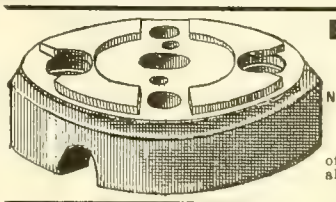
OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, **Rods, Tubing, Washers, Discs** and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

TO MAKE A STATION PAY

Buy only the best quality of goods. This you can do by sending your orders to us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR

National Alternating and Direct Current Dynamos, Generators and Transformers; Packard High Grade Lamps; Eddy Motors; "Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

931 Rookery, CHICAGO. 134 E. 6th St., opp. Hotel Ryan, ST. PAUL. 409 W. Michigan St., DULUTH.

SEND FOR CATALOGUE AND DISCOUNT SHEETS.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

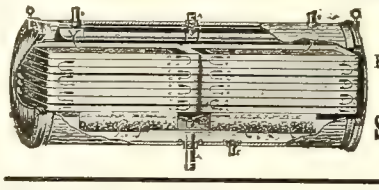
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

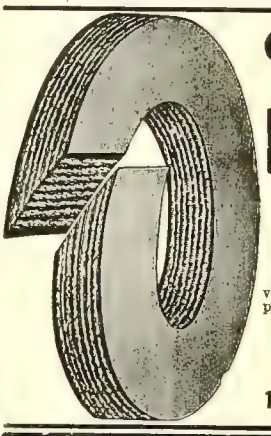
STILWELL & BIERCE MFG. CO.,

DAYTON, OHIO.

NOW THEN! FOR SALE CHEAP!!

Six 400 light Thomson-Houston Incandescent Dynamos, 110 volts. Perfect order.
Three 25 light 2,000 candle power American Arc Dynamos. A 1 order.
Two 50 light 2,000 candle power Sperry Arc Dynamos. A 1 order.
700 Goose Necks, Sockets, Lamps, etc., complete, good.
50 miles No. 10 American Electric Co. Wire, good order, used one year. In ¼ mile reels.
Two 400 light Thomson-Houston New Armatures.
70 American Single Carbon 2,000 candle power Arc Lamps. A 1 order.
Two 70 H. P., 700 volts, Edison Generators, used six months.
Ten 5 H. P. Sprague Motors, used six months.
Two Edison Electric Mining Rock Drills, used six months.
High Speed Engines and Full Station Equipments, Poles, etc.
Eighty 2,000 candle power American Double Carbon Arc Lamps, used three months.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.



GIVEN AWAY!!

SAMPLE ORDERS OF

Buxton's Packing

At Only 50c. Per Pound.

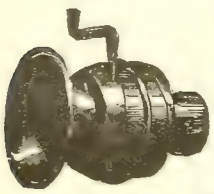
"The Engineer's Favorite."
All Orders Guaranteed.

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

ESTABLISHED 1882.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.



SPEAKING TUBES AND WHISTLES.

Oral, Electric, Pneumatic and Mechanical

ANNUNCIATORS AND BELLS.

FULL LINE ALWAYS IN STOCK.

W. B. OSTRANDER & CO.,

195 and 197 Fulton St., New York.

Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.

☞ Send for NEW CATALOGUE. Out August 1st.

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.

FITCHBURG, MASS, U.S.A.

MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.

ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

You Will Oblige

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers.

A GREAT RAILROAD.

By the absorption of the Chicago & Atlantic Railway between Marion and Chicago, the ERIE has at last effected its entrance into Chicago, and now occupies the proud position of being the only line between Chicago and New York entirely under one management.

One result of this is the arrangement whereby all the through trains of the Erie are now run solid between Chicago and New York without change. Passengers holding through tickets, whether first or second class, are able to go from Chicago to New York without changing cars.

Pullman's most modern Sleeping Cars are run on all through trains via this line, and on their Western Limited, Pullman's Dining Cars. No extra fare charged on this train. In fact, the rates via the ERIE are lower than via any other route offering equal facilities.

Manufacturers of

OCTAGONAL AND CEDAR TELEPHONE & ELECTRICAL RAILWAY POLES & CROSS ARMS

THE H. M. LOUD & SONS LUMBER CO.

OSCODA, MICH.

ELECTRIC LIGHT AND BATTERY

CARBONS.

THE NATIONAL CARBON CO.

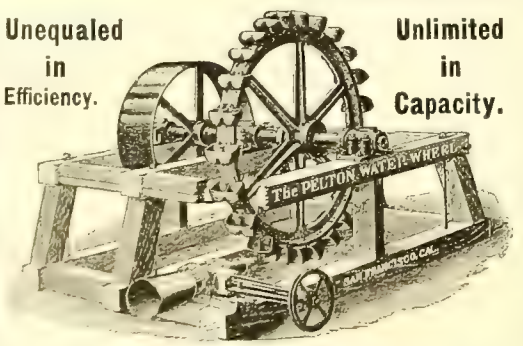
CLEVELAND, OHIO.

MOTOR BRUSHES.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 20 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,

121-123 Main St., San Francisco, Cal., U. S. A.

143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

"BE YE THE JUDGE."

HAVE YOU TRIED THE

ECONOMIC INCANDESCENT LAMP?

If not you are losing time and we are losing a customer. Everybody that *tries it, BUYS IT*, and everybody that buys it once, *buys it again.* Kindly inform us what voltage and style of base you use and *TRY IT AT OUR EXPENSE.*

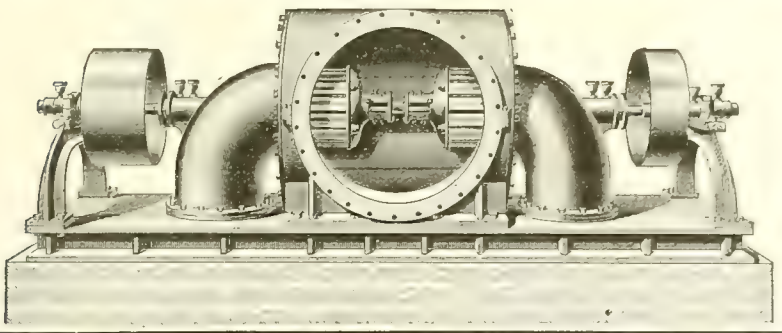
NORTHWESTERN ELECTRICAL SPECIALTY CO.,

GENERAL WESTERN AGENTS,

CEO. L. KIRKHAM, Manager.

1017 Chamber of Commerce, CHICAGO.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC [illegible] CLLE.
BRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** and **large Capacity** [illegible] diameter, being **double** the **Power** [illegible] by a number of the leading [illegible] economical use of water it is [illegible] of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents [illegible] VICTOR **TURBINES** arranged on a [illegible] Tubes, End Bearings for Shaft and Driving Pulley [illegible] a substantial cast-iron bed plate. The entire [illegible] strictly first-class in every particular. We are [illegible] Turbines, either single or in pairs or [illegible] admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO., RAVENNA, OHIO. MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. **136 Liberty St.,** NEW YORK.

WANTED.

A young business man to take interest in valuable Electric Specialty. Must have $2,000 and give his time to the business. Address,

Chicago Inventor,
Care WESTERN ELECTRICIAN.

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

HARRISON CONVEYOR

FOR HANDLING
GRAIN, COAL, TAN BARK, SEEDS, ETC.

Will convey all kinds of grain without mixing. Will carry two different kinds of material in opposite directions at the same time.

Will convey One-Hundred and Fifty Tons of Coal per hour. Made of Wrought Iron and Steel. Send for Illustrated Catalogue. **BORDEN & SELLECK COMPANY, 48 and 50 Lake St., Chicago, Ill.**

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

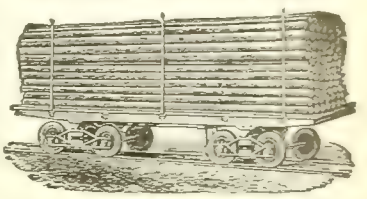
ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF
HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

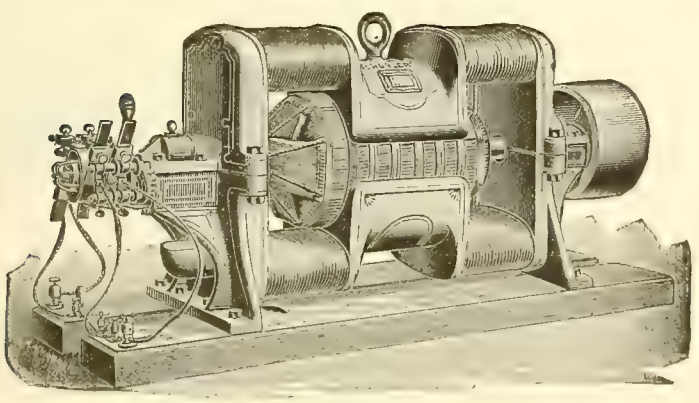
FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

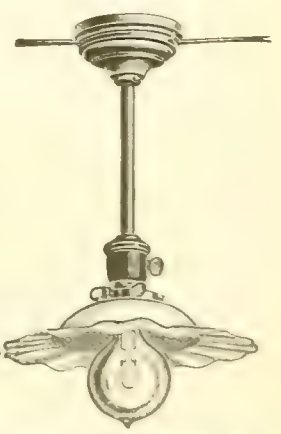
MIDDLETOWN, CONN.

BERNSTEIN ELECTRIC CO.

INCANDESCENT LAMPS

-FOR-

ARC LIGHT CIRCUITS.



SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.

620 ATLANTIC AVENUE,
BOSTON, - MASS.

TESTING

OF INSULATED WIRES AND CABLES.

A New Book Just Published.

A Practical Guide to the Testing of Electric Light, Electric Railway, Telephone and Telegraph Wires.

PRICE, POSTAGE PREPAID, $1.00.
SEND IN YOUR ORDER NOW.

ELECTRICIAN PUBLISHING COMPANY,

6 Lakeside Building, CHICAGO.

C. & C. ELECTRIC MOTORS and DYNAMOS.

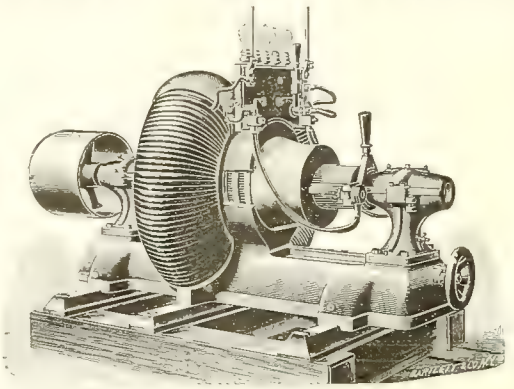
ELECTRIC MOTORS in all standard sizes, up to and including 100 H. P., for operating elevators, pumps, printing presses, and machinery for general manufacturing purposes.

POWER GENERATORS.

ELECTRIC MINING MACHINERY of all kinds, Hoists, Tram Cars, etc.

FAN OUTFITS. Electric Plants for pumping Church Organs.

We call the special attention of Station Superintendents to the fact that our machines are absolutely unsurpassed for economy of electric current.

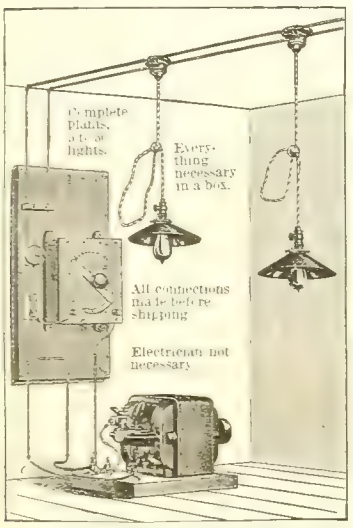


DYNAMOS for isolated plants and the equipment of Mills, Banks and Office Buildings with Electric Lights.

ELECTRIC BLOWERS for ship ventilation. Have equipped 18 U. S. and foreign War Ships with ventilating apparatus.

NEW ENGLAND Office, 63 Oliver St., BOSTON.
PHILADELPHIA Office, 38 S. Fourth St.
CHICAGO Office, - Phenix Building.
SAN FRANCISCO Office, - 35 Market St.
ST. LOUIS Office, - - 421 Olive St.
NEW ORLEANS Office, 78 Customhouse St

THE C. & C. ELECTRIC MOTOR CO., 402-404 Greenwich Street, NEW YORK.



You can	Lights	Thoroughly		Send
Put	Are Standard	Reliable	Prices	For
It up	And	And	Reasonable.	Illustrated
Yourself.	Full size.	Practical.		Pamphlet.

BAIN ELECTRIC MANUFACTURING CO.,

47 So. JEFFERSON STREET,

CHICAGO.

SAWYER-MAN ELECTRIC CO.,

BOSTON, 620 Atlantic Avenue.
NEW YORK, 510-534 West 23d Street.
CHICAGO, 217 La Salle Street.

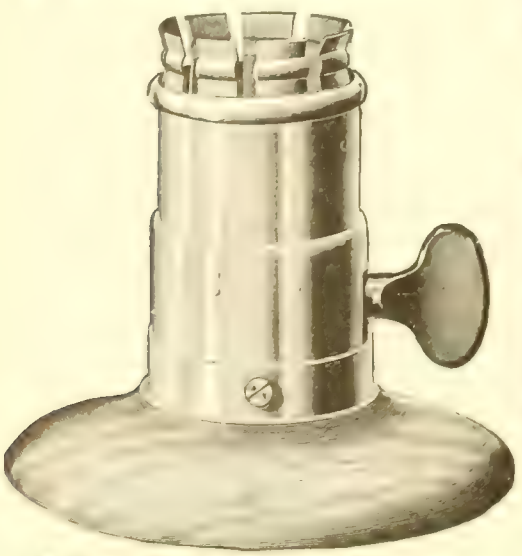
No. 135. All Porcelain Keyless Wall Socket.

INCANDESCENT LAMPS.

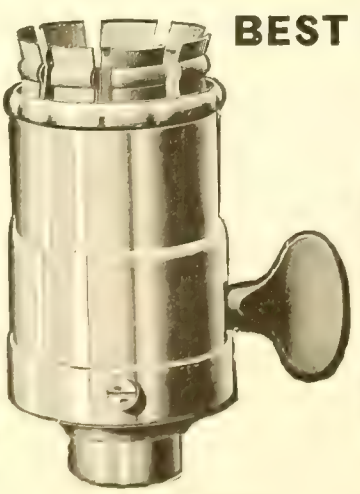
Orders Executed Correctly and Promptly.

SOCKETS.

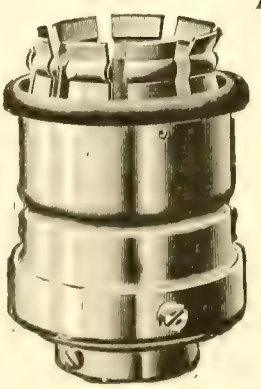
BEST AND CHEAPEST.



No. 125. Key Wall Socket—Porcelain or Wood Base.



No. 110. Key Socket.



No. 120. Keyless ¾ inch Socket.

ALSO—

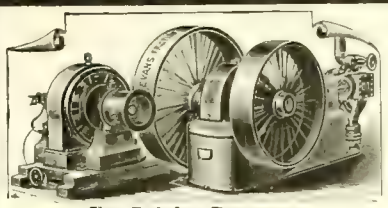
No. 115. Keyless Socket, 1-8 in.

No. 130. Keyless Wall Socket—Porcelain or Wood Base.

No. 145. Keyless Socket for 75, 100 and 150 c. p. Lamps.

No. 150. Waterproof Socket.

No. 140. Attachment Plug, with Fuses.

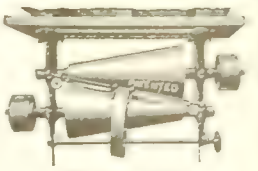


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones, For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

EVERYTHING IN

WIRE—FUSE— STRIPS.

MANUFACTURED BY

The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY

MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

ELECTRICAL INSTRUMENTS

RECALIBRATED.—REPAIRED.

CHICAGO ELECTRIC MFG. CO., 73 W. Jackson St.

H. WARD LEONARD & COMPANY.

Secure bid from us for Electrical Apparatus or Construction before deciding. Railways, Lighting, Transmission of Power, Wiring, etc.

Electrical Exchange Building,
NEW YORK CITY.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

A NEW BOOK!

NOW READY.

ELECTRIC TRANSMISSION HAND-BOOK.

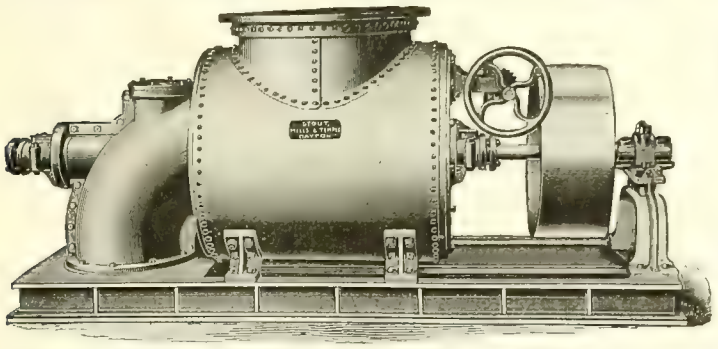
Lieut. F. B. Badt's latest addition to our famous hand-book series, of which 20,000 copies have been sold. The new book deals in the author's well-known practical style with all the problems of Electric Power Transmission.

NOW READY. PRICE. $1.00.

ELECTRICIAN PUBLISHING CO.,

6 LAKESIDE BUILDING, CHICAGO.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS.

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shafts.

THE DAYTON GLOBE IRON WORKS CO,

SUCCESSORS TO STOUT, MILLS & TEMPLE, DAYTON, O.

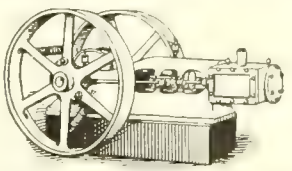
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

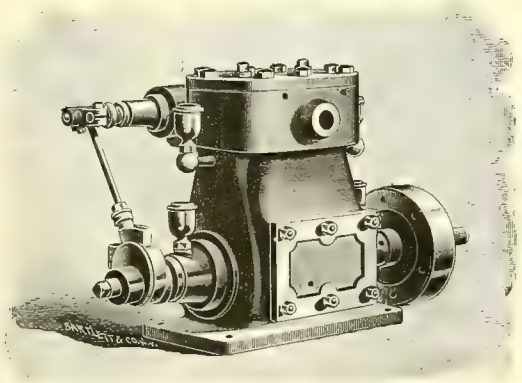


WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 447 North Street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Binders FOR THE Western Electrician $1.00.

WESTINGHOUSE ENGINES



THE ORIGINAL WESTINGHOUSE ENGINE,

BUILT A. D. 1880.

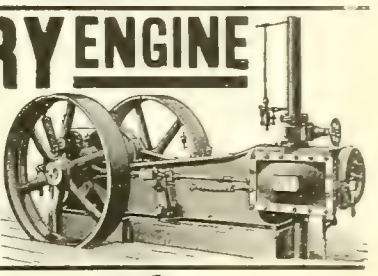
SIZE 3x3. 1,000 REVOLUTIONS.

Now preserved in the Offices of the Company, Pittsburgh, Pa.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH. PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
Catalogue sent on application.



STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg.
San Francisco, 29 & 31 Spear St.

FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. HALF TONE PLATE SPECIALTY CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.
ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC.

All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,
78-80-82 Franklin Street,
CHICAGO.

MAIN OFFICE,
649 and 651 Broadway,
New York.

Geo. H. Meeker,
Western Manager.

NEW YORK INSULATED WIRE CO. NEW YORK MOISTURE-PROOF VULCA ELECTRICAL WIRE-DUCT NON-INFLAMMABLE TRADE MARK
AND CHICAGO.

DID YOU SEE IT
AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.

THE

CRESCENT DRY BATTERY.

IT
Is Smaller Than Any Other.
Has Great Strength.
Has Great Durability and Recuperative Powers.
Is Not Subject to Freezing.
Does Not Evaporate.
Is the Best Battery on the Market.

THOUSANDS IN USE.

We want every Bell Hanger and Construction Man to send us his name on a postal card. It will pay him to do so.

Perkins' Incandescent Lamps

Never Disappoint You.

THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS AND DEALERS,

54 and 56 Franklin Street,

CHICAGO, ILL.

THE DENVER CONSOLIDATED ELECTRIC COMPANY
GENERAL OFFICE
1737 CHAMPA STREET
DENVER, COLO. Nov 27" 189 /

Mr Chas Wirt -
Elect Supply Co
Chicago Ill
Dear Sir:
I am so much pleased with the trial set of your new Commutator brush, sent us by your Company, that I take this opportunity of informing you, thinking you might be interested in knowing the result. I gave it the most severe test I knew of - placing them on a Commutator where even Carbon Brushes were not successful in reducing the Sparking, where there was a very heavy current at high potential, with a constant "chewing" up of the copper. Your brush has eliminated all trouble and I have asked our Company to order a number of them when I shall use them on other of our dynamos -
Yours Truly
W. A. Sterling
Electrician
P.S. Should be pleased to receive some information relative to your new Rheostat, the principle on which it works, etc -

The Wirt Dynamo Brush was designed with the intention of combining the good qualities of CARBON and COPPER brushes. It has accomplished this effectively. *Sparking*, with its attendant wear and damage to the commutator, has been almost entirely eliminated.

The Resistance Metal in these brushes is something new in electrical art, and has a resistance about fifty times that of copper, or three times the resistance of German silver. It is used in sheets as thin as letter paper, the result being great flexibility, producing smooth running, and as the contact on each successive commutator bar is made first with this high resistance metal, and broken also on the high resistance metal, the destructive short circuiting currents which cause the vicious sparking sometimes seen on commutators is almost entirely prevented. At the same time there is sufficient pure copper in the middle of the brush to carry the main current to the brush holder without undue heating.

We invite correspondence from those who have dynamos which are at all troublesome at the brushes. The Wirt Brushes are somewhat higher in first cost than plain copper brushes, but they will pay for themselves many times over in saving of labor and commutator copper.

These brushes are manufactured to order, and can be furnished on short notice. When ordering please give dimensions of brushes in use.

The Electrical Supply Co.,

WESTERN OFFICE AND WAREHOUSES
Cor. Randolph St. and Michigan Ave.,
CHICAGO.

Eastern Office and Factories
Ansonia, Conn.

Enclose Business Card for Illustrated Catalogues.

Cincinnati, Sept., 24, 1891.

W. D. Packard, Sec'y,

New York & Ohio Co.,

Warren, Ohio.

Dear Sir:-

In response to your inquiry as to how we like your lamps, will say, that they are giving excellent satisfaction, both as to brilliancy and long life. Recently our Mr. Cook, Supt. Brush Station, forwarded to me the following test, namely:- Thirteen lamps in test, each averaging 2,934 hours, lowest life 1,868 hours, highest 4,696 hours.

Hoping this will give you the data wanted and you will continue to improve your lamps, not forgetting, however, that price must improve with quality; that is, the better the lamp, the lower the price.

Very Respectfully
C. F. Hesser Vice Pres't

NEW YORK & OHIO CO., - Warren, Ohio.

AGENTS.

J. W. PEALE, 1 Broadway, New York.
THE E. E. & S. CO., 931 Rookery, Chicago; St. Paul and Duluth.
ELECTRIC ENG. & SUPPLY CO., Syracuse, N. Y.
ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

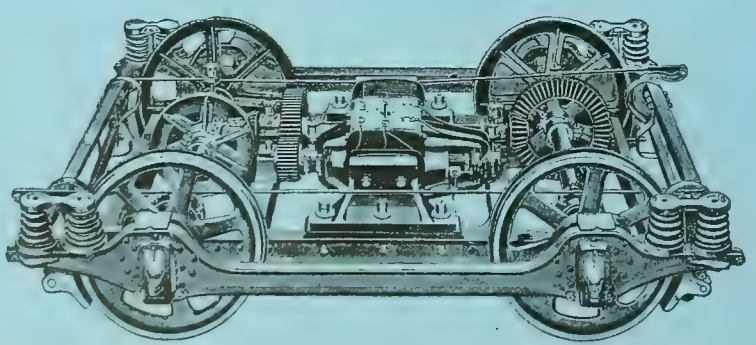
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

ONE MOTOR DRIVING BOTH AXLES

Of a street car, is the same principle as having all driving wheels of a locomotive connected, which is the AMERICAN SYSTEM.

Sizes: 15, 30 and 40 Mechanical Horse Power.



One Heat Proof Motor, Driving Both Axles.

This cut represents the latest construction of our Standard Apparatus equipped with our HEAT PROOF MOTOR. Attention is invited to the work being done by these equipments on the Merrimac Valley Street Railway, Lawrence, Mass.; Consolidated Street Railway Company, Grand Rapids, Mich.; and the People's Electric Street Railway, Springfield, Ill.; where, in each place, the two largest electric companies have put their latest equipments against them, with the result of proving our claims and strengthening the advantages derived from utilizing the full traction of the car, and driving all wheels simultaneously.

PATENTEES AND SOLE MANUFACTURERS:

DETROIT ELECTRICAL WORKS,

DETROIT, MICH., U. S. A.

A'so Manufacturers of Electrical Power Machinery, Standard Line Appliances and General Electrical Supplies.

CORRESPONDENCE INVITED.

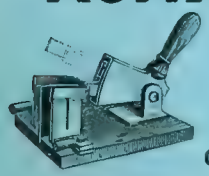
Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy

Vol. IX. CHICAGO, DECEMBER 19, 1891. No. 25

"AJAX"

DEFIES SHORT CIRCUITS.



ANY CAPACITY UP TO 1,000 HORSE POWER.

C. S. VAN NUIS, 136 Liberty St., New York.

The Minnesota Brush Electric Company

HAVE JUST BOUGHT

82½ MILES

of Arc, Incandescent and Power Cables

INVESTIGATION PROVED IT THE BEST.

OF THE Standard Underground Cable Co., New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAYS KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a centuary. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.

ALL SIZES *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

WILLIAM H. ECKERT, Gen'l Agent, 16 Dey St., NEW YORK.

Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,

20 CORTLANDT ST., NEW YORK.

GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET, "A.B.C."

WRITE US FOR PRICES OF ALL GOODS

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,

MANUFACTURERS, IMPORTERS AND DEALERS IN

THE "CHAMPION" BATTERY,

Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.

THE TRADE WILL BE PROPERLY PROTECTED.

Rod Zinc of Champion Battery.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery.

Electrical Supplies

Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

PACKARD HIGH GRADE INCANDESCENT LAMPS

Manufactured by the

NEW YORK & OHIO COMPANY, Warren, Ohio.

AGENTS: J. W. PEALE, 1 Broadway, NEW YORK. ELECTRIC ENG. & SUPPLY CO., SYRACUSE, N.Y. ELECTRICAL ENG. & SUPPLY CO., 931 Rookery, CHICAGO, and ST. PAUL. ST. LOUIS ELECTRICAL SUPPLY CO., ST. LOUIS.

E. E. KELLER. F. E. DEGENHARDT

Keller & Degenhardt, ELECTRICAL ENGINEERS,

542 Rookery Bldg., Chicago, Ill.

THE ONLY BUREAU OF ELECTRICAL INFORMATION IN THE WORLD'S FAIR CITY.

WILLARD L. CANDEE, H. DURANT CHEEVER, Business Managers.

The International OKONITE COMPANY, LIMITED.

13 Park Row, New York.

OKONITE TRADE MARK

INSULATED WIRES AND CABLES,

For Aerial, Submarine and Underground Use.

Candee Aerial Wires.

Manson Protecting Tape.

Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

WRITE FOR PRICES ON

TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.

R. D. Nuttall Company,

Allegheny, Pa. New York.

THE 1891 ELECTRIC MOTOR AND BATTERY.

SIMPLE. DURABLE. ECONOMICAL. EFFICIENT.

For Offices, Sick-rooms, Restaurants, Jewelers, Dentists, Confectioners, Amateurs, and at

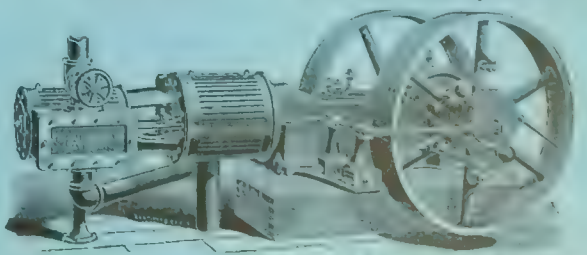
ONE-HALF PRICE.

Send for prices and descriptive pamphlets to

1891 MOTOR---8 Oliver Street, BOSTON, MASS.

IMPROVED BALL ENGINES,

BUILT BY THE BALL & WOOD CO., NEW YORK.



AGENTS: W. B. [illegible] & Co., [illegible] Thos. G. [illegible] W. A. Day, [illegible] Oliver St., Boston, Mass. A. M. Morse & Co., [illegible] Mead & Str[illegible] Hyde Bros. & Co., [illegible] Pittsburg, Pa.

The Thomson-Houston ELECTRIC CO.,

MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co ...—
Alexander, Barney & Chapin.....i
American Desk & Seating Co.....xv
American Electrical Works.....xiii
Andrews & Co., A. H..... ...—
Baggot, E xiv
Bain Electric Mfg. Co..... xvi
Ball Engine Co.....xix
Ball & Wood Co., The i
Beckerleg, Jas. G..... xii
Beggs, J. E., Mfg. & Supply Co.xvi
Bernstein Electric Co.....—
Braun Illustrating Co xix
Brownlee & Co..... xii
Brookfield, Wm..... xii
Brush Electric Co xvii
Butler Hard Rubber Co.....—
Buxton, Geo. B xiv
C. B. & Q. R. R..... xix
C. & E. R. R.....xiv
C. & C. Electric Motor Co.... xvi
Central Electric Co..... ... v
Chicago Electric Mfg. Co xiii
Chicago Electric Motor Co.....xiii
Chicago Insulated Wire Co xvii
Colburn Electric Mfg. Co xiv
Consol. Elec. Mfg. Co., The...—
Crocker-Wheeler Elec. Mo. Co..xiii
Day's Kerite Insulation.....i
Dayton Globe Iron Works Co..xix
Delaware Hard Fibre Co..... xiv
Detroit Electrical Works.....xxiv
Densmore Typewriter Co..... xii
Eastern Electric Cable Co.....xiii
Easton Electric Co..... xvi
Edison General Electric Co..... vi
Edison General Electric Co., Cable and Wire Department..... vi
Electric Construction & Sup. Co..viii
Electric Merchandise Co..... x
Electric Secret Service Co..... x
Electrician Pub. Co.....—
Elec. Construction Co., The.....xiii
Elec. Eng. & Sup. Co., The.... viii
Elec. Supply & Contracting Co..xiv
Electrical Supply Co., The... xxii
Elektron Mfg. Co.....xviii
Empire China Works..... ..xvi
Evans Friction Cone Co.....xvii
For Sale..... xvi
Foster, O. A..... i
Fort Wayne Electric Co..... xxiv
Gleason & Bailey Mfg. Co. Ltd. . x
Globe Carbon Co.... xv
Great Western Elec. Supply Co.. ix
Greeley & Co., The E. S.....i
Goodrich-Coleman Elec. Wks.. xvii
Heisler Electric Co.....xv
Hemingray Glass Co xiii
Hill Clutch Works.....xviii
Hirlimann, C. J xviii
Hine Eliminator Co.....—
Holmes, C. H xiii
Holmes, Booth & Haydens.... xviii
India Rubber & Gutta Percha Insulating Co..... xxiii
Interior Conduit & Insulation Co.. x
International Okonite Co..... i
Kartavert Mfg. Co..... xvi
Keller & Degenhardt..... i
Knapp Electrical Works xxi
Law Telephone Co xiii
Leonard & Co., H. Ward xvii
Link Belt Machinery Co.....xv
Loud, H. M. & Sons Lumber Co..xiv
Milliken Bros. xvii
Monitor Electric Co..... x
Mosher Arc Lamp Co.....—
Munsell & Co., Eugene.....xiii
Murphy, T. J..... xv
National Carbon Co.....xiv
National Electric Mfg. Co ..... —
N. Y. Belting & Packing Co....—
New York Insulated Wire Co .. xvi
New York & Ohio Co..... i
N. W. Elec. Specialty Co.....—
Nuttall Company, R. D..... i
Ostrander & Co., W. R x
Paiste, H. T..... xiii
Page Belting Co..... x
Partrick & Carter Co.....—
Payne & Co., Geo. W .....—
Pearson & Co., W. B.....xix
Pelton Water Wheel Co.....xiv
Phoenix Glass Co.....xviii
Pond Engineering Co xix
Powell Co., The Wm.....—
Pumpelly, J. K..... xiii
Queen & Co..... ... xiii
Ries Elec. Specialty Co., The... x
Rockford Electric Mfg. Co..... xii
Royal Electric Co.....—
Samson Cordage Works. xii
Sargent & Lundy..... xiii
Sawyer-Man Electric Co.....xi
Schawel & Co., Jas..... xii
Schieren & Co. Chas. A..... xii
Schoonmaker, A. O xii
Schuyler Electric Co..... xv
Security Insulator Co..... ix
Short Electric Railway Co xii
Shultz Belting Co.....xviii
Sperry Elec. Mining Mach. Co. xvii
Sprague, Duncan & Hutchinson, Ltd..... ix
Standard Underground Cable Co....i
Stanley Electric Mfg. Co..... xxiii
Star Electrix Co..... xiv
Stearns Mfg. Co.....xix
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co..... ix
Taussig, S... .....—
Temple, J. C..... xv
Thomson-Houston Elec. Co. ii, xx
Union Electric Mfg. Co., The..—
Union Electric Works..... xii
Union Hardware Co..... .. xii
U. S. Electric Lighting Co.....xi
Van Nuis C. S..... i
Vulcanized Fibre Co..... xv
Wanted..... xiii
Wasatch Asphaltum Co..... xii
Washington Carbon Co., The....vii
Western Electric Co..... ix
Westinghouse Elec. and Mfg Co—
Westinghouse Machine Co..... xix
Weston Electrical Instrum't Co.iv, xii
Williams Engine Works..... xix
Woodbridge & Turner Eng. Co. xv
Woodhouse & Rawson, Ltd....—
Worthington, Henry R..... xii

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Great Western Elec. Supply Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Electrical Supp y Co., The.
Knapp Electrical Works.
Samson Cordage Works.

Asphaltum.
Wasatch Asphaltum Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Greeley & Co., The E. S.
Hirlimann, C. J.
Law Telephone Co.
Monitor Electric Co.
Partrick & Carter Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Link Belt Machinery Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric, (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Leonard & Co., H. Ward.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Keller & Degenhardt.
Leonard & Co., H. Ward.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Sprague, Duncan & Hutchinson, Ltd.
Temple, J. C.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Knapp Electrical Works.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Easton Electric Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Northwestern Elect. Specialty Co.
Ries Electric Specialty Co., The
Star Electrix Co.
Sprague, Duncan & Hutchinson Ltd.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.

Elevators.
Link Belt Machinery Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E. Mfg. & Supply Co.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Northwestern Electric Specialty Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co.
Thomson-Houston Electric Co.
Union Electric Manufacturing Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Brookfield, Wm.
Gleason & Bailey Mfg. Co. Ltd.
Hemingray Glass Co.
Phœnix Glass Co.
Security Insulator Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Security Insulator Co.
Star Electrix Co.
Union Electric Manufacturing Co.
Vulcanized Fibre Co.
Wasatch Asphaltum Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Knapp Electrical Works.
New York and Ohio Co.
Northwestern Elect. Specialty Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene
Schoonmaker, A. O.

Mining Apparatus, Electric.
[illegible]

Motors.
Bain Electric Mfg. Co.
[illegible]

Name Plates.
[illegible]

Office Furniture.
[illegible]

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd.

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Northwestern Elect. Specialty Co.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Central Electric Co.
Chicago Electric Mfg. Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co
Weston Electrical Instrument Co

Transformers.
Electrical Eng. & Supply Co.
National Electric Manufacturing Co
Stanley Electric Mfg. Co
Westinghouse Electric & Mfg. Co

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Type Writer Co.

Valves
[illegible]

Wire, Bare.
American Electrical Works.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works.
Sperry Elec. Mining Machine Co.

THE WESTON ELECTRICAL INSTRUMENT CO.

Are pleased to inform Electricians, Electrical Engineers and others engaged in the application of electricity to the arts, that they are now prepared to supply a really first-class, reliable and permanent Voltmeter for accurately measuring the difference of potential on *alternating current circuits.* The instrument, of which a cut is here shown, is designated

THE WESTON STANDARD

PORTABLE

Alternating and Direct Current

VOLTMETER.

It is adapted for use on *either alternating or direct current circuits,* and its indications will be found perfectly accurate on either, to within one-fifth of one per cent.

It has received the most thoughtful study, and every detail has been worked out with extreme care to insure great accuracy, sensibility and permanency; and no pains or expense has been spared in the effort to produce a really reliable and durable instrument for use as a standard in determining potential differences on alternating current circuits, with the widely varying rates of alternations met in practice. It has been subjected to a most exhaustive and long continued series of tests in the laboratory, and has been put to practical use for a long time in order to discover any weak points, and to eliminate them before offering it for general and extensive use. We now offer it with perfect confidence, and feel assured that when its good qualities become known, it will be gladly accepted as THE Standard Portable Instrument for alternating current work.

It is not made upon the "cheap and nasty plan," nor is its beautiful exterior finish and pleasing design a cloak for beastly mechanical work inside. On the contrary, all its working parts are made to gauge by the aid of special expensive tools and machines designed to produce the most accurate and uniform quality of work. The moving parts are supported on the very best sapphire jewels, highly polished, and the pivots are made of hardened steel, accurately ground to gauge, and highly polished. Each instrument is carefully standardized at 20 different points on the scale and the divisions correctly marked, and each instrument after having its scale marked is again checked by comparison with an absolute standard, and certified to before being sent out.

It requires only from .02 to .056 of an ampere (according to range) to cause the index to move entirely across the scale. The size of the scale is the same as that used on the well known Weston Portable Direct Current Voltmeter, and readings can be made almost as quickly as with the latter named instrument. It is practically free from errors of self induction, so much so that the eye cannot detect any difference between its readings on a direct current circuit and an alternating current, having the same potential difference, but with much higher rates of alternation than is ever met with in practical work. It is therefore correct for all the rates of alternation met with in practical work. We make a large variety of ranges to meet the requirements of all kinds of work.

WESTON ELECTRICAL INSTRUMENT CO.,

Office and Factory: 114 to 120 William Street, NEWARK, N. J.

WHAT'S THE USE OF BUYING SWITCHES?

WE ARE GIVING THEM AWAY.

READ THIS.

We will for 30 days from the date of this notice, give away ten, five ampere, or nine, ten ampere Paiste switches to any one sending us an order for one hundred dollars worth of goods, accompanied by this blank filled in and signed.

CENTRAL ELECTRIC COMPANY,

November 23, 1891. CHICAGO.

Central Electric Company,
CHICAGO.

Please send with accompanying order .....ampere Paiste switches, for which you agree to make no charge.

Signed.....

.....1891.

A DEPARTURE IN CARBONS.

We are selling MOULDED Carbons, Chicago delivery at factory prices for FORCED Carbons.

THIS IS A DEPARTURE IN THE SUPPLY BUSINESS.

EVERY CARBON GUARANTEED

For straightness, brilliancy and life. A full stock of 7-16 and ½ inch plain or coated Carbons will hereafter be kept in our Warerooms, and prompt shipment assured. Save time and money by buying in Chicago instead of at the factories.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison General Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

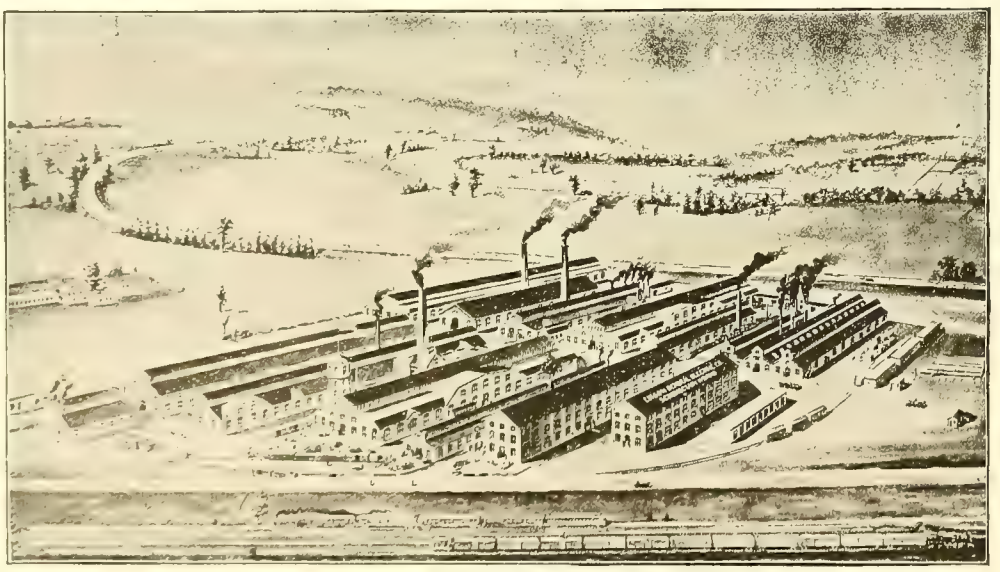
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine, Telegraph, Underground,



Telephone, Interior, Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass.
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE

WASHINGTON CARBON COMPANY'S

WEEKLY BULLETIN TO ITS FRIENDS.

Last week we stated that the ***Carbon Trust*** proposed to drive us out of the business by monopolizing the supply of raw material. ***To this end IT is bending all ITS energies.***

MORE ABOUT TRUST METHODS:

A representative of the ***Trust*** visited people who supply us with raw material, and proposed the following:

"The Trust will buy raw material from YOU, if you will agree to charge outsiders twenty-five per cent. more than you charge the Trust."

This little scheme would have enabled the ***Trust*** to ***Advance the price of Carbons***

$2.00 PER THOUSAND,

but ***it failed.*** By ***"Outsiders" it*** meant ***The Washington Carbon Company. It is part of its creed that no one but the Trust has any right in the business.***

We are glad to be "outsiders." We propose to keep on being outsiders, for it pays, as our order books show.

We are very busy, but have time enough to keep an eye out for the ***Trust***, and have gathered much interesting matter, which we propose to deal out in weekly installments.

As we have arranged for an abundant supply of raw material, we are prepared to make contracts for carbons at fair prices for a term of years.

THE WASHINGTON CARBON COMPANY,

LOOK OUT FOR NEXT WEEK! Washington, Pennsylvania.

The "Packard" Lamp

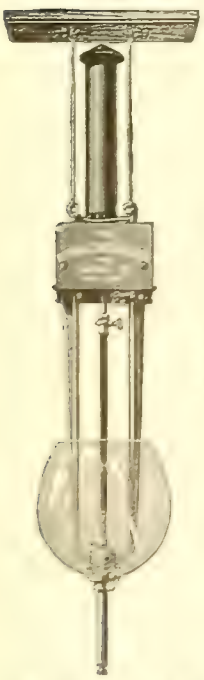
Agency has been transferred to

The Electrical Engineering and Supply Company

931 Rookery - Chicago, Ills.

The exclusive use of a strictly High Grade Lamp only will satisfy both patrons and Stockholders.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

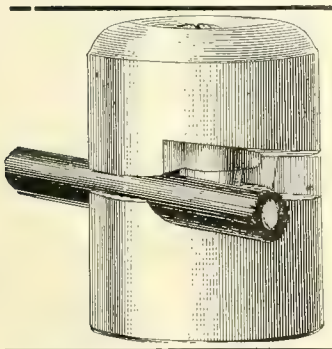
201-207 So. Canal Street, CHICAGO, U. S. A.

The Pocket Edition of our General Catalogue of July, 1891, is now ready for distribution, and we will send it to any one on receipt of request, by mail.

WESTERN ELECTRIC COMPANY,

227 SO. CLINTON STREET, CHICAGO.
COR. THAMES & GREENWICH STS NEW YORK.

AMES, EBERT & COMPANY, Agents,
ST. PAUL, MINN.



The Latest Thing in Insulators.

MANUFACTURED BY THE

Security Insulator Co.

An Insulator that is easily and quickly adjusted, and will securely clamp the wire without injury to the Insulation, thus doing away entirely with tie wires, and effecting a large saving of time and labor in wiring. Wire from $\frac{1}{8}$ to $\frac{3}{8}$ of an inch may be used, thus allowing of a variation of $\frac{1}{4}$ of an inch in size of wire. Made of the best Vitrified and Non-Absorbent Porcelain.

Write for Price and Full Particulars.

SECURITY INSULATOR CO.,
136 Liberty St., - NEW YORK.

SPRAGUE, DUNCAN & HUTCHINSON,
Limited.

FRANK J. SPRAGUE,
LOUIS DUNCAN, Ph. D.,
ALFRED BISHOP MASON,
CARY T. HUTCHINSON, Ph. D.

CONSULTING ELECTRICAL ENGINEERS.

15 WALL STREET, NEW YORK.

SUNBEAM INC. LAMP CO. SUNBEAM INCANDESCENT LAMP CHICAGO ILLINOIS U. S. A.

THE SUNBEAM INCANDESCENT LAMPS

Can be furnished of any desired efficiency or life to suit our customers. We make two standard styles of lamps, as follows:

High efficiency lamps, from 3 to 3 1-3 watts, which maintain their rated candle power from 750 to 1,000 hours.

Long-lived lamps, from 3 6-10 to 4 watts, which maintain their rated candle power from 1,500 to 3,000 hours.

Each style will be found to give more light per dollar expended in current than similar lamps made by other manufacturers.

SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

SOMETHING ENTIRELY NEW. Saves the Current, Regulates the Light. An Innovation in Electric Lighting. SIMPLE, EFFICIENT, ECONOMICAL.
INDORSED BY THE ELECTRICAL PRESS and prominent Electrical Engineers and Electricians.

NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED.

The Price of our No. 1 Ries Regulating Socket (for lamps 16 to 25 C. P. 50 volts) is

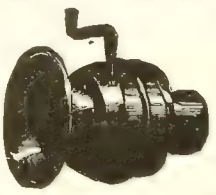
$1.27½ { $3.00 EACH LESS 57 1-2 PER CENT. DISCOUNT, MAKING THE NET PRICE $1.27 1-2 EACH, When Ordered in Quantities. } $1.27½

For particulars and prices, write to
THE RIES ELECTRIC SPECIALTY COMPANY, SOLE PATENTEES AND MANUFACTURERS,
BALTIMORE AND EUTAW STS., BALTIMORE, MD.

INTRODUCING ENTIRELY NEW PRINCIPLES.

Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT
IS MADE ONLY BY THE
Page Belting Company, Concord, N. H.
BRANCHES—Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.



SPEAKING TUBES AND WHISTLES.
Oral, Electric, Pneumatic and Mechanical
ANNUNCIATORS AND BELLS.
FULL LINE ALWAYS IN STOCK.
W. R. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE. Out August 1st.

BINDERS
—FOR THE—
WESTERN ELECTRICIAN,
ONE DOLLAR.

"WINTER SPECIALTIES."

BRAND'S STEEL WIRE TRACK BROOMS,
WARDWELL'S TRACK BROOM HOLDERS,
BURTON ELECTRIC HEATERS,
—AND—
ELECTRIC RAILWAY SUPPLIES
OF EVERY SORT—
FOR ANY SYSTEM.

ELECTRIC MERCHANDISE CO.,
W. R. MASON, Gen'l Mgr. CHICAGO. 11 Adams Street.

Gleason & Bailey Mfg. Co.,
(LIMITED.)

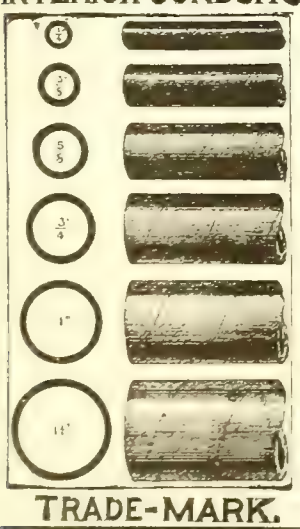
Manufacturers of, and Dealers in, a line of General
ELECTRICAL MERCHANDISE.
ALSO ELECTRIC AND COMBINATION
FIXTURES AND GLASSWARE.

Rubber Covered Weather-Proof Wires
and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and new catalogue.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding
ELECTRIC CONDUCTORS
Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.
INTERIOR AND UNDERGROUND
CONDUITS
MANUFACTURED BY
INTERIOR
CONDUIT AND INSULATION CO.,
WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,
General Offices: 42 & 44 Broad St., New York.

Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Mountain Electric Co., Denver Colo.
American Electrical Supply Co., 226 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 511 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

MONITOR
CARBON
BATTERY
Unsurpassed in Strength and Durability.
LIBERAL DISCOUNT TO THE TRADE.
Write for Quotations.
G. A HARMOUNT, M'gr,
Monitor Electric Company
149 WABASH AVENUE,
. . . . Chicago, Ill.
Western Agents Alfred F. Moore's Wires and Cables.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,
45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

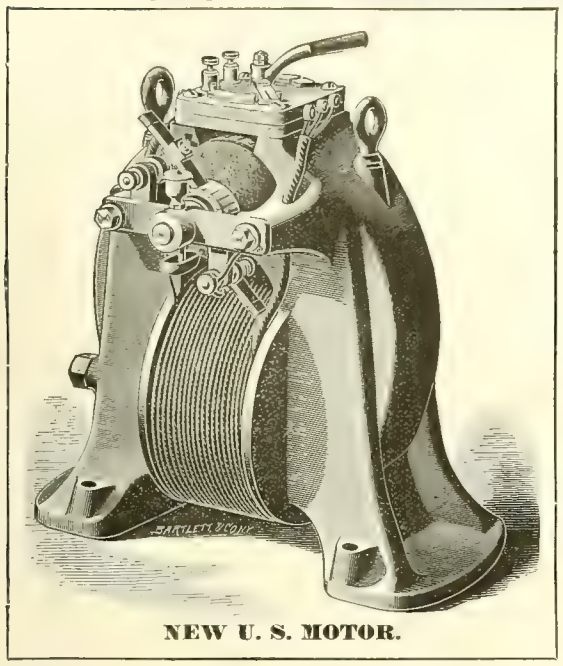
LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

This System Saves Mileage of Circuits, Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

THE UNITED STATES ELECTRIC LIGHTING CO.,

(THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Lessees.)

ARC AND INCANDESCENT ISOLATED ELECTRIC LIGHT PLANTS.



NEW U. S. MOTOR.

Automatic Dynamos.—Perfect Devices.

More than 1000 Plants in operation in Factories, Hotels, Office Buildings, Theaters, Etc.

ELECTRIC

MOTORS and GENERATORS

Direct Current GENERATORS and MOTORS for all purposes, 1-8 H. P. up to any power required, and at any required E. M. F.

Superior in Design and Workmanship, and Unequaled in Efficiency.

Send for New U. S. Catalogues on Incandescent Lighting and Motors.

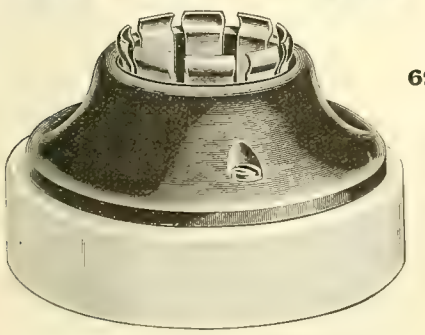
GENERAL OFFICES: EQUITABLE BUILDING, - - 120 BROADWAY, NEW YORK.

SAWYER-MAN ELECTRIC CO.,

BOSTON, 620 Atlantic Avenue.

NEW YORK, 510-534 West 23d Street.

CHICAGO, 217 La Salle Street.



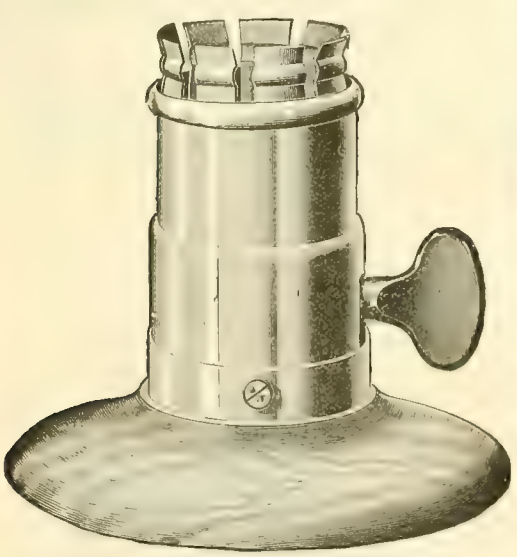
No. 135. All Porcelain Keyless Wall Socket.

INCANDESCENT LAMPS.

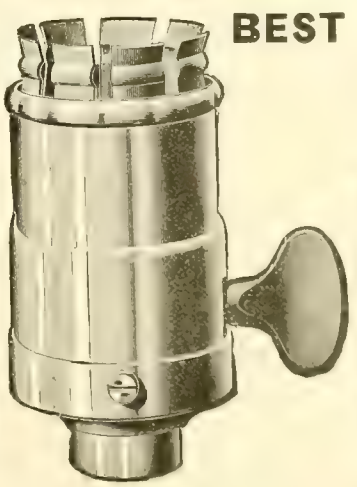
Orders Executed Correctly and Promptly.

SOCKETS.

BEST AND CHEAPEST.



No. 125. Key Wall Socket—Porcelain or Wood Base.



No. 110. Key Socket.

No. 120. Keyless ⅜ inch Socket.

ALSO—

No. 115. Keyless Socket, 1-8 in.

No. 130. Keyless Wall Socket—Porcelain or Wood Base.

No. 145. Keyless Socket for 75, 100 and 150 c. p. Lamps

No. 150. Waterproof Socket.

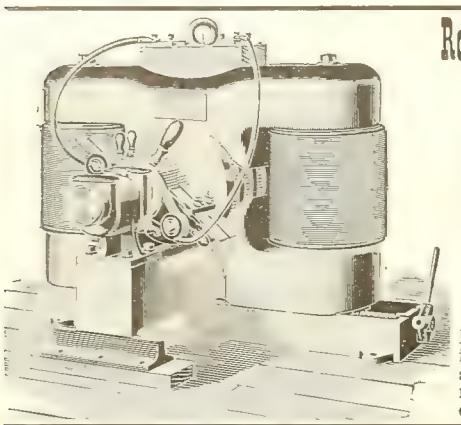
No. 140. Attachment Plug, with Fuses.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.



Rockford Electric Mfg. Co.,

ROCKFORD, ILL.,

Manufacturers of

MOTORS,

(Stationary and Railway).

Incandescent Dynamos and Generators

(MAYO SYSTEM).

Specially adapted to Isolated Plants. Absolutely self-regulating and reliable. The Motors are the most efficient now in the market. Agents wanted in unoccupied territory.

PLATINUM. JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

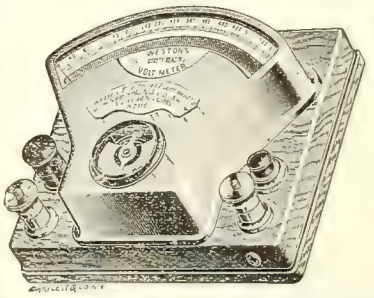
CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

THE WESTON STANDARD

Voltmeters and Ammeters.



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work.

Send for Illustrated Catalogue.

ADDRESS

WESTON ELECTRICAL INSTRUMENT CO.,

114—120 William Street, **Newark, N. J.**

THE WORTHINGTON STEAM PUMP.

Henry R. Worthington, New York, N. Y.

BOSTON. PHILADELPHIA. Chicago Branch, 93 and 95 Lake Street. ST. LOUIS. ST. PAUL.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

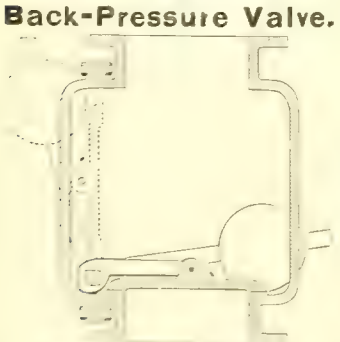
A. O. SCHOONMAKER,

158 William St., NEW YORK.

THE EXCELSIOR

Straight Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,

229 S. Franklin St., Chicago.

Wasatch Asphaltum

COMPANY.

Proprietors of the largest and richest Asphaltic Limestone mines in the world.

MANUFACTURERS OF

ROCK ASPHALT MASTIC,

For Paving, Roofing, Basements, etc.

ASPHALTINE

(Or Liquid Asphalt),

For Coating Piles, Ties, Poles, etc.,

ALSO SOLE AGENTS FOR

—THE SALT LAKE—

GILSONITE

COMPANY'S

PURE GUM ASPHALTUM

For all INSULATING Purposes.

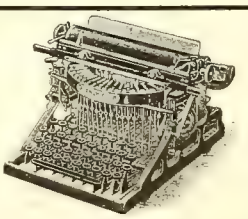
Office, 71 Culmer Block, Salt Lake City, Utah.

FOR SALE BY

F. S. FREDERICK,

39 River Street. CHICAGO.

Correspondence solicited and samples furnished



The "DENSMORE,"

The World's Greatest Typewriter,

Should be examined before purchasing any other.

MANY IMPROVEMENTS. HIGHEST STANDARD.

Invented, owned and controlled by men having had fifteen years' experience on type-bar machines.

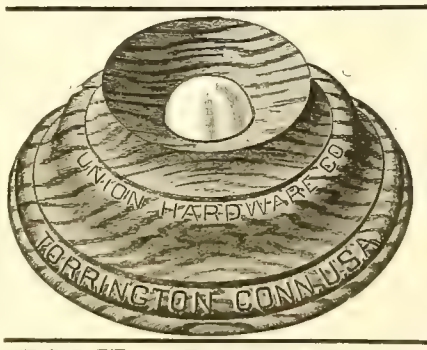
Simplicity, Strength, Durability, High Speed, Easy Action, Permanent Alignment. Most convenient. Two interchangeable carriages. Steel throughout.

STANDARD KEY-BOARD, with shift carriage for capitals. Call or send for catalogue.

"A perfect machine. Am delighted with it. A pleasure to run it." CHAS. D. KELLY, Stenographer West Shore R. R., New York.

We will appoint a reliable dealer in all cities as soon as possible, and in the meantime will ship machines on approval to parties having a good commercial rating.

DENSMORE TYPEWRITER CO., 202 Broadway, New York.



—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

POLES

CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

UNION ELECTRIC WORKS,

207 South Canal St., CHICAGO, ILLINOIS.

The Best Electric Bell [illegible]

WRITE FOR PRICES.

We will also manufacture articles for Inventors or the Trade. We have skilled Workmen and do first-class work.

THE SHORT DYNAMO.

Efficiency, 92 Per Cent.

From 75 to 500 Horse Power.

Flat Ring Armature.

Multiple Brushes.

Large Commutator. Independent Coils.

Perfect Ventilation.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, DECEMBER 19, 1891. No. 25

Electric Lights in Plymouth Church, Brooklyn.

For many years the name of Plymouth Church, Brooklyn, has almost been a household word in and about New York. Tourists from abroad, too, have seldom failed to make a visit to this noted house of worship. The church, which is of the Congregationalist denomination, is situated on Orange street, between Henry and Hicks streets. It was from this pulpit that Henry Ward Beecher for nearly fifty years preached to the immense throngs that weekly crowded the church. In fact, the answer to a stranger's inquiries regarding the location of "Beecher's church," was almost invariably: 'Take the Fulton street ferry, and follow the crowd."

While this church has stood so many years until it is almost a landmark, it has, nevertheless, kept up with the times in recognizing the importance of the applications of modern science to the comforts of life. About two years ago, just prior to a prospective renovation, the question as to the advisability of lighting the edifice by electricity was proposed. But nothing came of the scheme, and the idea was given up for the time. During the early part of June of the present year, however, the subject of lighting the church was again broached and resulted in the board of trustees sending to the Edison company in Brooklyn for estimates and plans relative to the wiring of the building. Satisfactory arrangements were made and soon after work was begun.

Scattered throughout the building at present there are about two hundred 16 candle power incandescent lamps, while installed in the cellar are two electric motors. The current for the entire installation is furnished from the Pearl street station of the Edison company in Brooklyn.

Under the great reflector in the center of the ceiling of the auditorium, the gas jets have been replaced by sixty 16 candle power lamps, so hung that they can be lowered if necessary.

FIG. 1. ELECTRIC LIGHTS IN PLYMOUTH CHURCH, BROOKLYN.

In the accompanying view of the interior of the church, Fig. 1, the chandelier is shown, together with the two clusters on either side of the organ, and above the pulpit. About forty more lamps have been distributed at various points in the galleries and on the lower floor. The Sunday-school room and lecture room are each equipped with about forty lamps, while the parlors, halls and passages are all lighted in the same way. The two 220 volt "C. & C." motors, one of 1 horse power and the other of 2 horse power, Fig. 4, serve as motive power to pump the organ. The motors are placed in a room directly beneath the bellows room, and by means of the accompanying diagram, Fig. 2, the mode of operation will be easily understood. An automatic device for regulating the air supply is used, but it is so simple in its construction that an explanation is hardly necessary. Directly above the upper and movable portion of the bellows a weight is suspended from a rope which passes over a couple of pulleys, thence down to a wheel connected with the movable arm of a resistance box. As the bellows fill with air the weight is lifted and the opposing weight on the other side of the wheel on the resistance box carries the movable arm around the series of contact plates, thus reducing the speed accordingly.

The switch board, Fig. 3, shows the three-wire system as it enters the cellar from the street. The upper meter is on the church circuit; the lower and smaller one is in the motor circuit, and it will be noticed that it is connected for 220 volts.

An isolated plant of 650 lights capacity will be installed in the tinware mill of Norton Bros., River street, Chicago, by the Chicago Edison company. One dynamo will be used, and the building will be wired for 500 lights at first.

Lighting Chicago's Parks and Boulevards

The South Park Board [illegible] has been discussing the subject of improving the lighting of the parks and boulevards under its control. At its meeting last week the subject of adopting electricity was discussed, but no definite action was taken. The cost and merits of several systems of electric lighting and the manner in which the lights should be distributed throughout the parks and boulevards were the main points considered. The board expects to construct a plant of its own shortly with a capacity of from [illegible] to 200 arc lights. The South Side boulevards, it is agreed, should be lighted by electricity, as they will be thronged nights as well as during the day by visitors to the World's Fair in 1893. Michigan avenue is the only South Side boulevard that is well lighted and on this thoroughfare gas is used. The Grand, Oakwood and Drexel boulevards are poorly lighted, and unless a change is made will not be a credit to the city. Electric lights, of course, should be introduced on all these boulevards and in view of the approaching exposition the improvement should be introduced at once.

It is to be hoped that the North and West Side park commissioners will also take early action looking toward the introduction of electric lighting on the West and North Side boulevards and parks.

Underground Wires for Cities.

The aldermen of Rochester, N. Y., recently sent out a visiting committee to inspect underground electric wire systems in other cities. On the return of the committee City Electrician Barnes, in an interview in the Rochester *Post-Express*, said:

"In Chicago one may walk for an hour in the center of the city and not see a pole or a wire. It is a noteworthy fact to a person from Rochester. Experience with all kinds of wires underground in Chicago and other cities settles beyond question all doubt of the practicability of such systems. We were shown a wire that had been underground fifteen years, and it was as good as ever. The companies out there made a fight against the underground system at first, just as they have in all cities on account of the expense. But now they are perfectly satisfied. They say the cost of maintaining the underground system is not one-quarter as much as before. Chicago does its own electric lighting, and the city set the electric companies an example by burying its wires and proving the practicability of the system. In Minneapolis the wires are being put underground, the electric street railway

feeder wires among the others. In Washington all wires are being put underground. Everybody who has had any experience in the matter expressed the greatest satisfaction with the system. In the West subways six feet six inches in height and five feet in width are used to some extent. But they are expensive, and conduits would do for a city like Rochester."

Tesla's Oil Insulated Condenser.

The two forms of condenser shown herewith were constructed by Nikola Tesla, New York, with a view of obviating certain defects which had been observed in the ordi-

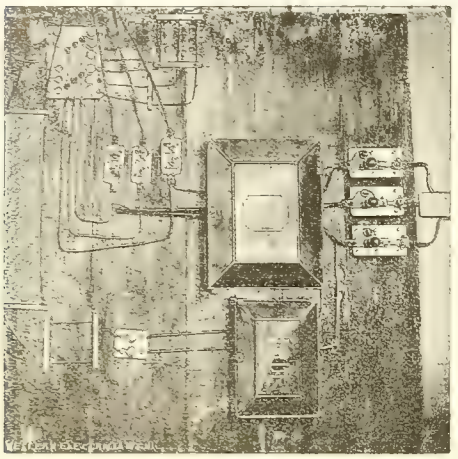


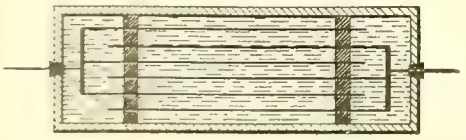
FIG. 3. ELECTRIC LIGHTS IN PLYMOUTH CHURCH, BROOKLYN.

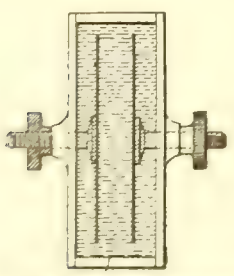
nary forms of such apparatus when employed in the Tesla system of producing light and other effects by means of currents of high frequency and high potential.

Mr. Tesla found that insulating material such as glass, mica, and, in general, those bodies which possess the highest specific inductive capacity when currents of the kind described were employed, were inferior as insulators to those possessing high insulating power together with a smaller specific inductive capacity. He also discovered that it is very desirable to exclude all gaseous matter from the apparatus in order to prevent heating by molecular bombardment. To accomplish these results and produce highly efficient and reliable condensers, Mr. Tesla resorted to the use of oil as a dielectric.

The cuts illustrate diagrammatically the manner in which the oil is employed. The upper figure is a section of a condenser constructed with stationary plates, while the lower cut is a similar view of a condenser with adjustable plates. The construction of the two forms of condenser is evident at a glance. The plates are connected respectively, to two terminals which pass out through the sides of the case. The plates ordinarily are separated by strips of porous insulating material. These are used, however, merely for the purpose of maintaining them in position. The space within the can is filled with oil.

In many cases it is desirable to vary or adjust the capacity of a condenser, and this is provided for by securing the





Mr. Tesla claims to have discovered peculiar properties in oils, which render them very valuable in this particular form of device.

Reform in Telephone Numbers.

Beginning February 15th, the Chicago Telephone company will introduce a new system of telephone calls by numbers that will, it is thought, prove to be a great improvement over the present cumbersome method. There are eight exchanges embraced in the Chicago Telephone company, and heretofore they have been distinguished by numbers in the calls for each. Thus, telephones numbered from 1 to 2,999, and also from 4,000 to 5,399, were in the down-town district; 3,001 to 3,999 in the North Side district; 7,001 to 7,999 on the West Side, and so on. This is all to be changed, however, and after February 15th, the name of the exchange as well as the telephone number must be given, as printed in the directory of subscribers. Thus, a person desirous of connection with the telephone now numbered 3,752 will, after the change, call for "North, 752;" and if the instrument now known as 7,062 is desired, "West, 62," will be called for. In short the prefix numbers will be dropped and names substituted, except in the case of telephones connected with the main exchange, for which the present numbers will be used, with the prefix "Main." Thus the call for the WESTERN ELECTRICIAN will be "Main, 1,746." A full complement of numbers is thus assigned to each of the several exchanges and the use of numbers containing more than four figures is done away with, abating a nuisance that is unsatisfactory to subscribers, and one that, as experience has shown, is responsible for many of the errors on the part of operators. The same system, of course, will apply to long distance calls. This method is now in use in New York and Boston, and has worked well.

The following table shows the present and the new assignment of numbers:

Present numbers 1 to 2,999 and 4,000 to 5,399 become "Main, 1," to "Main, 5,399."

Present numbers 3,001 to 3,999 become "North, 1," to "North, 999."

Present numbers 7,001 to 7,999 become "West, 1," to "West, 999."

Present numbers 8,001 to 8,999 become "South, 1," to "South, 999."

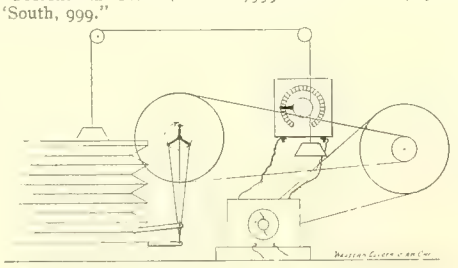


FIG. 2. ELECTRIC LIGHTS IN PLYMOUTH CHURCH, BROOKLYN.

Present numbers 9,001 to 9,499 become "Canal, 1," to "Canal, 499."

Present numbers 9,500 to 9,799 become "Yards, 500," to "Yards, 799."

Present numbers 9,800 to 10,999 become "Oakland, 800," to "Oakland, 999."

Present numbers 12,001 to 12,499 become "Lakeview, 1," to "Lakeview, 499."

A Secondary Battery with an Iron Electrode.

Isaiah L. Roberts of Brooklyn, N. Y., has devised an improvement in secondary batteries, which will be of interest to manufacturers experimenting in this line. Mr. Roberts describes his cell as follows:

"I employ as electrodes a plate of iron and a plate of a material electro-negative to iron, as, for instance, carbon, similar to the ordinary negative carbon element of a galvanic battery. For the excitant I use a solution of chloride of iron. If both electrodes are immersed in this liquid, and a current passed through the battery from the iron to the carbon, iron is deposited on the iron plate and sesquichloride of iron formed in solution. If the cell be divided by the ordinary porous diaphragm of an electric battery, which is permeable by liquids, the formation of the sesquichloride in the carbon compartment is greatly facilitated. In order to prevent or impede local action, I separate the electrodes by a diaphragm of any suitable form of the kind which I call "non-porous," for the reason that such diaphragms are practically impervious to fluids under ordinary circumstances, and yet are electrolytic, in so far that they permit electrolytic action to take place through them. These diaphragms may be of ordinary porous ware or plates, the pores of which are filled with gelatinized silicate of soda or starch paste, or they may be composed of a material generally known as "fibrite," or [illegible] fiber which, when immersed in the solution, becomes a good conductor. I have found that this material is admirably adapted for the purpose and prefer to use it in my battery. Before charging I fill each compartment of the cell with a solution of chloride of iron, which however, produces no appreciable effect or action, of itself.

"To charge the battery the positive pole of the dynamo is connected to the iron electrode and the negative to the carbon. The passage of the current decomposes the chloride of iron in solution in the iron compartment, carrying the chloride over to the carbon electrode and depositing

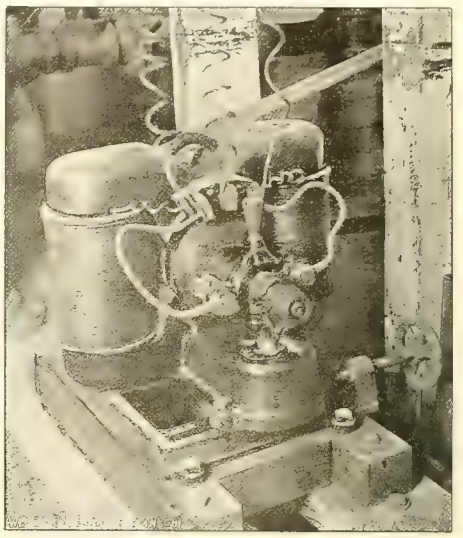
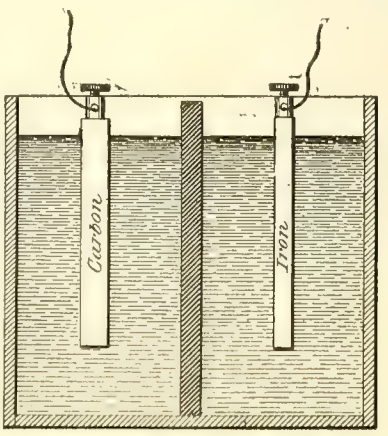


FIG. 4. ELECTRIC LIGHTS IN PLYMOUTH CHURCH, BROOKLYN.

metallic iron on the iron plate. The transferred chlorine is taken up by the chloride of iron in the carbon or anode compartment, one additional atom of chlorine being absorbed for each two atoms of iron present in the chloride of iron solution (FeCL) in the carbon compartment, forming sesquichloride of iron (Fe_2CL_3.) This action continues until the solution in the iron compartment is depleted or that in the carbon compartment has absorbed its full quota of chlorine. The device thus becomes a source of electrical energy of great value on account of its capacity and steady action. The return to the original conditions existing before the electrical current is passed through the battery is not affected to any appreciable extent until the circuit between the electrodes is closed, because, owing to the fact that the fluids on opposite sides of the substantially impervious diaphragm are not permitted to intermingle, the local action is very slight. On closing the circuit of the battery the sesquichloride returns to the condition of chloride of iron, and the excess of chlorine goes back to the iron electrode, with which it recombines." In the accompanying cut the battery is shown in vertical central section.

The Fiske Range Finder.

A report has recently been received at the Navy Department from Capt. W. S. Schley, commanding the United



SECONDARY BATTERY WITH AN IRON ELECTRODE.

States cruiser Baltimore, now on its way from Valparaiso to San Francisco, on the practical working of the Fiske electric range finders aboard that ship. The report was originally drawn up by a board of line officers, consisting of Lieut. S. H. May, Lieut. H. O. Dunn (junior grade) and Ensign B. W. Wells, Jr. The report was indorsed by Capt. W. S. Schley, and in turn forwarded to the secretary of the navy. The board gives the result of a number of tests, showing that the true distances of targets varied but slightly from the readings of the instrument.

Electricity at the World's Fair.

Since the plans of the electricity building were first made public in the WESTERN ELECTRICIAN of April 25th last there have been many important changes in the design for the interior of the building. Not only has the space been divided up, but the location of the stairways, the position of the galleries and the structure of the building itself have been changed. The plan of the first floor, as now determined upon, is shown in Fig. 1, while the arrangement of the galleries is given in Fig. 2. The exterior of the building has not been changed.

The central nave of the building has been changed from wood to a structure of steel arches. These arches will span 115 feet and will be 114 feet high. They are indicated in Fig. 1. The arrangement of the stairways has been entirely changed after careful study by Chief Barrett's assistant, Mr. Keller. In the galleries the two bridges at the center of the building containing the main stairways have been entirely removed and larger stairways placed at the side of each main entrance. This will give eight grand staircases, located near the main entrances, where a large open space would naturally have to be left, and will save approximately 30,000 square feet of space formerly devoted to stairways in other locations and to the bridges in the center of the building.

The connections at the ends and sides of the building between the four sections of the gallery have been made of sufficient width to accommodate all visitors in their passage from one section to another. Cloak rooms have been provided at each side of the main entrance at the south end of the building, and also at each side of the east and west entrances. Lavatory and retiring rooms have been provided at the southern and northern extremities of the building, both on the ground floor and in the galleries. In the two large bays at the northern end of the building the gallery floor space has been given up for kitchens and restaurants. These restaurants are arranged with a large dining hall in the center of each, bay with smaller rooms surrounding in a semicircle, to be used for private dining rooms. The balcony between these two bays on a level with the gallery floor is to be used for serving patrons of the restaurant during pleasant weather. It is thought that this feature will attract an additional number of people to the galleries. In order to carry this idea still farther provision is being made for a number of electric elevators, but these have not been definitely located as yet.

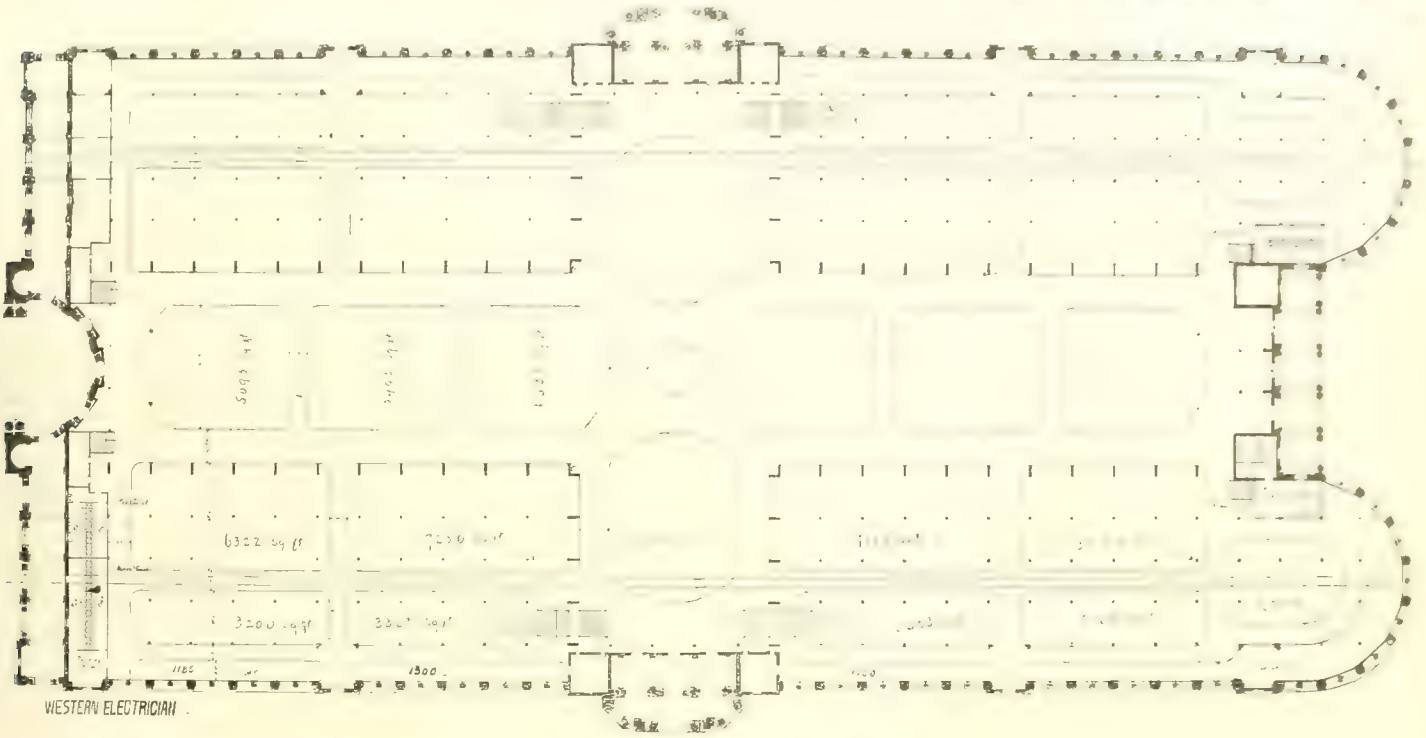


FIG. 1. ELECTRICITY AT THE WORLD'S FAIR.

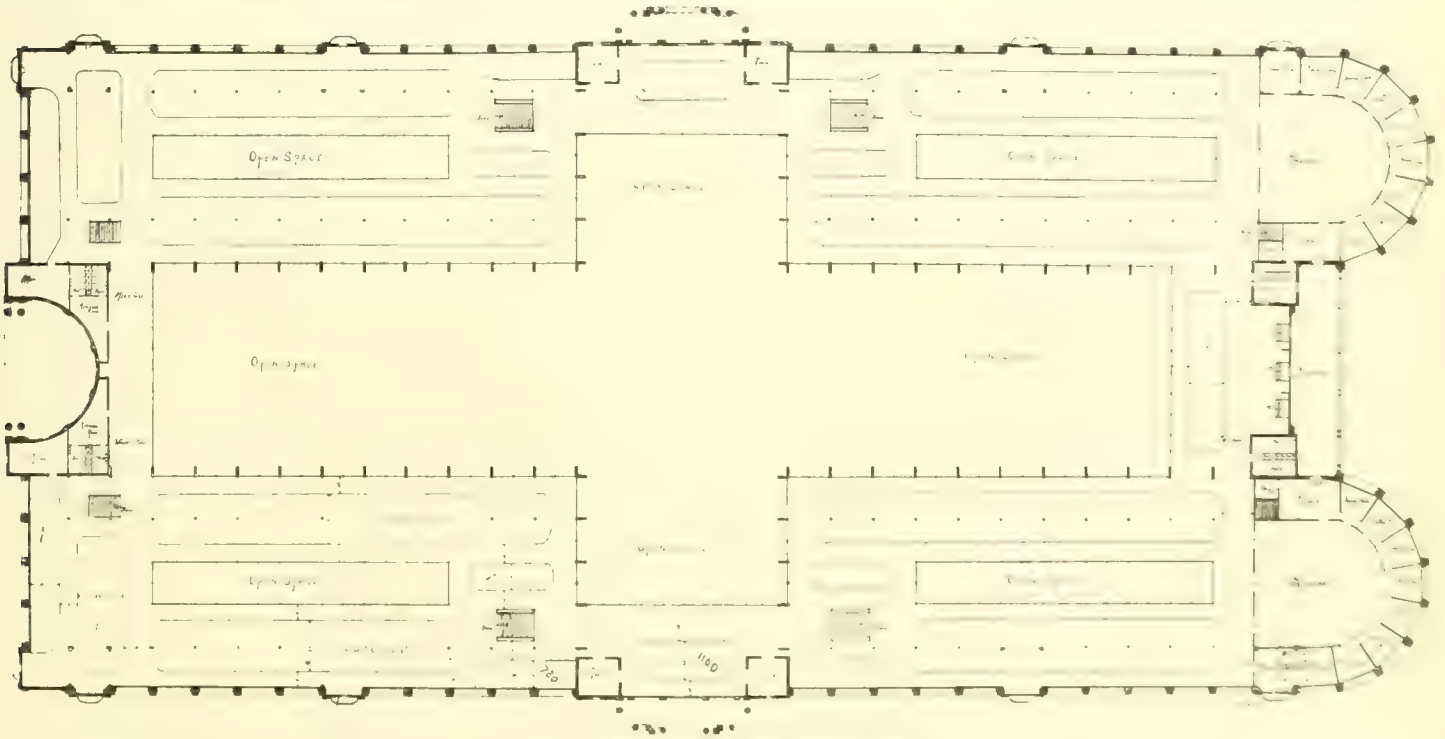


FIG. 2. ELECTRICITY AT THE WORLD'S FAIR.

[illegible] an attraction that could not be had if the aisles were laid out without taking this fact into consideration. The exhibition spaces as laid out aggregate a little over 207,000 square feet of actual exhibition space. Railway tracks will traverse the building, as shown in Fig. 1, to provide for the installation of exhibits directly from freight cars. The foundations under these aisles have been strengthened sufficiently to carry [illegible] ered over before the opening of the exhibition.

It is probable that the prospectus of the electricity department, which has [illegible] be issued before [illegible] the direction of Mr. [illegible] Barrett, and at last week's meeting of the committee on electricity it received the sanction of [illegible]

discussion. This prospectus will be much more elaborate and complete than any issued by any other department of the World's Fair, and will contain all the information necessary for the guidance of electrical exhibitors, both American and foreign. A considerable portion of the pamphlet will be devoted to the statement of facts that are considered to come under the authority of the chief of the bureau of construction, and so Mr. Burnham's approval must be secured before the prospectus is issued. Little difficulty is apprehended on this score, however, as many misapprehensions were cleared away at the general discussion at the committee meeting referred to, and a friendly feeling was the result. It is not supposed that there will be any difficulty in securing the approval of Director

FIG. I. SCHLOSSER'S TROLLEY POLE.

general Davis to any prospectus that the departments of electricity and construction agree upon.

At the meeting of the committee on electricity on Thursday of last week Herrn Vogel and von Babo appeared and presented their desires in the way of making an exhibit, as given in the WESTERN ELECTRICIAN of last week. A general discussion ensued, but no conclusion was arrived at, the matter being postponed until the next meeting. The representatives of Siemens & Halske are very anxious to have their exhibit all together, either in a distinct building or in the electricity building. They do not look with favor on the idea of placing their generating machinery in one place and the rest of their display in another, which is the plan decided upon for all electrical exhibits. They want to show their dynamos working under full load, and for that reason desire to take part in the general lighting arrangements. They do not expect to make money out of this, however, saying that their object in making a display at Chicago is to secure the advantages of the exhibition and not to make a profit. The representatives of the German firm simply ask that, if current furnished for lighting purposes is to be paid for, they receive the average price.

Herrn Vogel and von Babo, were busy last week in looking the ground over. They made a long visit of inspection to Jackson Park and surveyed the progress thus far made on the buildings and grounds with great attention. On Friday of last week they were shown over the new *Chicago Herald* building—the model newspaper office of the West--by James W. Scott, the publisher, and were

[illegible]

electrician. This is Dr. Channing of Pasadena, Cal., who writes to assert that he is still alive and that he does not want his name inscribed as that of a dead man on the walls of the electricity building. The mistake was discussed by the committee on electricity at the last meeting, and the name of Stephen Gray, an Englishman, was substituted. The correct list of forty-one names is, therefore, as follows:

Franklin,	Arago,	Galvani,
Daniell,	Ampère,	Jacobi,
Faraday,	Wheatstone,	Ohm,
Gauss,	Sturgeon,	Vail,
Morse,	Bain,	Siemens,
De La Rive,	Davy,	Joule,
Volta,	Saussure,	Henry,
Cooke,	Oersted,	Varley,
Coulomb,	Steinheil,	Ronalds,
Guericke,	Page,	La Place,
Weber,	Gray,	Gilbert,
Priestley,	Davenport,	Maxwell,
Sœmmering,	Coxe,	Don Silva,
Thales,	Cavendish.	

The English Royal Commission for the World's Fair is bestirring itself. A recent advertisement in the London *Electrician*, signed by Sir Henry Wood, directs applicants for space in the British section to apply at the office of the Society of Arts, John street, Adelphi, London, W. C.

At the last meeting of the Society of Operative Electricians, of Chicago, Secretary Hornsby was present to explain the method of exhibiting in the department of electricity. It was decided to endeavor to have all the amateur electrical societies of the country combine to make one general exhibit. A committee of five was appointed to formulate plans for combining the organizations.

Electric railway men will be interested in the rules just issued by Chief Willard Smith of the department of transportation, as many manufacturers of street railway apparatus contemplate placing exhibits in the transportation as well as the electricity building. Following is a copy of the rules:

1. Power (electric or compressed air) will be furnished for operating such machinery or appliances as can only properly be shown in that manner. No direct steam power will be furnished, nor will any lines of shafting be erected in the building. Electric or compressed air power must be taken direct, and the exhibitor must furnish his own motor for utilizing the same.

2. Steam heat will be furnished under adequate pressure for testing car heating and other devices requiring it. The escape of such steam into the atmosphere will not be permitted, and the exhibitor must provide for taking care of condensation.

3. Loan exhibits accepted by the chief of the department will be cared for without expense to the owner. Special arrangements will be made in each case for exhibits which are non commercial in character, but designed to add to the completeness and educational value of the exposition.

4. Platforms, counters, ornamental partitions, showcases, etc., will be at the expense of the exhibitors and must not exceed these dimensions: Showcases, fifteen feet above the floor; counters, two feet, ten inches; platforms, one foot.

5. All exhibits of machinery in operation must be inclosed by a railing two feet and six inches in height, to come inside the space. Railings of the same height may be used to inclose and protect other exhibits, in the discretion of the chief of the department.

6. No signs will be allowed to extend over the passageway, and no signs will be allowed made of muslin, linen, canvas or paper.

7. The department will lend any proper assistance to exhibitors in securing the services of reliable attendants or care takers.

8. The chief of the department reserves the right to modify any of the above rules upon proper occasion, and to promulgate such further rules as he may deem necessary, from time to time.

A recent issue of the Baltimore *Sun* contained an exhaustive article on the World's Fair, with particular reference to Maryland exhibits. The following interesting paragraph was included in the account:

It is possible that the Baltimore & Ohio will make a representation in the electrical building of the laying of the first telegraph line in the world, which was from Baltimore to Relay. To use the term laying instead of stringing, as now, sounds odd, but the first telegraph line was laid, and under the ground at that. It was the common bonnet wire, drawn through a lead pipe, and this pipe [illegible] windlass, which was attached to a plow that cut a trench about two inches wide and fifteen deep. The combination of windlass and plow was drawn by sixteen [illegible]. The plow was made at the Baltimore & Ohio [illegible] and the man who devised and made it is still upon the company's pay-rolls.

By a vote of [illegible] to 21 the city council of Chicago has [illegible] the $[illegible] franchise of the Cal[illegible] company recommended by [illegible] The company [illegible] to extend [illegible] lines on Michigan [illegible] avenue to One Hundred and [illegible] to Wentworth avenue, [illegible] One Hundred and Sixteenth [illegible] The extension [illegible] the West Pullman [illegible]

Schlosser's Trolley Pole.

A novel trolley pole construction is shown in the accompanying illustrations. As ordinarily arranged the trolley pole is urged upward by strong springs, and it frequently happens that in the event of running off from the overhead wire the arm is thrown upward above its normal position, so that it comes in contact with the span wires or other line fixtures.

The manner in which the inventor, J. W. Schlosser, Washington, D. C., overcomes this difficulty is very ingenious. From the cuts it will be seen that the arm, instead of being made in one continuous piece, as usual, is constructed in two parts, which are connected by a pivot, so that the upper section will, when released, drop independently on the remaining portion, as shown in Fig. 1.

A latch pivoted to the lower member of the arm and arranged to engage over the lower end of the upper member is provided, and by this latch the two parts can be locked together, so that they constitute for the time being a rigid trolley operating like those in general use.

A trip arm is located as shown so that whenever the trolley is disengaged from the conductor or otherwise released and rises above the desired limit, the latch will encounter the trip-arm and be disengaged from the upper part of the trolley, and so the upper end will fall to the position shown in Fig. 1. The bracket is provided with an outreaching arm carrying a roller, which serves to arrest the falling end of the trolley.

In order to restore the trolley to an operative condition after its upper end has been tripped and permitted to fall

FIG 2. SCHLOSSER'S TROLLEY POLE.

it is only necessary to pull downward on the cord. By this action the lower section of the pole is depressed while the upper end is supported and caused to turn upon the roller as a fulcrum until the parts are again brought into line, when the latch automatically locks them together, as in Fig. 2.

In order to permit an adjustment of the device so that the trolley will be released at a higher or lower level, the trip-arm may be mounted on a horizontal pivot and secured, as indicated, by a pin, adapted for insertion in either of a series of holes in the bracket. This arrangement permits the trip-arm to be changed in position as may be required.

Treating Filaments for Incandescent Lamps.

By the use of the apparatus shown herewith a carbonized incandescent lamp filament may be freed from loose or partly detached particles of carbon and then treated most conveniently with hydrocarbon, from which a deposit is made on the filament by an electric current.

The construction of device will be understood after an explanation of its operation, which is as follows: The cock in a compressed air pipe is turned to open communication with the chamber. The pressure of air on the mercury in the chamber causes the latter to flow down the tube, raising the hydrocarbon fluid, immersing the filament and filling the cup at the top to a point above the cup. At this instant the cock is turned to open communication from the chamber with the open air. The removal of pressure from the mercury causes it to flow back to its normal position, allowing the fluid hydrocarbon to drop to a point below the filament leaving the upper end portion filled with hydrocarbon gas, and the upper end of the cylinder sealed by the cap and liquid in the cup. The electric current is now turned into the

filament, which is heated to incandescence. As a result the filament receives a deposit of carbon from the hydrocarbon bath and the inert hydrocarbon gas by which it is surrounded. To facilitate the operation a second pipe and cock are connected as shown with an exhaust chamber. By this last named pipe communication may be opened or closed between the exhaust chamber and the mercury chamber. By the use of this arrangement the mercury may be moved more quickly to draw the hydrocarbon down from filament. A small spigot is provided at or near the lower end of the cylinder by which the hydrocarbon may be drawn out.

James Bradley, Massillon, O., is the inventor of this method.

Morrison's Storage Battery Electrode.

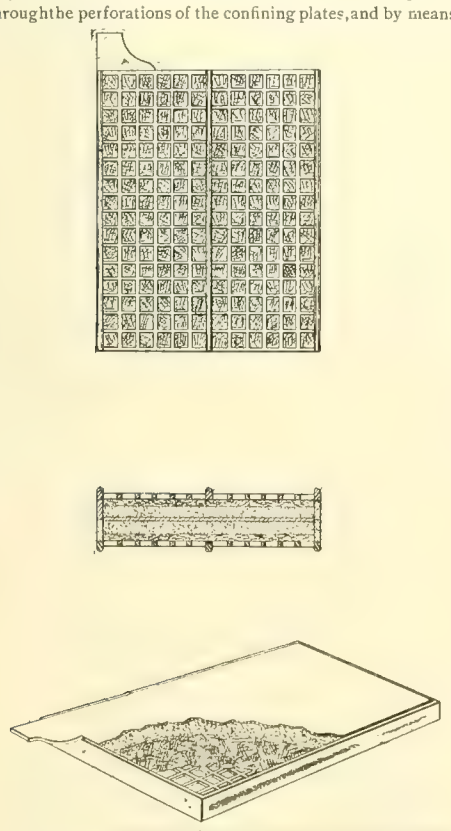
In the operation of secondary cells trouble is frequently encountered by reason of the breaking away of the materials used in the composition of the plates. These particles, passing into the solution, are precipitated upon the insulating strips or the bottom of the cell, forming a conductor between the plates, thus oftentimes short circuiting and setting up local action. To overcome the difficulties mentioned, William Morrison of Des Moines, Ia., devised the plate illustrated herewith.

Of the cuts presented Fig. 1 is a side view of the completed plate; Fig. 2 is a sectional view, and Fig. 3 is a perspective view of one-half of a plate broken away to show the materials. Referring first to Fig. 3 the construction will be understood.

First there is a grid, and on top of this is a layer of "glass wool." This material, it should be explained, is made up of finely divided fibers of glass, and is, therefore, highly porous. Glass wool is practicably indestructible, not being subject to the action of the acids. A layer material to become active is spread over the glass wool, and this is followed by a conducting plate or cover, as shown.

The other side or half of the electrode is built up in the same manner, with the exception of the conducting plate.

An electrode is produced in this way which has a central conducting plate, to which the leads are connected, and a layer of active material on each side of the conducting plate and layers of glass wool interspersed between the outer confining plates and the active material. It is obvious, consequently, that the active material is very thoroughly exposed to the action of the solution, since the latter passes through the perforations of the confining plates, and by means

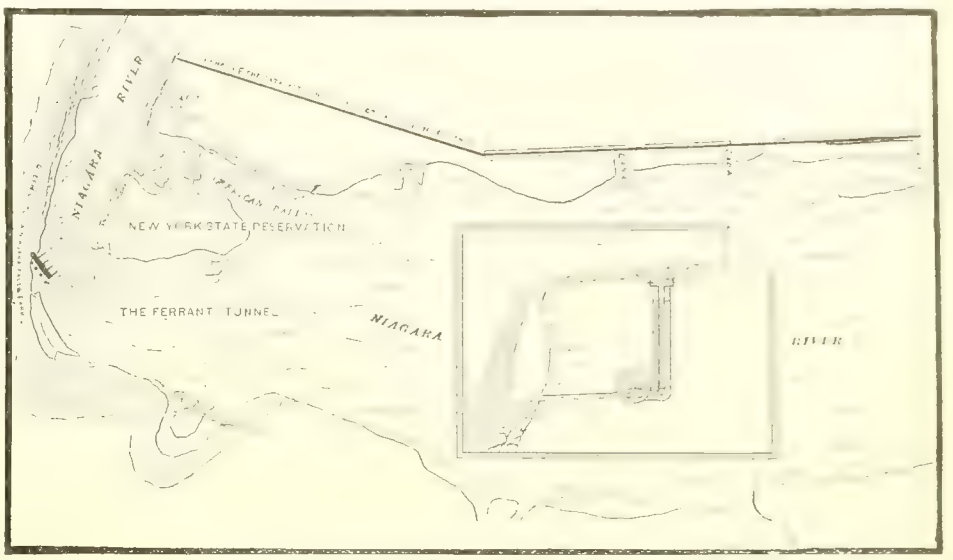


FIGS. 1, 2 AND 3 MORRISON'S STORAGE BATTERY ELECTRODE.

of the great porosity of the wool is enabled to enter into and upon the material. At the same time the glass wool being finely divided, its pores are so small that the active material is confined and held from passing out into the solution to set up local action. There is, however, a perfectly free circulation of the gases and solution. The glass wool being held against the face of the active material by means of the outer perforated confining plates, a space is formed between each electrode when joined in couple within the cell, so that gas finds a ready means of escape to the surface of the solution.

Utilizing the Power of Niagara.

The subject of utilizing the power of Niagara is occupying the attention of engineers in this country and abroad, and there are several plans now under consideration. In a recent issue of the WESTERN ELECTRICIAN attention was called to the fact that Mr. Ferranti was engaged on this problem in the interest of the company which controls the Canadian rights. The work has progressed to such an extent that there is now no doubt that operations will be commenced at an early day. The accompanying cut,



UTILIZING THE POWER OF NIAGARA

which is reproduced from *Power*, gives an idea of the character of the enterprise. The same paper says:

"A project is on foot for the erection upon the Canadian side of the great cataract, of a plant for the development of power and its electrical distribution under high voltage, to neighboring cities. The responsibility of at least the electrical portion of the enterprise is accredited to no less an authority than Ziani de Ferranti, whose work at Deptford was the first successful demonstration of the possibilities of transmission to a distance by means of high tension electricity. It is reported that a very strong syndicate of capitalists has obtained a franchise from the Canadian government, and will sink a series of shafts into the bed of the river just above the falls on the Canadian side, as indicated on the lower left-hand corner of the accompanying cut. Placed at the tops of these shafts are to be heavy iron gratings to prevent the entrance of stones and ice, and the water delivered through vertical iron flumes upon Pelton wheels connected to enormous Ferranti dynamos situated in a subterranean dynamo-room, from which a horizontal flume or tail-race discharges the water from the wheels at the base of the falls, as indicated in the central sketch. The large machinery tunnel will be extended under the bank with an entrance ashore, and the first vertical shaft sunk upon the edge of the bank, which will upon completion be cut away to admit the water. Further shafts will be sunk, as the demands for power increase, by the use of anchored caissons. Great stress is placed upon the flexibility and immediate availability of the system, which can be started into operation as soon as one vertical and one horizontal shaft are completed, and the main or machinery tunnel carried to their point of intersection; whereas, the long tunnel upon the American side, the position of which is indicated in the engraving, must be entirely completed before a wheel can be turned. It is quite probable that the work, if undertaken, will be under the personal charge of M. Ferranti, who, it is said, proposes to extend his operations to this country, and who has full faith in his ability to utilize Niagara Falls."

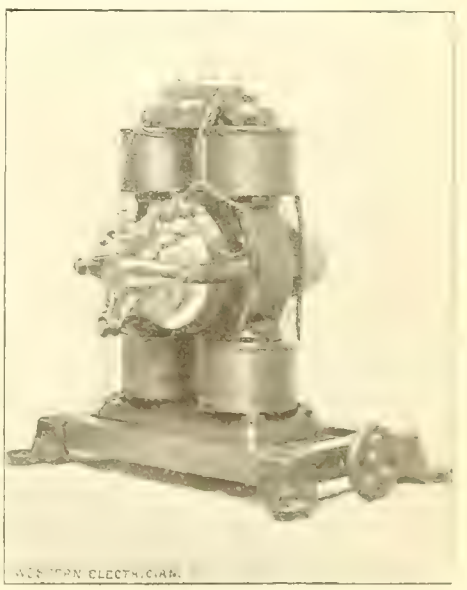
Mr. Ferranti will be encouraged by American engineers in his undertaking, and will receive a hearty welcome on his arrival in this country.

Electric Lighting in London.

According to a correspondent at the British capital the people of London are crying for more light. He says: "Electric lighting in London is making wonderful strides, and the only thing which now stands in the way of its universal adoption is expense. The cost of wiring a house for electric light for a reception averages 32 shillings, or about [illegible] house-wiring are covered by patents, which naturally increase [illegible] when the patents on them expire, it will be possible to get [illegible] the wiring at the rate of about $5 a lamp, and it will not be many years, therefore, before gas will be superseded in the household except when used for fuel. The advantages of this will be sufficiently obvious, and then it is to be hoped that the civic authorities will institute the universal application of the electric light for the illumination of the streets of the city, and so remove the stigma of the greatest city in Europe being the worst lighted."

La Roche "Special" Dynamo.

The La Roche Electric Works of Philadelphia have just completed a fine calibrating direct current dynamo for Queen & Co of that city. This machine was made especially for Queen & Co. and is said to be of very superior workmanship. The specifications called for a range in electromotive force from 1 to 1,000 volts, but when it was



THE LA ROCHE "SPECIAL" DYNAMO.

tested at the La Roche laboratory, and also at the [illegible] laboratory, it was found to have a range [illegible] to 1,200 volts. It can be readily seen that [illegible] develop 1,000 volts would be useless if a large [illegible] turns of wire, and with such an armature running [illegible] field at full speed without any current going through the fields whatsoever there would be considerable pressure developed on account of the magnetism left in the iron. In the La Roche machine the amount of magnetism is controlled by a special method so that it can be raised or lowered from the lowest to the highest point.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, - - - - - - - Editor and Publisher
[illegible] E. O'HARA, - - - - - - - }
[illegible] L. PERRY, - - - - - - - - } Associate Editors.
[illegible] E. KELLY, - - - - - - - - - }
[illegible] L. BAKER, - - - - - - - - - Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK
W. F. OSBORNE, Manager

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3 [illegible] for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions, foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—The WESTERN ELECTRICIAN—***the only general electrical paper published in the West***—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE

[illegible] Lights [illegible] Church, Brooklyn. Illustrated ... 355, 356
[illegible] Chicago's Parks and Boulevards ... 355
[illegible] Wires for Cities ... 355, 356
[illegible] Condenser. Illustrated ... [illegible]
[illegible] Telephone Numbers ... 356
A [illegible] Battery with an Iron Electrode. Illustrated ... 356
[illegible] World's Fair. Illustrated ... 357, 358
[illegible] Illustrated ... 358
[illegible] Incandescent Lamps. Illustrated ... 358, [illegible]
[illegible] Storage Battery Electrode. Illustrated ... 359
[illegible] Niagara. Illustrated ... [illegible]
[illegible] ... [illegible]
[illegible] Dynamo. Illustrated ... [illegible]
[illegible] ... 360
[illegible] Meter. Illustrated ... 361
[illegible] ... 361
[illegible] Thos. G. Grier ... [illegible]
[illegible] Hand Elevator. Illustrated ... [illegible]
[illegible] ... 361
[illegible] Frank K. Irving ... 361, [illegible]
[illegible] Illustrated ... [illegible]
[illegible] Illustrated ... [illegible]
[illegible] ... [illegible]
[illegible] ... [illegible]
[illegible] Influence upon the [illegible] J. D. Bonnar, M. D. ... [illegible]
[illegible] ... 364
[illegible] ... [illegible]
[illegible] ... [illegible]
[illegible] ... [illegible]

DEPARTMENTS.

[illegible]

[illegible] published publication in [illegible] attempt will be made [illegible] in- [illegible] competent [illegible]

[illegible] for the [illegible] an interesting study, and it is to be regretted that the deci- [illegible] main, satisfactory. Foucault's name is not in the list, [illegible]

ed as a mistake. It is not too late yet, however, to make any changes that may be thought desirable.

CHICAGO wants more electric street lights, especially on the South Side parks and boulevards. The South Park commissioners are now considering a proposition to introduce electric lighting throughout the system. It is proposed to have the boulevards leading from the business district to Jackson Park lighted by electricity during the World's Fair. Any other arrangement would be a reflection on the enterprise of the city of Chicago.

THE prospective change in the system of telephone numbering in Chicago is a gratifying indication of the growth of the service in the western metropolis. It is certain that only by the greatest skill and most improved system of "calls" can the company hope to avoid hopeless confusion during the year of the World's Fair. Undoubtedly the new system, which is approved in Boston and New York, will enable the company to approximate the ideal service which it undoubtedly desires to afford its patrons.

THE opposition to the electrical execution law in its present form in New York continues, and it is quite probable that one of the first acts of the Legislature will be to repeal the provision of the present law which prohibits the publication of the details of executions. A contemporary make the following criticism: "The policy of executing men by an untried method, in secret, in the presence of witnesses sworn to reveal nothing in regard to the method of execution, is so vile that it is a mystery to us how any man with the slightest idea of the principles of liberty and justice can accept it."

RELIEF from the present inadequate street railway service in Chicago, as furnished by the cable campanies, is demanded on all sides. The press is very severe on the North and West Side companies, and it has been urged that the charters of these corporations be revoked, if such a step can be taken legally. One good result of all this agitation is that the attention of the people is more and more attracted to electric railways as the probable solution of the problem, and the prospect for the general introduction of the modern method of rapid transit in Chicago is becoming brighter every day.

THE absence of telegraph and railroad facilities in China is felt by the government as it finds considerable trouble in collecting troups and transferring them. Much time has been wasted by both the government and insurrectionists and but meager information of the movements of either has been sent out by cable. A good telegraph service would enable the government to follow closely the movements of the rebels and would greatly facilitate the handling of forces. It is expected that this will be fully impressed upon the government, and that an improved telegraph system will be established throughout the empire.

NOW that the aisles and other space in the electricity building at the World's Fair that are not to be used for exhibition purposes have been definitely located and determined, it can be readily seen that the prediction of the electrical people, before the building was begun, that the structure would be too small, was well grounded. The aisles and open space have been kept down to the lowest practicable limit, and there is 207,000 square feet of floor space left for the exhibitors' use. Already applications for space aggregating 175,000 square feet have been received, and these include but few requests from foreign nations and only a portion of the American houses that will be sure to make exhibits. It is evident that before the fair is opened Chief Barrett will have received applications for as much space for exhibits as would fill two or three buildings of the size of the structure now going up. This will necessitate a rare degree of judgment and tact on the part of the chief in the way of adapting the [illegible] to the supply. No doubt this will be done in a manner to satisfy everybody as nearly as the exigencies of the case will allow, and Chief Barrett is on record as giving an assurance that "everybody will have a show." But it is still a pity that the compressing and pruning [illegible] necessary.

[illegible] of New York, on returning from his [illegible] of rapid transit. He [illegible] in London, and did not appear [illegible] the underground system. Referring to [illegible] to de-

scending into the bowels of the earth to take a train." The opponents of the proposed underground system for New York are naturally well pleased with this utterance. Moreover, Mayor Grant adds: "The underground system in London is not a perfect system." This, of course, is no argument against the New York project. It has not been contended that the underground service of London was perfect. Its faults have been recognized, and the solution of many of the problems that have presented themselves since the London road was started has since been found. It is not proposed to copy the errors in the English system, but to profit by the experience of the projectors of the Greathead system, and improve the service in many particulars." As a matter of fact the advocates of elevated structures have little advantage in the controversy. What Mayor Grant says of the Greathead system has long since been said by the people of New York about the "L" road—it "is not a perfect system." There has been great unanimity on this point among New Yorkers, and it is hardly possible that Mayor Grant's views on the underground system of London will prevent them from giving the plans of the Rapid Transit Commission fair consideration.

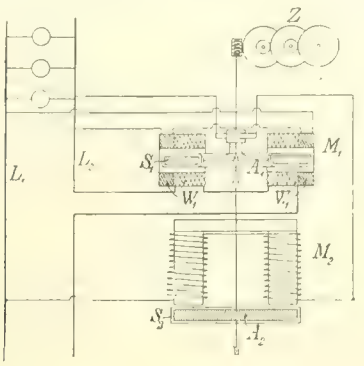
THE utilization of the vast water power of Niagara Falls is a subject in which all engaged in electrical work are deeply interested. It is proposed by the corporation controlling the Canadian rights to install an immense electrical plant, and the services of Mr. Ferranti have been enlisted in this undertaking. It is proposed to transmit power from the generating station on the Canadian side to points on the American shore, where it will be utilized for furnishing light and power for manufacturing establishments. It is estimated that current can be delivered in Buffalo at a price that will make competition from other sources of power practically impossible. The policy of the American company, it is announced, is to establish a large manufacturing town on the site which it has secured, and devote its attention to the development and improvement of this property. It proposes to rent water rights, and it claims that it has already sufficient assurances to guarantee the success of the enterprise. At present it will not give much attention to the transmission of power to Buffalo or other distant points. Later it may turn its attention to this subject. It is to be regretted that the Americans have not taken up this subject at once. If the Canadians once get a foothold, it will be difficult to supplant them. Their plans are now about completed, and assurance is given that operations on a large scale will be begun at once. Mr. Ferranti is expected in this country shortly, and it is believed that he will be induced to devote his entire attention to the solution of the Niagara problem.

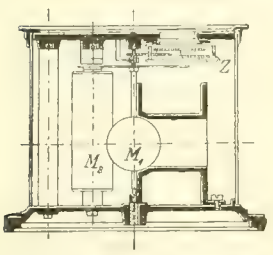
DURING the last year it has been a noticeable fact that a number of the ablest American electrical engineers have severed their connections with the companies on whose staffs they have been so actively employed. The majority of these men occupied prominent, and in several cases, the most prominent positions in their respective lines of work. Now we find these engineers branching out for themselves. By many this movement may be looked upon with indifference, or it may be ascribed to the natural inclination and ambition of Americans to be thoroughly independent in all their thoughts and actions. Yet there are still others who ascribe this general movement to a far different cause. At the present time, it is argued, there is not so much need for strictly original work. The development of the electrical business has reached the point that the companies manufacturing apparatus on established lines feel that there is less demand for this class of engineers. In the pioneer days the brilliant man, always equipped for emergency, had to be retained at any price. He possessed what little experience there was then to be obtained, and to be without him was to be like the ship without the compass.

We do not wish to be understood as implying that the master minds are employed only as independent engineers. Can it be, though, that there is a growing tendency to stand still, so to speak, where companies, at this stage in a growing business, yield to the temptation to design and stubbornly maintain a standard equipment? "Of course competition regulates this," someone will say. For this very reason, then, Americans should look to their laurels. On all sides we hear of the work of foreign engineers. It is reported that Ferranti is coming to this country to show us what can be done with the alternating current, and it is pretty well known that Siemens & Halske are even now negotiating for the installation of an electric railway with underground conductors in Chicago. It must not be forgotten, either, that Siemens & Halske have already done underground work that will secure them a hearing. In view of these facts it is not without reason that the warning may be given Americans to look to their laurels.

Hummel's Motor Meter.

Shuckert & Co. exhibited at the Frankfort exhibition an interesting form of motor meter devised by Herr Hummel. Fig. 1 is a diagram of the arrangement. A_1 is the motor armature wound with wire S_1 in shunt across the installation to be measured. The field magnets have two circuits, one in shunt to the installation and the other in series. The shunt excitation is very small, and is only just enough to overcome the pivot friction of the motor. The torque due to the main excitation is proportional to the product of the main current and the pressure—that is to say, it is proportional to the power. A_2 is a second





FIGS. 1 and 2. HUMMEL'S MOTOR METER.

armature, which is short circuited, and is acted on by a field M_3 in series with the motor armature. The torque needed to turn this armature is thus proportional to the speed and pressure. The speed of the motor is thus proportional to the main current, so that the instrument is a coulomb-meter. Fig. 2 shows a section, and Fig. 3 is a perspective view of the meter. In practice the second armature takes the form of the usual Arago disk. The cuts are reproduced from London *Industries*.

Large Wiring Contracts.

The Western Electric company has lately been awarded three important contracts for the electrical equipment of new and important buildings in Chicago. One of these—that for the great Leiter building on State street—has already been mentioned. The other two are for the Woman's Temple, La Salle and Monroe streets, and the Ashland block, Clark and Randolph streets. The former is one of the most beautiful buildings in Chicago. It was put up by the Woman's Christian Temperance Union, and is now about completed. It will be wired for 3,600

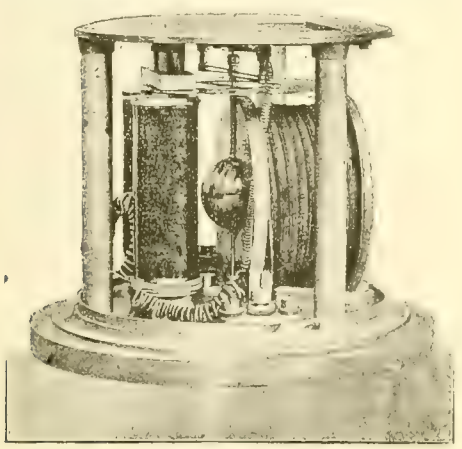


FIG. 3. HUMMEL'S MOTOR METER.

incandescent lamps, and an isolated plant will be installed, consisting of three 1,300 light Western Electric dynamos driven by two Fitchburg engines of 200 horse power each. Hill clutches and rope transmission will be used. In the big Ashland block 3,650 lights will be wired. The exact nature of the generating plant has not been decided upon, but it will be of 180 kilowatts capacity. Ideal engines will be used.

Memorandum on Rope Transmission.

[illegible] G. Gill

In the discussion as to the comparative efficiencies of rope transmission and electrical transmission there seems to be little actual data in regard to the loss in existing plants using rope transmission. The loss in an electrical plant may be easily determined, and in fact can be estimated with a very close approximation before the plant is installed, but it is not so in regard to rope transmission.

To obtain some figures upon an existing plant in average condition, the cards on an engine operating six fans by means of rope transmission were taken, and cards were also taken giving the power required for the transmission apparatus when the fans were uncoupled. It was found that the maximum power developed was 98 horse power, and the power developed to operate the transmission apparatus alone was 33 horse power. The efficiency of the outfit it will be seen was at maximum load less than 70 per cent. There is a very apparent fact in connection with this rope transmission, and that is that the 33 horse power which is used for operating the transmitting devices is a constant factor, and should at any time a decrease in the load be desired, several of the fans being uncoupled because their services were not needed, the loss of 33 horse power is still there. In an electrical installation to have an efficiency of 80 per cent. under maximum load would be an easy matter. This would mean a loss of 20 per cent of the maximum power developed, and should the load be reduced to one half, we have a reduction of about one-half the loss of power. The only factor of loss remaining constant in an electrical transmission plant is the loss required to energize the fields of the generator and the power of overcoming the inertia of the engine and dynamo.

Rope transmission has many friends among the engineers of to-day, yet the time is not far distant when these same adherents of rope transmission will find that their allegiance cannot withstand the march and progress of the age. Cornell University is investigating the economy of rope transmission, and with their figures before us we will have an additional reason to more strongly favor the transmission of power by means of electrical energy.

Transmitting Power from an Electric Motor to a Hand Elevator.

Seeing the need for an attachment through which the hand power elevator might be transformed into an electrical elevator without great cost, the Smith-Hill Foundry and Machine company, of Quincy, Ill., is placing on the market the new electric power transmitter presented in the accompanying illustration.

A glance will show the utility of the arrangement. The machine is described as compact and strong, and requiring little attention. The journals are run in phosphor bronze ball and socket boxes, having sight-feed automatic oilers and are designed for high speed. All the belts are endless, and have screw and ratchet belt-tighteners.

Loose pulleys are provided with self-oilers. The most important feature claimed for the apparatus is that not the slightest change is needed in any hand power elevator in attaching the transmitter.

For safety, a positive automatic brake, top and bottom stops and hand stops at each floor are provided.

The motor may be instantly controlled from any floor and stops may be made where desired.

Especial stress is laid on the fact that the first cost of the transmitter is very small and that the cost of operating is slight. The motor required is of 3 horse power, which is enough for handling general freight. The cut is reproduced from the *Age of Steel*.

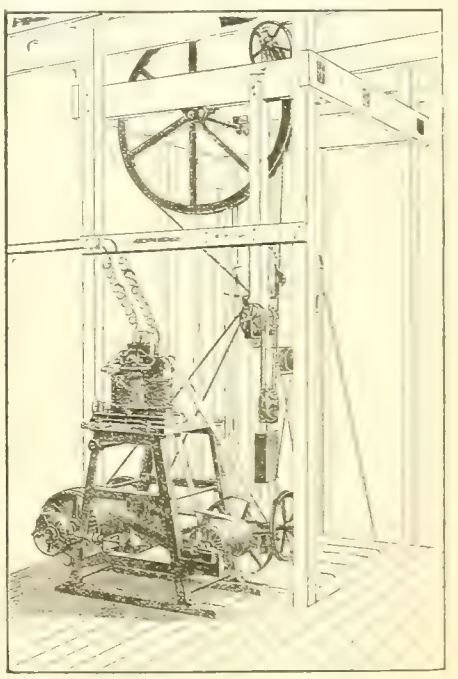
Chicago Electric Club

Judging from the attendance and amusement caused, the social meetings of the Chicago Electric club are proving a great success. On Monday evening there was a large number present to witness the farcical proceedings at a session of the council of the city of Abbs, which met to receive proposals for an electric light plant. The burlesque was heartily enjoyed, thanks to the efforts of C. G. Armstrong, T. P. Bailey, C. E. Gregory, W. J. Buckley, F. E. Degenhardt, F. L. Perry, E. C. Ferguson, J. L. Martin and others. Mr. Gregory as the clerk of the board and Mr. Buckley, as a poor lone female, determined to assert her rights despite the "sassy men," were especially funny. The evening's entertainment was rounded out by excellent recitations by L. A. Ferguson and Mr. Fowler, and songs by Messrs. Harding and Jampolis. Refreshments were afterward served.

The Chemistry of the Primary Battery.

[illegible]

gy from chemical combination. Yet, strange to say, up [illegible] seemed strange to [illegible] subject. We want to commence at the beginning in studying this subject, and take it step by step, weighing each result obtained by experiment carefully, and drawing the conclusions and the reasons thereof to the best of our present knowledge. Now let us start with the most simple cell, that of amalgamated zinc-copper and acidulated water, and for the sake of simplicity we will first suppose the liquid in the cell to be pure water, neglecting, for the present, the sulphuric acid which it contains. Now water is composed of two gases—oxygen and hydrogen—which, having a certain strong liking or, as we say, chemical affinity, for each other, and so long as they are not too powerfully affected by external circumstances, they remain firmly united together to form this well-known liquid. Now, as with every other kind of matter, whether solid, liquid or gaseous, the physicist believes water to be made up of a vast number of extremely minute particles, which he calls molecules or little masses, each of these molecules being so extremely small that by no mere physical process can it be subdivided. Nevertheless, small as it is, to all intents and purposes it is water, just the same as the largest body of that fluid which it is possible to imagine. Here the physicist stops. This molecule, which he defines as the smallest particle of a substance which can be or

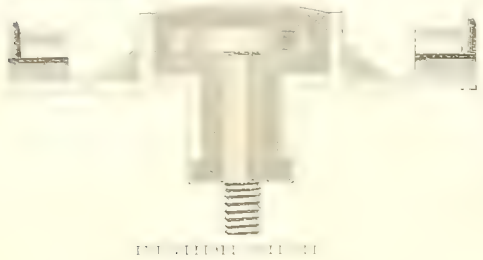


TRANSMITTING POWER FROM AN ELECTRIC MOTOR TO A HAND ELEVATOR.

exist in a separate state, he takes as the unit which he employs in all his theories and calculations. Now the chemist comes in. He takes the molecule and by chemical decomposition splits it up into its component atoms, defining an atom as the smallest particle of an elementary substance that can be moved in the molecule or from one molecule to the other. This atom is the unit of the chemist. Now if I have made the above clear, it will be understood by the reader that the molecule is the smallest particle of a substance, whether simple or compound, which can be obtained by mere physical division, while the atom is the smallest particle [illegible] which can be obtained from the chemical decomposition of a molecule.

Using the above definitions, we would now say that each molecule of water is made up of three atoms—two atoms of hydrogen and one atom of oxygen [illegible] the chemical shorthand, or symbol [illegible]. Now when our plates are united in the battery, a disturbance of the chemical equilibrium of [illegible] is the affinity of oxygen for hydrogen [illegible] greater liking for zinc; thus the molecules of water are decomposed, the oxygen uniting with [illegible] oxide of zinc, the hydrogen being given off at the copper

pole. In the explanation of the cell as above, we have assumed the liquid to be pure water, although dilute sulphuric acid is most always used, for the reason that the oxide of zinc formed does not readily dissolve in the water, but tends to cling to the zinc, thus impeding the further generation of a current. The chemical action, when sulphuric acid is used, is precisely similar to that just given for water. The molecule of sulphuric acid consists of one atom of sulphur, two atoms of hydrogen and four atoms of oxygen, a fact which is expressed by the chemical symbol H_2SO_4. From this compound molecule the hydrogen is displaced and the SO_4, or sulphion, unites with the zinc and forms a sulphate of zinc, $ZnSO_4$, which is freely solu- in the liquid.



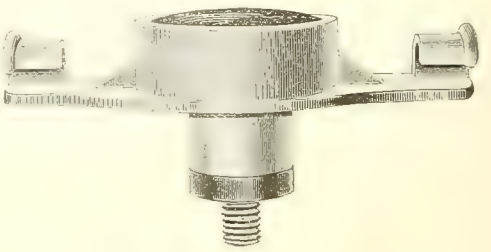
Upon such an assumption as this, it is, of course, easy to understand the production of a current in an ordinary cell, and to discover the causes of its diminution, which are these: The positively charged hydrogen turns toward the negative, copper plate, while the negative oxygen goes to the positive, zinc, the oxygen uniting with the zinc, and the product of the combination being dissolved in the solution. Thus the positive plate is kept clean and always ready for a fresh attack of oxygen, but with the copper plate it is different. There no combination of hydrogen takes place, consequently the negative plate soon becomes coated with a film of hydrogen gas, which acts injuriously in two ways: First, gases being almost impenetrable by low tension current, acts as a non-conductor; secondly, hydrogen being positive, we have virtually two positive plates in the cell, which, of course, tends to prevent any generation of current. As, moreover, the hydrogen film is more positive than the zinc, it tends to give rise in the liquid to a counter electromotive force from the copper to the zinc, thus equalizing the current which should be produced, and producing a slight reverse current in some cases. We also find another reason for the deterioration of the current in the production of a super saturated solution of zinc sulphate ($ZnSO_4$) which occurs from the uniting of the sulphion (SO_4) with the zinc (Zn), thus preventing the dissolving of any further salt of zinc, and practically stopping the chemical action on the zinc plate.

Now that we have finished a brief analysis of the zinc-copper element, let us take up a few of the well known batteries now in use, commencing with the one nearest in construction to the one we have just described, which is the Smee. In this battery we have two zinc plates and a plate of platinum or platinized silver. In this form of [illegible] is prevented by the

in the Smee to free the hydrogen, and there being no combination made between the carbon and hydrogen, this battery soon polarizes or becomes coated with the hydrogen film first mentioned. But on the other hand if we mix a little powdered bichromate of potash ($K_2Cr_2O_3$) with the dilute acid solution, we find that not only is the hydrogen taken up, but that the electromotive force is increased to 1 89 and the internal resistance decreased to about .45 of an ohm. Now let us see what chemical action takes place to produce this result. The sulphuric acid goes to the oxidizing zinc and forms a sulphate. The hydrogen goes to the carbon, but encounters on its way the chromic acid (Cr_2O_3), which has been liberated from the bichromate of potash ($K_2Cr_2O_3$), the potash having gone to the sulphuric acid to form chrome alum and sulphate of potash (KSO_4). This chromic acid, as we see from the chemical symbol, Cr_2O_3 is very rich in oxygen, containing three equivalents. Now the hydrogen, having a great affinity for oxygen, takes one atom of oxygen from the chromic acid and becomes water. (We have already shown that two atoms of hydrogen and one atom of oxygen form water). The chromic acid, now having lost one atom of its oxygen, becomes the green oxide, or protoxide of chromium (Cr_2O_2). This statement can be easily verified, as we will see on examination that the red color of the solution will soon change to green. This battery is considered one of the strongest cells, having a high electromotive force and a small internal resistance, but it has a great many faults, some of which we will look into. When the cell is not in use, the chromic acid being very easily decomposed, the zinc oxidizes at the expense of the chromic acid, reducing it to the green oxide, or protoxide of chromium (Cr_2O_2), without the generation of any current; also when the battery is in use, the zinc becomes coated with the chromic oxide and assumes a polarity similar to the carbon. Then the sulphuric acid having a chemical affinity for potash, a compound is formed known as chrome alum. This compound clings to the carbon and reduces the conductivity, also increasing the internal resistance. This statement can also be very easily verified by mixing the bichromate of potash, acid and water together, the water being hot. Let the mixture stand thirty-six hours and decant, and we will find the sulphate of potash (KSO_4) in crystals at the bottom, leaving free chromic acid in solution. If this compound is used in the battery, we will not be troubled with the chrome alum deposit, and we will also have much better results on account of the solution being mixed and cooled before use.

We now come to a class of batteries using two or more separate solutions—one solution, usually the dilute acid and zinc, in the jar, and the depolarizer and carbon, or other material, in a porous earthenware cup or cell. The simplest and most constant of these is the Daniell. In this battery we have a copper plate with a solution of sulphate of copper ($CuSO_4$) in the glass jar, and a solution of sulphuric acid and water, one to sixteen, with the zinc in the porous cup. Now, as in the original form we first examined, the dilute acid unites with the oxide of zinc (formed by the union of the oxygen, evolved at the zinc pole, with the zinc) and forms a sulphate of zinc. The disengaged hydrogen of the molecule of sulphuric acid next to the zinc plate reacts upon the next molecule and displaces its hydrogen; this hydrogen displaced from this second molecule of sulphuric acid reacts in a like manner upon the next molecule, and so on, until the porous cup is reached. Here the "nascent" (or active, as it is called when in this state) hydrogen meets with the sulphate of copper ($CuSO_4$) and displaces from its nearest molecule the copper, forming with its other atoms sulphuric acid, and this copper, reacting upon the copper of the next molecule, displaces its copper, and so on until the molecule next to the copper plate deposits its copper upon the plate. By this it will be seen that sulphuric acid is formed in the outer cell, which tends to replace that used by the zinc, [illegible] the copper plate is increased in [illegible] deposit of metallic copper resulting from the decomposition of the [illegible] by the hydrogen. The amount of sulphuric acid liberated in the outer cell is regular, and is proportional to the acid used in the porous cup. This battery has its faults also, one of the greatest [illegible] caused by the sulphate solution dialyzing through the porous cup and oxidizing at the expense of the zinc. This [illegible] resistance. The constants are: Electromotive force, 1.098; [illegible]

cup we use strong nitric acid (NO_5) with a plate of platinum. As in the other cells, we also have the sulphate of zinc formed, and hydrogen set free. At the porous cup the hydrogen meets, not with sulphate of copper, but nitric acid. From this nitric acid (NO_5) the hydrogen takes one atom of its oxygen, with which it forms water, leaving nitrous acid (NO_4), and thus liberating hyponitric acid fumes. In this battery we have the nitrate of zinc (Zn_2NO_3) formed, as well as the sulphate; also the red oxide of mercury (HgO). This is due to the nitric acid dialyzing through the porous cup and attracting the zinc and mercury used to amalgamate the zinc. These hyponitric vapors may be prevented by the addition to the nitric acid of any compound rich in oxygen and held together by a weak chemical affinity.



THE ELLIOTT PULL-OFF.

Suppose we use bichromate of soda ($Na_2Cr_2O_3$). Now, as soon as the hyponitric acid is liberated, it takes up one atom of oxygen from the soda and becomes nitric acid again. We also have a nitrate of soda (Na_2NO_3) formed, but this does not affect the working of the battery in any way. The constants of the plain nitric acid battery are: Electromotive force, 1.93, resistance, .025; when chromic acid is added, electromotive force 2 02, resistance, 023.

Thus we see from the several experiments we have examined that the difficulties which sometimes appear great are small when studied out; also, that the vast domain of chemistry opens numerous ways for the perfection of the primary battery, if they are carefully studied.

The Elliott Pull-off.

The general construction of this little fixture is clearly shown in the illustrations. It should be explained, though, that the Elliott hanger and pull-off has an additional insulating surface not shown in the cuts. This improvement has but recently been added. The insulation extends upward, and entirely covers the lower shank of the hanger and pull-off, thus increasing the insulating surface by one inch all round. The construction, too, is such that the device cannot be struck by the trolley pole or wheel.

This pull-off has been placed on the market by the Revere Rubber company, Boston, Mass.

Hale's Live Wire Cutter for Firemen.

When one notes the respect with which high tension electric light wires are handled by those whose business it is daily to manipulate them, there arises a natural inclination to sympathize with any fireman who, in the pursuit of his hazardous calling, may be loth to take charge of the sometimes extremely energetic "live" wire. The fireman, as a rule, prefers that the lighting wire shall be relegated to the central station lineman, but there are cases when professional pride outweighs prudence. It is then he sighs for the means whereby he can himself do the work without the risk of what may be a deadly shock. It was the desire to provide means by which the fire department might be enabled to clear the way without having to call upon outsiders that led Chief G. C. Hale of the Kansas City, Mo., fire department to devise the simple but most efficient tool illustrated in the cut.

This clipper is so perfectly insulated that it is practically

HALE'S LIVE WIRE CUTTER FOR FIREMEN.

impossible to receive a shock or detect any current whatever while cutting the most highly charged wires. It is also very useful for cutting and clearing wires from the streets after they have been torn down by falling walls. One great advantage of this cutter, which is about five feet long, is that the operator can stand on the cross arms of the poles, or on a ladder, and reach a considerable distance to the right or left from his position. The tool is light and easily handled.

This cutter has been placed on the market by the Kansas City Fire Department Supply company of Kansas City, Mo.

Chicago Electric Club.

The paper on "Safety Devices" by C. C. Haskins, read before the Chicago Electric club December 7th, which was presented, together with the formal discussion, in the last issue of the WESTERN ELECTRICIAN, excited considerable interest. Following the remarks of Messrs. Cutter, Bain, Wirt and Sperry, there was a general discussion, a stenographic report of which is appended:

THE CHAIRMAN: It seems to me most fortunate that we should have selected a subject for this evening of so much importance to the electric light business, and I think the papers we have listened to have fully indicated the absolute necessity of something being done to put this matter of safety devices in much better shape than it is to-day. We lack a proper way of standardizing these things. But in 1893 we expect to have here an electrical congress, and it is hoped at that time a great many things will be corrected that are somewhat out of joint just now. I submit for your consideration whether it would not be well for this club, taking advantage of the discussion we have had this evening, to appoint a committee to prepare a communication which I presume might be presented to Professor Elisha Gray for the purpose of having included in the list of subjects that ought to be considered by the World's Electrical Congress the standardizing of fuses.

G. P. NICHOLS: There is no question but that the subject of safety devices for motors is as important, perhaps more so, than any other application of electrical devices. Of course in protecting an electric motor the fuse is a supplementary safety device. The motor should be provided with such appliances as to make the fuse almost unnecessary. To begin with, no motor should be put up without having a double pole switch, with a third insulator at the back. This should be so designed that when thrown open it would be held there, making it impossible to close it unless it were forced back. This cuts off all connection of the motor with the main circuit. But while the motor is running there are always dangers resulting from a little knowledge of the matter, particularly so with the rheostat, and the statements which Mr. Haskins makes in this connection are well considered. But in all cases a motor should be provided with a suitable fuse or automatic device which would be released and would cut off the current when more than a certain number of amperes were put on.

G. D. DORMAN: As far as my experience goes I have not been familiar with any fires or accidents occurring from the failure of fuses to act, but I believe that the terminals of fuses should be standardized as much as the wire in the length of the fuses. In that way the conditions would always be the same. I know of such a fuse introduced on the other side of the water. It is meant to fuse at the high melting point of metal. The wire is inclosed in a glass tube, with capped ends, the glass tube being always of the same length, and the caps at the ends being always the same shape and size. I believe that fuses will continue in use for currents up to ten amperes; but beyond ten amperes a magnetic cut-out will be the future safeguard. With regard to motors I agree with Mr. Haskins that the switch should always be right closed or right off. It is possible to make the wires in a rheostat thicker at one end than at the other end, but by having a spring or weight to throw the arm down, or spring catch at the other end to keep it in position, a wire of the same size will do through the whole rheostat.

LOUIS A. FERGUSON: I agree with Mr. Haskins on the question of starting rheostats for motors. It has been a particular hobby of my own for some time, and I vame a set of rules for the installation of motors for the company I am working for a year ago this month. The reason was not theoretical at all. In my own experience in Chicago there were at least five fires caused by the contact arm of the switch being left at intermediate points just as Mr. Haskins has described.

There was one thing that Mr. Wirt spoke of in regard to fuses which I think is important, and that is the terminals of the fuses themselves. A great deal of the trouble with fuses is caused by poor contacts. I have been often called upon to examine plants where they thought they had an overload. The first thing I would do would be to have the strips replaced and examine the connections of the cut-outs if they were cut-outs on the switch-board, and following along the wire to ascertain the temperature and the source from which it came. In almost every case of that kind I found that the cause of the strip blowing was either due to the imperfect connection of the wire with the cut-out, or to the bad contact of the terminals of the fuse with the cut-out itself. There are certain strips made for protecting circuits where copper itself is used as the terminal. In other cases a composition is used, and in a great many cases I found where this composition is used the trouble that I speak of occurs; whereas where pure copper is used for the terminal you have very little trouble from the blowing of fuses from poor contact.

MR. NICHOLS: The gentleman speaks of some fires resulting from rheostats. May I ask the condition in which the rheostat was left, and was it intentional or through ignorance—that is, in trying to regulate the speed—or whether it was the natural consequence of the construction?

MR. FERGUSON: In the first case the cause of the trouble was the very one that Mr. Haskins cites. It was in a printing office, and was caused by a boy leaving the office and throwing the switch over, and instead of reaching the farthest contact point and opening the circuit it stopped on the second last contact point, and the result was that the excessive current going through burned the box up. Other causes I have known have been through ignorance, the man not understanding what a resistance box was for; supposing that instead of being used as a starting box it was to be used to regulate the speed, and had used it so. Outside of those cases I do not know of any other cause of fires.

MR. NICHOLS: In the majority of the cases was the trouble caused attempting to regulate the speed of the motor by the rheostat?

MR. FERGUSON: No, sir; attempting to regulate the speed, and also leaving the switch on an intermediate point through carelessness.

MR. DORMAN: I have this to say, that with the [illegible] is absolutely safe, and there is not the necessity for springs and weights and catches. As long as the ordinary rheostat is used according to the directions the machine ought to be all right.

MR. FERGUSON: In the case I cited on State [illegible] there was a card of instructions over the box.

MR. HASKINS: Those signs are all over town.

MR. FERGUSON: And I don't think you can make the people of Chicago believe everything you tell them. They don't always trust the starting and stopping of a motor to a man that knows enough about its working.

F. L. PERRY: It seems to me all this points in the direction of a magnetic cut-out. We have them on our arc lamps, and I think we will concede they are working very satisfactorily. The lamps cut out when the carbon breaks. You ought to have a safety box that is locked and have it so arranged that when you leave your lever half way on your cut-out will act.

MR. DORMAN: The fuse must be made of the same thickness or carrying capacity as the rheostat wire; and it is probable that the fuse may burn out at a normal current. A safety device would protect the rheostat if the latter were made of such thick wire that it wouldn't burn out at the normal current of the machine.

MR. PERRY: That still points to a magnetic cut-out. I don't see why you cannot have a magnetic cut-out in addition to a fuse.

GEORGE CUTTER: I feel that I would like to emphasize the importance of this question, as I view it. Theoretically we should have devices to protect our wires. Why not have them practically? Why have one house supply us with wire that will carry ten amperes and the next forty, and the next twenty five, and no uniformity at all? With the rapid growth of electric lighting and motor work it is time that some action should be taken to prevent such uncertainty and positive know-nothingism about our safety devices.

Electric Power Distribution [1]

By H. C. SPAULDING.

The commercial possibility of transmitting power for comparatively long distances by electrical means, when the losses attendant upon such transmission by any other system would be prohibitory, is sufficiently well known and acknowledged at the present time to call for no extended comment. Curiously enough, our friends on the other side of the Atlantic are now far in advance of us in the utilization of natural energy for lighting and power service, although the number of water-power installations is rapidly increasing in our Western states and territories, where the high cost of fuel would naturally bring about such a result. In Switzerland alone there are already upward of two hundred electric power stations utilizing water power for operating lights and motors over extended areas, while possibly the best known illustrations of such service in our own country are at Spokane Falls and Aspen.

It is the purpose of this paper, however, to separate, so far as possible, the closely allied topics of power transmission and power distribution, electrically considered, and to treat the latter principally in the light of its adaptability to manufacturing and constructing operations. It is accordingly immaterial, so far as the scope of this article is concerned, whether we are to utilize a water privilege ten or fifteen miles away, and possibly so situated between high and precipitous banks as to render it impossible to locate our manufacturing plant there, or to distribute the power furnished by a steam plant in the immediate vicinity, which may, however, be so isolated as to reduce fire risks to a minimum while taking advantage of the most economical situation for coal and water supply. Let us assume, therefore, that we are provided with an electric current supply sufficient in quantity to operate whatever apparatus we may wish to connect and of sufficiently low pressure or "voltage" to allay any fears of personal injury on the part of employes.

The "main shafting" naturally demands our first attention, and if the buildings are of more than one story, the advisability of dividing the plant into sections, each one of which may be started or stopped independently of any other, and without belt towers or belt holes (those efficient dust and fire conveyors), is evident to the most superficial observer; while in a single story building such sub-division reduces to a minimum the friction of lines of shafting, run most of the time, it may be, for the operation of only two or three machines. Engineers will appreciate fully the tales the indicator will tell, in nine out of ten of our larger manufacturing plants of the power devoted to revolving the immense "main shaft," and in transmitting power from one line of shafting to another when not a single machine tool is in operation. While it is not advisable to run any but the largest tools by separate motors, it will usually be found possible to group machines in systems requiring from 10 horse power upward, and so arranged that the average of power required will not vary between wide limits, and such variations will not occur suddenly. We can then connect with the shafting for each group a properly designed motor, which may be started or stopped almost instantaneously, and if desired allowing of delicate adjustment in speed.

The increase during the past few years in the size of construction parts and machine tools has called for a corresponding increase in the power of devices for handling them, as demonstrated by the number of traveling cranes put in by the larger manufacturing plants. The friction losses in transmission by square shafts or other prevailing methods are excessive, and the possibility of operating the heaviest traveling cranes without mechanical connection between the crane trolley and the source of power, as provided by electrical means, appeals at once to the engineer,

[illegible] one on each side of the main floor, resting on insulators, [illegible] the wire as it passes along, somewhat as in the method employed by cable cars in lifting their cables. The motors on the crane trolley receive their current through carbon [illegible] the bridge. The total longitudinal travel of the crane is [illegible] vided, which holds the hoisting gear automatically and instantaneously whenever the supply of current is shut off from the hoisting motor. The extreme ease of operation, and the fact that the expendure of power is almost exactly proportional to the work accomplished, and ceases absolutely when the crane is not in motion, are important features of this class of apparatus.

One of the most useful applications of electric motors is in connection with hoisting apparatus of various kinds, including passenger and frieght elevators. A power hoist is often required in a storehouse or shipping room at some distance from line shafting, which it would be expensive to extend, while steam piping means possible injury to stock from frozen or leaky pipes, and a small steam plant means increased insurance. Under these circumstances the electric hoist is available, taking its power from a pair of wires which may be carried over and through buildings and around corners with a minimum of space, care and expense, and a maximum of [illegible] These hoists, when used for loading and unloading steamers, are furnished with a few feet of flexible cable, and may be connected in a few seconds with "service plugs" located in various parts of the wharf, the current being taken either from the lighting wires on the steamer or on shore, or, better, from a special power circuit, if such be available. Hoists of this kind may be advantageously used for building operations, and are appreciated on account of the absence of smoke and noise.

The earlier applications of electricity to elevator service were not especially successful, except for slow speeds, as it was not for some time considered feasible to start, stop and reverse the motor itself, thus imposing the disadvantages inherent in "open and crossed belt machines" upon all electric elevator installations.

The only practical method of using motors for high-speed passenger work was for some time, therefore, in operating the pumps of hydraulic systems but of late the development of quick controlling and reversing apparatus, with special types of motors, has made possible results fully equal in smoothness of operation to the best hydraulic practice, while the running expense is usually considerably less. Designs are in use for a double-drum freight or slow passenger type of machine, in which the movements of the apparatus are controlled entirely by electric means, the armature shaft of the motor being run in either direction at will, and at any desired speed.

The enormous areas required by many of our industrial concerns for carrying on the various processes of manufacture to the best advantage necessitate new and improved methods for the transportation of fuel, supplies, and material in various stages of treatment from one part of the plant to another; and here again the invisible agent, electricity, offers its services in a safe, compact and effective form.

Among the numerous auxiliary uses to which electric apparatus may be put is that of pumping, either for boiler feed or general supply purposes. A number of automatic switches are now on the market, by means of which an electric pump may be automatically started or stopped by a change of water level either in a gravity or pressure tank, a feature susceptible of numerous adaptations as suggested by circumstances.

An objection sometimes offered to the adoption of electric apparatus is that, owing to the "youth of the art," the types of machines now built and on the market will in a few years be obsolete, like a coat outgrown though not outworn, so that the necessary investment is an unwise one on the part of the purchaser. This view seems to the writer not fully warranted, in the light of recent developments in electro-dynamics, since the efficiency of this class of machinery is now so high as to direct the ingenuity of electrical engineers rather to the invention and improvement of auxiliary apparatus for controlling, measuring and protecting the currents produced, than to the invention of new apparatus for their production.

The claim may now fairly be made also that the various "gauges" of the electric systems have been brought to standard, and that a [illegible] reliable company is [illegible] with apparatus [illegible] ing, concern, provided the two systems are of the same general nature. This is just as necessary as that there should be [illegible] supplies [illegible] courtesy [illegible]

In [illegible] mechanical [illegible] with the source of power is concerned, the entire transmis-

1. Abstract of a paper presented at the New York [illegible] American Society of Mechanical Engineers.

Heat in its Relationship to Electricity and its Influence upon the Animal Body in Health and Disease.[1]

By J. D. Bonnar, M. D.

We all know that the great source of all light and heat is the sun, in fact, we may truly say, of all motion, either in masses or molecules, that its origin may be traced to the sun—the great luminary of day and night. The cause of heat is rays from the sun, and by pressing this investigation still further we will find that heat and electricity bear a very striking relationship to each other. We all know that heat and motion are convertible terms; either will produce the other. This is true of matter in masses or in molecules; but we find that the combination of substances having chemical affinities for each other produces heat. Here we must conceive of the motion being a movement of the atoms or molecules to form a new compound; but by so doing we find as an accompaniment of the process heat and electricity. To go back to our starting point, viz.: That the sun is the origin of all heat, and also of all light. We are told by astronomers that the sun is a great molten mass. From our own experiments, we learn that all bodies which combine chemically with each other have certain opposite electrical conditions, and they unite with each other, producing an electrical current, which may be conveyed along wires to distances remote from the place of origin. We find that the electrical conditions are in definite and constant proportion to the attraction or force with which bodies seek to combine with one another. Hence may we not justly conclude that in the sun the same conditions control the chemical combinations continually going on in its structure? If we are justified in this inference, then we are also justified in the assumption that electrical attractions between the bodies entering into combination are set up and currents sent in all directions throughout the solar system and only producing light and heat when they reach the atmosphere which envelopes the earth. The currents of electricity are met by the resistance of the atmosphere, which is a very poor conductor of electricity. Hence we have both light and heat, which we know is produced by electrical currents when transmitted through bad conducting media, such as platinum wire or bamboo cane, and just in proportion to the resistance offered in the track of the electrical energy. The diffused light of day can then reasonably be regarded as the fruits of the infinitely great number of electrical rays passing from the sun through the resisting atmospheric media. When the air is full of moisture, the day is darker, due, no doubt, to the well-known fact, that moist air is a much better conductor of electricity than dry air, presenting as it does much less resistance to the electrical effort to reach the earth.

A friend of mine very tersely remarked that "the sun might then be looked upon as a huge battery," in which the elements are constantly combining and decomposing, and thereby originating or generating electrical rays, which I have been endeavoring to show are the direct agents in the production of light and heat. When the sun sets at night we generate electrical rays by means of dynamos, propelled by energy, laid up for ages in the coal fields—detached charges, as it were, deposited there by the sun's rays, in the carboniferous age. Or the energy may come from a fall of water like Niagara, which will be utilized for the purpose of generating electricity. The waterfall in the first place gets its potential energy from the sun's rays, which evaporated the water, and in fact the sun is continuously carrying the water up hill again, for future use. What I claim is that the agent in all this work is primarily electricity, and it may be expressed in the various conditions of heat, motion, chemical, action and light. As already mentioned, heat and electricity are so intimately related, as to be, in fact, an offspring the one of the other, and it often tests the discernment of the most astute reasoner or observer to tell which is the parent power. I am of the opinion, and hope that I may have some support from you here to-night, that electricity is the parent power, and heat is one of the first born in this illustrious family—heat, motion, chemical action and light. What I wish to draw your attention to just now is the fact that co-incident with an increase in the electrical potential in a body or part of a body, there is also an increase in the heat of tht same, and when our bodies are in a highly electrical condition or in high potential, we are warmer than when the potential is lower; so, therefore, we find people more vivacious and [illegible] and [illegible] warmer than in damp conditions of the atmosphere. By means of the moisture the electri[illegible] Again we find that in all inflammatory conditions there is an increase in the positive elec[illegible] potential the vital energy is increased, [illegible] that positive means positive, [illegible] negative, and vice versa so, there [illegible] and I see which show [illegible] by applying the positive pole over the affected part. Or, conversely, in affections where [illegible] electrodes, by applying the negative over the seat of the [illegible]

electricity of higher potential in one is flowing over to the other of lower potential. As with water so with electricity, it is seeking its level whenever there is a way of escape from the higher to the lower. This is true also of heat. If you connect two rods or pieces of metal together which have been unequally heated, the current of heat, so to speak, runs from the warmer to the cooler metal, following the same law as its parent, electricity. Hence we infer that the uses of heat may be similar to those of electricity, in the cure of disease; in fact we are using this heat agent vastly more often than electricity, because its character and effects are vastly better known.

Electrical Engineering at Columbia College.

An undergraduate course of four years in electrical engineering has been established in the School of Mines, Columbia College, in addition to the present two year post-graduate course, which has been in successful operation for several years. Thus there will be two complete courses in electrical engineering in New York city.

The latter course is for graduates of scientific schools and colleges, and is entirely devoted to electrical engineering proper, the students having already passed the necessary preparatory studies in mathematics, physics, chemistry, mechanics and drawing. This course is found to give the most excellent results by reason of the maturer years and better training of post-graduate students.

In addition to such graduate students there are, of course, a much greater number of younger men who desire to enter a course of electrical engineering immediately on leaving school, without going through a previous collegiate course.

A new four year course has therefore been established parallel to the well known courses in mining engineering, civil engineering, chemistry, architecture, etc., at the School of Mines, with the same requirements for admission, which are equal to the regular entrance examinations at first-class scientific schools.

The first two years of the new course will cover the preparatory work in mathematics, physics, chemistry, mechanics, drawing, etc., required for admission to the post graduate course. The last two years will be devoted to a thorough course in electrical engineering proper and will be equivalent to the present post-graduate course.

As a preparation for the study of electrical engineering the first two years of this course are equivalent to four years in any course other than electrical engineering, thereby saving much time without sacrificing electrical engineering subjects.

The instruction in electrical engineering will be conducted as heretofore by Prof. Crocker and Dr. Pupin. The mathematics, physics, etc., will be taught by the respective professors of those subjects.

The degree given to those who satisfactorily complete the course will be that of electrical engineer. The new course will regularly begin October, 1892. Examinations for entrance will be held in June and September.

The one year partial or special course will be abolished next year to make room for the students in the regular courses.

Wanted to See the Lamplighter.

A story come from New Jersey in which the resolute pursuit of scientific knowledge did not meet with the encouraging reward it deserved. Near the banks of the Morris canal is a little village in which the electric light has lately been installed. An old man, who had heard much of the new-fangled light, was greatly pleased at its introduction; but there was one point about it that mystified him greatly, and he determined to take his own way in solving it. A foot passenger on the banks of the canal observed the old man intently looking at one of the lights one evening. There was a look of disappointment on his face, and when asked the reason he explained that he was anxious to see how the lamps were lighted. He had watched for the man to come around and light them, and having missed him for several evenings, he had made up his mind to catch him and find out how it was done. He accordingly took up his position at early dusk, determined that this time the man should not escape him. He was greatly chagrined to find that the man had sneaked past him in some way and had lighted the lamp while he was looking for a moment in a different direction. He said he proposed to find out all about the lighting of the lamps if he had to stand alongside the pole until the man came around the next time.

Washington Carbon Works.

The Washington Carbon company of Washington, Pa., announces that it has a capacity for 50,000,000 carbons per year. This company is making a strong push for business. It has recently introduced improved methods, and with an experienced corps of employes the company bids fair to make itself felt in the market. The company writes that it proposes to continue in the front rank, and in order to insure a superior article it has arranged in advance for a [illegible] supply of raw material. It further announces that it has no connection whatever with any other company [illegible]

[illegible] Railroad company [illegible] of property owners for the right [illegible] and Lexington, with the [illegible] where the [illegible] the right that the [illegible] will be obtained [illegible]

Carl Hering and the Electrical Congress.

To the Editor of the Western Electrician

In your issue of November 21st there is an editorial on page 304, which refers to my report as chairman of the delegates of the American Institute of Electrical Engineers to the Frankfort Congress.

In this editorial you have taken the unwarranted liberty of picking out a paragraph of this report and leaving out a very important modifying clause which immediately follows it. That you did this knowingly, and for a purpose, is evident from the fact that, if you had quoted it fairly and honestly, it would not have served your purpose. That such procedure reflects more on the editor of your paper than on the author of the report, or on the American Institute of Electrical Engineers, will be evident to the numerous readers of other journals who have been given an opportunity of reading the report, which was published by them as it was given to them.

I distinctly stated in my report that at the time the invitation which you object to was extended it was not known to the delegates that any official action had been taken by the government or by the World's Fair commission regarding the holding of the congress. That the American Institute of Electrical Engineers long ago urged the holding of a congress during the time of the World's Fair, and that they, as the leading electrical society of this country, contemplated taking a leading part in the same, will be seen from the fact that precisely the same invitation was extended by their delegates to the congress of 1889, at Paris.

In justice to the American Institute of Electrical Engineers, as well as to their delegates and to myself, as author of the report, I request that you publish this explanation in your paper, and without leaving out any portions of the same.

Carl Hering.

[We do not consider it necesary to add anything to the editorial of November 21st by way of explanation despite the fact that Mr. Hering does not appear to grasp the situation. He either evades the point of issue or does not realize the position in which the "invitation" places the Institute. His communication does not contain any argument in justification of the course pursued nor does he attempt to show in it that the Institute had any reason to assume that the Electrical Congress was "to be held under the auspices of this Institute." In gratifying Mr. Hering's desire to see his communication published we may be pardoned for expressing the regret that he assumed that anything further than a personal request from so high an authority on journalistic ethics would be required. "In justice to the American Institute of Electrical Engineers," however, it would be well to reserve further discussion of this topic until some better plea than that advanced by Mr. Hering can be made in its behalf.—Editor Western Electrician.]

CORRESPONDENCE.

New York Notes.

New York, December 12.—After any excitement however slight there comes, usually, some sort of a reaction, and in so far as New York electrical news is concerned this was certainly the case last week.

The creditors of Field, Lindley, Wiechers & Co., among whom, as was stated last week, is Frank Sprague, are not much wiser now than when their troubles first came to light. Wall street practically speaking knows nothing new regarding the disgraceful collapse. It is thought, too, that an attempt will be made to cover up the true condition of affairs. In banking circles there has been some talk about young Field having forged warehouse receipts with the name of his father, Cyrus W. Field and others; but all this is nothing more than gossip.

Last week the Western Electrician printed a dispatch announcing the most recent execution by electricity. There has been the same agitation by the newspapers over the secrecy of the proceedings at Sing Sing, but to a lesser degree this time than was the case during the occurrence of the wholesale piece of barbarity which took place about a year ago. Of course the newspaper cry is now more against the secrecy with which the death penalty is applied than the electrical method. Everything is and must be to a great extent surmise until publicity is given to these horrible proceedings. Assemblyman Myer J. Stein, from this city, has drafted an amendment to the electrical execution law. It provides that six representatives of newspapers published in the State of New York shall be present at the execution, such representatives to be chosen by the warden of the prison where the execution takes place. The amendment strikes out the clause prohibiting newspapers from publishing the details of the executions.

While on the subject of electrical executions mention must be made that another victim has received his sentence, Jeremiah Catto has been found guilty in Judge Moore's court in Brooklyn of murder in the first degree. He is to be sent to Sing Sing to die by electricity.

There was a chance for a sensational article on the danger of the electric wire in Orange last Monday, but strange to say the papers noticed the accident only to the

extent of a paragraph or two. Miss Kate Weiss employed in the No Name Hat Factory in Orange Valley, received a shock from an incandescent electric light wire and fell unconscious to the floor. It was thought at first that she was killed, but this was not the case. Both of her hands, however, were badly burned.

For some time in Brooklyn there has been agitated the question of the application of the trolley system to street railways, and last week the street railway presidents were before the city fathers, but nothing definite was accomplished. Last Thursday President Lewis of the Brooklyn City Railway company, accompanied by E. W. Bliss, one of the company's directors, left for Pittsburg to examine the system of the Westinghouse company. They are sanguine of securing the consent of the board of aldermen to the introduction of the trolley system, and prosent tour is being made with the object of investigating several motors. Before returning, a number of systems will be examined, it being Mr. Lewis' purpose to go to Cleveland and Schenectedy to inspect the Short and Edison motors.

Bids for the street lighting in New York were received by Mayor Grant on Thursday. The bids were for the lighting of the city for the year 1892. The gas companies made in their new bids the same rate as that which the city is now paying. While on the subject of city lighting mention should be made that several hundred residents of Seventh avenue and adjoining streets have signed a petition asking that electric lights be placed on Seventh avenue from One Hundred and Tenth street to the Harlem river. The petition has already been brought to the mayor's office. The Brush Electric Lighting company bid for 151 lamps at 40 cents per night, and 114 at 45 cents. It is now lighting 204 lamps at 40 cents, and 69 at 45 cents. The United States Illuminating company bid for 235 lamps at 40 cents, and 66 at 45 cents. This compauy is now lighting 294 lamps at 40 cents The East River Lighting company bid for 247 lamps at 40 cents, and 16 at 60 cents. It is now lighting 138 lamps at 40 cents. The North New York Lighting company bid for 243 lamps at 45 cents. It is now lighting 166 lamps at 45 cents. The Mount Morris company bid for 154 lamps at 40 cents, the same as their present contract. The Harlem Lighting company bid for 161 lamps at 40 cents, 15 at 45, and 19 at 50. The Harlem company is now lighting 156 at 40 and 19 at 50. The bids were referred for tabulation.

Perhaps there will be before long an electric railway between Red Bank and Seabright, N. J. This is an enterprise which was agitated some two years ago, but up to the present time nothing has come of it. It is now stated that a company has obtained franchises, and that New York capitalists will furnish $100,000 so that the work can be pushed through in time to have cars running early next spring. Stages are now running between Red Bank and Seabright. The company proposes to purchase land at Seabright, build pavilions on the beach, and lay out excursion grounds.

Although the New York electric light companies know the law and are doubtless fully aware that sooner or later their wires must be laid underground, he would be a hard hearted electric light man indeed who could not entertain a feeling of sympathy for these companies under the present losses due to the storm. The damages of the Manhattan, the Brush, the East River and the United States Electric Lighting companies have been estimated as aggregating $120,000. The Board of Electrical Control refuses permits to re-erect poles, pointing to subways with the remark: "Now is your time to go under." Attempts are being made to erect poles on the sly. The Manhattan company made a move to place its poles on Twenty sixth and Fortieth streets, but the police interfered, and the gang was compelled to leave. Patrolmen and watchmen are conspicuous in the district where such attempts are liable to be made. The officers have orders to allow no one to touch the wires or the poles. Also to permit no movement that could be construed into an attempt at replacing the poles. It is evident that the Board of Control means business, for there were reservations of police at the station houses. The Manhattan and East River electric light companies were permitted to take down the broken poles on First avenue, but the police assisted them.

Frank A. Knight, superintendent of construction of the Metropolitan Electric Light company, and the four linemen, who were arrested on Monday night for repairing wires on First avenue without a permit, were held for trial at the Yorkville police court.

The Brush Electric company and the Consolidated Electric Storage company last week petitioned Judge Green of the United States Circuit court at Trenton, N. J., to enjoin the Accumulator company and secured a restraining order prohibiting further operations by the Accumulator company until January 7th, when the injunction order will be argued. W. F. O.

Kansas City, Mo.

KANSAS CITY, December 12.—For the last two or three years it has been a matter of current rumor that the Inter-State Consolidated Rapid Transit company—the somewhat cumbrous name of the organization controlling a system of cable lines, elevated steam railway and electric roads—would change its entire motive power to electricity. So often as the rumor started, so often was it denied by the high officials of the company, but at last the officials themselves have started the story, and they have done so by applying to the councils of Kansas City, Mo., and Kansas City, Kan., for the privilege of changing their motive power from steam and cable to electricity. The company has made no effort yet to select a system, although a part of the road is already operated by the Thomson-Houston system. The portion of the system operated by cable is short, but until recently has been the most important part of the road. It was built at great expense, for it necessitated the digging of a tunnel through almost solid rock for nearly 1,000 feet. It gave the system its only entrance into the uptown part of Kansas City, Mo., the cable cars unloading the passengers at the terminus within one block of the junction, the heart of the business portion of the city. Recently a transfer arrangement has been effected between the company and the Kansas City Cable company, by which passengers at the terminus of the elevated road can be transferred to either road, that being also the terminus of the Kansas City Cable company's line. The Kansas City line takes the passengers to the junction, and since then the "L" road's cable line has been playing a oozing engagement. This renders it probable that the cable line and its expensive tunnel will be abandoned. The cable power house could easily be converted into an electric power house and the "L" road is particularly easy to be changed to an electric line.

All the electric lines in the two Kansas Cities have proved profitable, as profits have been going in street railways lately, with the exception of the Ivanhoe Park line. That road, built during real estate boom days, and as a steam dummy line, is not paying. But it is no fault of the Thomson-Houston system. The road was built to boom a certain tract of land. There was no population to carry, and the line is reached only after a long ride on a cable line. People would rather ride home without changing cars, and as they can get just as cheap homes on the longer and direct lines as on the Ivanhoe line they do so.

New electric lines are still being talked of. The old Union cable line, which was never built completely and never put in operation, offers enticing opportunities for an electric line. It is reported that a New York engineer was here recently looking at it for the purpose of seeing whether it could be converted into an electric line and operated with any show of success. He has gone back to New York to report to the capitalists who employed him. No report has come West from New York since.

The Missouri, Kansas & Texas Trust company and other people interested in the Kansas City & Suburban Belt line, the Kansas City & Independence Air line and the Consolidated Terminal company have another scheme. It is an electric line starting at the Wyandotte street terminus of the Suburban Belt line on Second street and running south on Wyandotte to Seventeenth street, crossing on its way the Eighth street cable line of the "L" road, the Ninth street line of the Kansas City Cable company and the Twelfth street line of the Metropolitan Street Railway. From Seventeenth street the line is to run east to Vine street, crossing the Westport line of the Grand Avenue Cable company, the Holmes street line of the same company and the Troost avenue line of the Kansas City cable company. On Vine street it is proposed to run south again as far as Eighteenth street and then form a connection with the Ivanhoe Park line. Some effort has been made toward securing signers to a petition for a franchise, but nothing else. Guesses are made offhand that this is all that ever will be done.

The Kansas City, Kan., council now has under special consideration the Thayer-Enright electric street railway franchise, one of the most important measures that has been before the council for years inasmuch as it is the first Kansas City, Kan., line that has ever applied for a franchise. All the other lines have been Kansas City, Mo., extensions. The road's northern terminus will be near the site of the great Anglo-American Cotton Milling company. It will then pass through the choicest residence portion of the city, pierce the center of the business portion and continue to the suburbs of Armourdale and Argentine. Branches of the road will run to various parts of the city. Some years ago the company obtained the franchise and would have built the road had not money become so tight in the East. Recently the old franchise was declared

[illegible] City and vicinity have not been the easiest for some time. The first serious trouble to arise was between the Kansas City Electric Light company of this city and the American Electric Light [illegible] for a pole [illegible] which is occupied by the Union Passenger depot, the freight depots, [illegible] houses, etc. The matter was taken into the courts, and there it was compromised.

Then came the Supreme Court's decision which declared that Kansas City's extension of limits had not been accomplished in the proper way, and was therefore null and void. This cut off considerable revenue and the result was that the city was in a hole financially, economy became the watchword, salaries were reduced, forces were cut down, fees dwindled and along with other things the city's lighting fund was reduced to $75,000 and that had been nearly used up in seven months. What should be done for the remainder of the term? In brief, the lighting companies, gas and gasoline as well as the electric light companies were placed on the ragged edge. Bids were invited but the maximum rates were fixed in the advertisements so low that nobody responded. Then new advertisements were inserted with a flexible maximum, and everybody bid. The bids were so numerous, complex and manifold that nobody could tell which was the lowest and best bid, and finally the board of public works decided to continue lighting the city as at present but to pay not the former rate but the proportionate share of what remained in the lighting fund. This meant that the companies must either be satisfied with their proportionate share and light the city at a loss, or decline to do so and let some other company get all the lighting at good rates. The companies yielded to the request. But that was only a temporary settlement of the matter. Something will have to be done when the new year begins

So much for what has caused Manager Weeks of the Kansas City company, and Manager McMillan of the American, sleepless nights on this side of the Kaw. On the other side recent electric light history has been much more sensational and continues so to be. President Friedburg of the Kansas City Consolidated Electric Light company wants to sell his plant. About three months ago he offered it to the city for $340,000. The council looked into the matter and appointed a committee of its own members and a committee of citizens to investigate. This joint committee did so. It reported the plant in good condition, dynamos, wires, poles, lamps, buildings and all, and to be worth all the way from $350,000 to $450,000. The committee said it had employed expert electricians to examine the plant and these experts had declared the system and machinery to be first-class in every respect. Then the council proceeded to prepare for the purchase. But about this time the Taxpayers' league took up the question. This league had been organized when the campaign of economy began in Kansas City, Mo. It believed what was good for people east of the Kaw was good for people west of it The league also secured expert electricians to examine the plant and they reported "that $340,000 ought to buy five electric light plants each and every one better than that of the Consolidated" and have money left on hand; in other words, that the plant was worth about $60,000, and therefore it was to be inferred, that the $280,000 above that was to be distributed where it would do the most good. This report caused a good deal of bitterness and one evening when the council was in session for the purpose of buying the electric light plant, the league met. Fiery speeches were made. The councilmen were denounced as thieves, brigands, looters of the people's treasury, etc., and the meeting adjourned to move on the council. Strange and threatening cries were [illegible] the thieves into the river;" "String 'em up," etc. The council heard the noise and saw the rapidly advancing throng in the street. A motion to adjourn was hurriedly made, put and carried, and [illegible] league procession arrived, not a councilman was in sight. At the next meeting of the council the electric light company withdrew its proposition [illegible] ground that it would lose if it sold for less than $375,000.

Now the matter has came up anew. The company has now offered to sell for $300,000 and the proposition is to be submitted to the people on December 29th. It has now been discovered that although when the former deal was on, the council committee pretended to hire experts to examine the plant, [illegible] presented to the city, and the opponents of the measure are anxious to learn [illegible] council were [illegible]

Milwaukee, Wis

MILWAUKEE, December 12.—At the annual meeting of the Wisconsin Electric club the following named officers were elected for the ensuing year: President, W. S. Johnson; vice-presidents, J. D. McLeod, E. C. Wall, A. J. Rogers, G. H. Benzenburg and Don J. Whittemore; secretary, H. F. Boggis; treasurer, W. H. Hyde; board of managers, M. McManman, I. Bradshaw, C. N. Harrison, J. Schroeder, C. L. Goss, together with the president, vice-presidents, secretary and treasurer; committee on membership, H. Fountain, F. E. Parker, H. P. Andrae.

The Milwaukee & Rapid Transit company is again in shape to carry out its objects. The injunction secured by the Chicago, Milwaukee & St. Paul Railway company, restraining the Rapid Transit people from building across its tracks at Walnut street, has been dissolved, and no more trouble seems to be feared from that quarter. The St. Paul company, to be sure, has taken occasion to build three additional tracks at Walnut street, but that simply increases the cost to the Rapid Transit company of putting in a crossing at that point, and does not prevent it from completing and operating its road. The Rapid Transit company, which at first thought of erecting a power house of its own or drawing power from the Pabst brewery, has quietly purchased the stock of the Wauwatosa Electric Light company and now controls the plant and business of that concern. The plant is located in a brick building west of the Wauwatosa depot. It is equipped with two 225 light incandescent dynamos and the necessary engines and boilers. The electric light company was organized four years ago. The frame building at first erected was destroyed by fire, and the present brick structure was then built. The business has not paid very well. The plant will be remodeled so as to adapt it to electric railway purposes. The incandescent lighting business will be continued, however, and an arc light plant may be put in, so as to light the streets of Wauwatosa.

Manager Lynn of the Cream City line has had built an electric patrol wagon that is pronounced the finest thing of its kind in the country. Built on the principle of a police patrol wagon, it is large enough and strong enough to carry a full outfit of supplies for an electric line. It is supplied with a steel and hickory combination ladder for use in repairing wires. The lower portion of the ladder is of steel and the top part is of hickory, which is let down by means of a crank inside the steel portion. The team and linemen are kept at the Farwell avenue car house, in constant readiness, like a fire engine company. Similar outfits will be provided for different parts of the Villard system as soon as the system is complete.

Nearly all of the fifty new cars for the Villard system have arrived from St. Louis. They are considerably wider than the old cars.

Engineer Meyer, who has had charge of the work on the Villard line from the beginning, has tendered his resignation. His successor has not yet been appointed. Mr. Meyer has done excellent work here, but has had trouble right along with the old street railway people. It is said that Mr. Meyer is a member of the German army and is in America on a furlough. He will remain in charge until certain work is completed, which probably means un-

In a short time the East Water street bridge will be swung

Notwithstanding the cold weather the work of completing improvements in process on the Villard system is being pushed. The building of half a mile of track and a few crossings will permit the operation of electric lines on

Nashville, Tenn.

The Nashville Electric Light & Power company's line has been operated at a dead loss from the start. Last week nearly all the motor men, conductors and employes quit on account of non-payment of salaries and wages. The line passes through a sparsely settled portion of the city and has no transfer arrangement with any other line. As a condition attached to the granting its franchise the city required the company to pave and keep in repair the portion of the streets between its rails and two feet on the outside of them on each side of the track. The company has not been able to comply with this condition and has failed in the effort to have it rescinded. The future of the road is uncertain.

The Citizens' Rapid Transit is another road that covers new and thinly populated territory, and its operation has not as yet proved profitable.

The relations between the newly elected city government and the Capitol Electric company are somewhat strained The company gave as a reason for the unsatisfactory public lighting service insufficiency of power by reason of the breaking down of one engine. The city electrician's report shows that the company has ample power, but it is claimed it is expended on its commerical lighting contracts. The fact is that the company took the public lighting contract at a price that entails a loss in operating.

The Cumberland Telephone company has 1,600 subscribers in the city besides exchanges in nearly all the towns in middle Tennessee. Its present quarters have become too cramped for the business. A permit for the erection of a new three-story building in the center of the city has been issued and the contract is to be let immediately. B.

Toledo, O.

TOLEDO, O., December 12.—This city, which has enjoyed the benefits of natural gas for some years, has already begun to feel the want of it for her manufacturing establishments. The supply has been so short that it has been deemed necessary to cut off the power houses of the electric railway systems as well as the electric light works of this city, together with other large consumers, in order to meet the demand of the resident portion of the city. Where heretofore only the large smoke-stacks were seen, now there are huge volumes of smoke emitted, and as these power houses are in the heart of the city, it is very annoying to those who are compelled to live under clouds of soot and inhale coal smoke in place of pure air as formerly.

The recent snowstorm had a tendency to delay electric cars somewhat, as the companies were hardly prepared for the sudden change, but under the circumstances little fault can be found with the service rendered. The Robisons received their large snow plow a few days since, and are now prepared for the severest snowstorm. The new machine requires three motors to operate it to propel it and one to operate the brushes in raising and lowering them. The Robisons have also received twenty additional motors and a number of new cars which will be placed in service as soon as they can be wired and gotten ready.

The Consolidated Street Railway company has two proposed legislation in the city council for the purpose of obtaining permission to build and operate a line of electric road from the intersection of Cherry street and Central avenue to Woodlawn cemetery. This would take it past Cycledale and the Lozier and Yost Bicycle Works. The county commissioners have already granted the right of way outside the city limits. The railroad committee of the council has also taken favorable action on it.

At present the Toledo Gas Light & Coke company is occupying the attention of the city legislature. A bill passed the board of aldermen reducing the price of artificial gas from $1.35 to $1 per 1,000 cubic feet. It also passed the council last night with one or two amendments. It now rests with the mayor to decide whether the company shall furnish gas at an even dollar or not. Mr. Walbridge of the gas company has notified them that they will be unable to furnish gas for one dollar, and if this ordinance is passed, the citizens of Toledo will have to look elsewhere for gas. Further developments are looked forward to with interest. The Western Union Telegraph company, in this district especially, is taking up the matter of fire very emphatically. At this place, small hand grenades are

three Junior Champion fire extinguishers and one large ex-

and speed. The necessary tools for cutting the wires, etc., with rubber handles are placed behind the switch-board in case electric light wires should at any time fall across their

three different occasions by prompt action. At one time the whole switch-board seemed one sheet of fire and another was a case of a relay melting like lead. It will be almost impossible for a fire to get started now, with the present precautions. H.

Louisville, Ky.

LOUISVILLE, Ky., December 14.—A receiver has been appointed for the Gaynor Electric company, an establishment which has been in existence in this city for the last six years. The officers of the company say that this action was taken in order to protect the stockholders and creditors of the company. There has been some trouble in this direction, and considerable money has been lost of late because of the inability of the directors to reach an agreement. "A receiver," President Sutcliffe said, "was an absolute necessity in order to get the affairs of the company straightened out. The plant is valued at $68,000, and the open accounts amount to $48,000, which makes the assets $116,000. The liabilities are only $50,000. The business will be continued.

J. Bacon & Sons have just closed a contract with the Edison company for 500 incandescent lights, to be strung on the front of their establishment. Three hundred and fifty of the lights will be used in the firm's sign. This is the largest number of lights ever placed on the exterior of a building in this city.

The California Fig Syrup company has contracted for a 5 horse power Edison motor and a 270 light plant.

One of the new type slow speed Edison motors has been placed in the Louisville Street Railway company's station This company has also contracted for two 210 horse power Edison generators.

During the past week the Edison company sold eleven motors of different sizes. The *Christian Observer* company has purchased a 14 horse power motor with which to run its presses.

L. H. Cooper & Co. have been appointed agents for Kentucky for the Central Thomson-Houston company. The Maxwell Electric company, electrical engineers and contractors, and the Louisville Electric company are two new firms which have organized in this city during the present month. C. C. Y.

PERSONAL.

Mrs. Elisha Gray sailed for Europe on December 10th.

F. R. Colvin, business manager of the *Electrical Engineer*, New York, was in Chicago last week.

C. A. Daigh, of the Electrical Engineering & Supply company, St. Paul passed through Chicago last week.

J. H. McGraw of the *Street Railway Journal*, New York, has been in Chicago during the last week.

J. P. McQuaide, treasurer of the National Conduit Manufacturing company, New York, was in Chicago last week. Mr. McQuaide is making a western tour.

F. W. Carr, until recently engineer in charge of construction on the Minneapolis electric street railway, was in Chicago on Saturday last. Mr. Carr will spend the winter in the South.

A. C. Shaw, the New England editor and manager of the *Electrical Engineer*, has returned to New York after a six weeks' visit to London. Mr. Shaw states that great interest is manifest among electrical people of England as to the World's Fair. He says that, although there may not be a large exhibit from that country, still it will be well represented. Arrangements are even now being made by the electrical interests to be represented.

NEW INCORPORATIONS.

Electric Reduction company, Albuquerque, N. M., capital stock, $20,000; reduction of gold, silver and other ores; Bernard S. Rodey, Albuquerque, N. M.

West Jamaica Electric Light company, Richmond Hill, N. Y.; capital stock, $2,500; to manufacture and use electricity for light, heat and power, etc.

Phillipsburg Granite Electric Light company, Phillipsburg, Mont.; capital stock, $50,000; manufacturing, furnishing and selling electric light and all kinds of power, heat and fuel.

Ottumwa Electric Railway company, Ottumwa, Ia.; capital stock, $500,000; to construct, purchase, lease and operate electric street railway lines in the city of Ottumwa, Ia., McNett & Tisdale, Ottumwa, Iowa.

Card Electric Motor & Dynamo company, Cincinnati, O.; capital stock, $100,000; manufacturing and selling electric motors, electric dynamos, furnishing electric light and power, etc.; C. B. Simrall, Cincinnati, Ohio.

Belleville Electric Light company, Belleville, Essex county, N. J.; capital stock, $100,000; to own, lease, construct, maintain and operate works for the generation, supply and distribution of electricity; Wm. L. Baker, Jersey City, N. J.

Franklin-Morse Electrical & Mechanical Manufacturing company, East St. Louis, Ill.; capital stock, $5,000,000; to

manufacture all kinds of mechanical and electrical devices and appliances. Wm Halleck Jones, Edwardsville, Ill.

Fresno Electric Railway company, Fresno, Cal.; capital stock, $1,000,000; to deal in electrical appliances and patents and operate the machinery and about 10 miles of street railways in Fresno, Cal.; L. E. Cory, Fresno, Cal.

Middletown, Highspore & Steelton Street Railway company, Middletown, Pa.; capital stock, $100,000, operating a street railway by electric power from Middletown to Steelton in Dauphin county, Pa.; Weiss & Gilbert, Harrisburg, Pa.

Atlas Electrical Manufacturing company, Chicago, Ill.; capital stock, $12,000; to manufacture and sell dynamos, motor switches, electric batteries and other electrical appliances; J. B. Albertson, Royal Insurance building, Chicago, Ill.

Hudson Land company, Spokane, Wash.; capital stock, $50,000; to build and operate railroads, steamboats, telegraph and telephone lines, gas and electric light plants, water works, etc.; Fred Flint, secretary, 4 Tull building, Spokane, Wash.

Crocker-Wheeler Electric company, Jersey City, N. J.; capital stock, $200,000; making and selling motors, machinery and appliances for generating, reducing and employing electricity for power, light and heat; Parly, Olendorf & Fisk, New York city, New York.

Yuma Water & Manufacturing company, Los Angeles, Cal.; capital stock, $50,000; acquiring rights, building and maintaining waterworks, in Yuma, Arizona; developing and distributing electricity and making artificial ice, etc.; T. H. Ward, Los Angeles, Cal.

Massachusetts Wire company, Malden, Mass.; capital stock, $25,000; to draw and cover all kinds of magnet or other wire; to make, buy, sell and deal in all kinds of wire and electrical supplies; to buy, sell and deal in raw materials for the manufacture of the same.

Jonesboro & Marion Electric Street Railroad company, Jonesboro, Grant county, Ind.; capital stock, $10,000; constructing, owning, operating and maintaining a street railroad from the town of Jonesboro to the city of Marion, Grant county, Ind.; Morrison & Holman, Kokomo, Ind.

New York Electric Railway company, Jersey City, N. J.; capital stock, $25,000; contracting to build and construct railways of all kinds, including surface, elevated and underground railways, and other works of improvements within said states; Hoadly, Lauterbach & Johnson, New York city, N. Y.

Owatonna Electric company, Owatonna, Minn.; capital stock, $25,000; to construct, maintain and operate plants for manufacturing and generating electricity; to deal in and furnish electrical supplies for light, heat and power; to manufacture and repair any and all kinds of appliances necessary and used in said business; to lease, purchase, sell, convey, mortgage and exchange real and personal property; Northwest Thomson-Houston Electric company, 403 Sibley St., St. Paul, Minn.

ELECTRIC LIGHTING.

The Donaldson, La., Ice company will put in an electric light plant next season.

The city of Paragould, Ark., is reported as making preparations for the erection of an electric light plant.

The gas and electric light interests of Dixon, Ill., have been combined and hereafter both companies will be conducted under the same management.

Some weeks ago, "anchor ice" formed so rapidly in the stream from which power is supplied to the generating station of the Appleton, Wis., Electric Light company that the residents were speedily minus their supply of arc and incandescent lights.

Owing to the high price of coal, it is said that the English Electric Supply company of Madrid, in Spain, is endeavoring to purchase some unused water power, situated about twenty miles from the city, which might be used in the generation of current.

The special committee on electric lighting of the general council, Mobile, Ala., has asked authority to advertise for bids for erecting a plant for illuminating the streets with electricity; also for bids for lighting the city under contract for a term of years.

It is said that the merchants of Zanesville, O., have organized a co-operative electric light company, with the object of lighting their places of business at first cost. There has been some complaint about the price charged and service rendered by the light companies, which led to this action.

ELECTRIC RAILWAYS.

All of the street cars of Lynn, Mass. are to be operated by electricity.

The Petersburg, Va., Street Railway company has, it is stated, made arrangements for operating its railway by electricity.

The Gadsden & Attalla Union Railway company of Gadsden, Ala., is reported as about to convert its dummy line to the electric system.

A Boynton electric bicycle road is proposed for the West Side, Chicago, similar to the experimental line at Coney Island. A company has been formed, and an elevated structure on Randolph street and Ogden avenue is proposed. A light steel and iron construction is favored.

The International Trust company of Boston has filed an application for a receiver for the Keokuk, Ia., Electric Street Railway & Power company. The plaintiff claims, among other things, that the street car company, contrary to an agreement entered into when certain first mortgages were executed, has neglected to pay the city taxes for 1891 and county taxes for 1890, and that the property for which a receiver is wanted is about to be sold for taxes. The plaintiff also charges that the street railway company has a large floating debt and that unsecured creditors are about to institute suits against defendant and may attach and sell the property. It is also affirmed that the street car company is insolvent, and unable to meet current expenses.

ELECTRIC MINING.

The Thomson-Van Depoele company has a contract for a combined lighting and hoisting plant at the works of the Paymaster Mining company, Southern California.

The *Colorado Miner* states that the Westinghouse company will soon send an expert to Denver to examine the water power of the Atlantic-Pacific Railway Tunnel company, with a view of putting in an electric plant for drilling, and for lighting and running the cars in the tunnel. The plant is to be not less than 200 horse power. When ready for railway service the tunnel is to be 40 feet wide and 25 feet high, the center to be occupied by double broad gauge tracks; and on each side will be tracks for mining purposes.

TELEGRAPH.

The Western Union Telegraph company has declared the regular quarterly dividend of 1¼ per cent, payable on January 15th.

A dispatch from El Paso, Tex., states that the telegraphers of the Pacific division of the Southern Pacific railroad struck on December 11th rather than subscribe to a sworn statement that they were not members of the Order of Railway Telegraphers, and that they would not join the order while in the employment of the company without permission from the general superintendent. The company requested the Western Union people to handle the dispatches, but the Western Union operators refused to take or send the messages. The men were notified that they would be discharged and blacklisted for refusing, and most of the operators in the Western Union office at El Paso walked out.

The governing committee of the New York Stock Exchange on Saturday, December 12th, announced that the contract with the Gold & Stock Telegraph company had expired, and that, pending other arrangements, the Gold & Stock would be given the quotations only on the payment of $100 daily until January 1st, the distribution of quotations by them to be subject to such restrictions as the Stock Exchange saw fit to impose. The members of the Stock Exchange have their own ticker company, and the Gold & Stock Telegraph company, which inaugurated the present system of quotation service, has distributed reports of transactions on the stock exchange to other than members in all the large cities East, West and South. All the newspaper offices depend on the Gold & Stock tickers for their service and will be greatly discommoded if the tickers are cut off. It was stated last Saturday, however, that the Western Union had accepted the terms offered, and that the Gold & Stock quotation service would be continued as usual.

MISCELLANEOUS.

Boston is said to have over 4,000 miles of electric wires strung over its streets.

Justice John M. Davy, of the New York Supreme Court, has sentenced Joseph L. Tice to be executed by electricity at Auburn prison during the week beginning January 18th. Tice was tried and convicted at Rochester for wife murder.

Electricity plays a prominent part in Adelina Patti's castle in Wales. One of the whims of the fair proprietor is the custom of ringing a curfew bell. At a certain hour she touches an electric button, which informs the corps of servants all over the house that the lights must be extinguished for the night.

The electrical linemen who held a convention in St. Louis completed their work by forming an organization of the electrical workers of America. The officers of the organization, which will be known as the National Brotherhood of Electrical Workers of America, are: Henry Miller, St. Louis, grand president; J. T. Kelly, St. Louis, grand secretary and treasurer. The next convention will be held at Chicago in November, 1892.

TRADE NEWS.

The Standard Electric company, 205 Canal street, Chicago, will soon be in its new building on Canal street, near Harrison.

A. T. Smith, 6 West Fourteenth street, New York, has several electrical novelties which he will place on the market in the near future.

That platinum is being used more than ever in electrical work, is shown by the large number of orders booked by James Schawel & Co. of New York. This concern reports business as being unusually good, a large number of orders coming from the West and Southwest.

Thompson & Robertson of New York state that their orders for their new fibrous batteries continue to increase rapidly, and the indications are for a large business for the ensuing year. This battery is giving universal satisfaction, as shown by various testimonials from prominent dealers.

[illegible]

[illegible] mines which his company controls. Mr. Culmer claims that the product of this mine possesses high insulating properties, and is attracting considerable attention among electrical people.

[illegible] novelties in which this metal is used. He shows a large line of rings set with the various precious stones, and numerous other articles for the holiday trade. He reports that the call for this valuable metal by the electrical trade is increasing rapidly.

Stanley & Patterson, 32 and 34 Frankfort street, New York, are now prepared to receive orders for anything in the way of electrical supplies. Mr. Stanley is very well known to the electrical trade through his connection with the firm of Stanley, Hall & Co. Stanley & Patterson have been the successful bidders on the wiring, etc., of several large office buildings which are now in course of erection.

Nathan Hubbard, of 93 Pearl street, Brooklyn, the well known manufacturer of vacuum pumps, reports that he has recently received a large number of duplicate orders as well as many communications from persons who desire to purchase as soon as the Edison lamp case assumes a more decided aspect. Among his recent shipments is one to the New York & Ohio company, of Warren, O.

A. H. Bauer writes from Boston to Pullman's Palace Car company, that one of the double-decked Pullman cars which are now running on the West End company's tracks covered a distance of 110 miles on December 4th, and carried 1,431 passengers, of which number 711 were upper deck passengers. Mr. Bauer says that he heard many expressions of approval of the easy motion, etc., of the car.

J. K. Pumpelly, Chicago, has just finished an improved battery for dental work. His new equipment consists of two cells, or, if needed, three cells, handsomely encased, so as to be acid-tight. In placing these batteries on the market it is agreed to recharge for the owner at little cost; or still further to accommodate the dentist, he will exchange batteries, without extra charge, so that the owner need not be without cells at any time.

The Rollason Gas Engine company, 134 and 136 Liberty street, New York, has completed several gas engines of 18 horse power capacity, to be used in running electrical apparatus. It is stated that during a recent test at the company's works in England, this engine showed a variation of but 2 per cent. One of the Rollason engines is en route for New York, where it will be on exhibition in the Electrical Exchange building.

The American Electric Elevator company, New York, has recently issued a new and very comprehensive catalogue, profusely illustrating the various electrical apparatus used in connection with its well-known elevator. This company has made a very important addition to its apparatus in the shape of the directly connected machine, which has proven most economical in the use of current. The new electric dock and ship hoist is being rapidly adopted by large shippers.

The Laclede Gas Light company, St. Louis, will double the capacity of its incandescent electric lighting plant. It has ordered of the Pond Engineering company two 250 horse power compound condensing Armington & Sims engines, with Blake pumps and independent condensing apparatus. It is expected that one of these engines will be in operation by January 1st, and the other shortly thereafter. The first engine will be belted direct to a 2,500 light alternator. The foundations will be carried to solid rock.

The Pond Engineering company, through the Chicago office, has closed a contract to replace the 60 horse power Armington & Sims engine in the American Express company's building, on Monroe street, Chicago, with an engine of the same make, of 120 horse power. The present engine will be moved to the express stables on Sebor street, to operate the lighting plant in that building. For the last nine years the American Express company's plant has been operated by an Armington & Sims engine.

Readers of the Western Electrician will be interested to learn that Charles E. Chapin, who was so well known from his connection with the firm of Alexander, Barney & Chapin, New York, will open a general purchasing agency for central stations, and for firms that are in the electrical business. He will purchase anything that may be desired in the way of electrical machinery, wire, etc., also estimates can be secured from him for anything in the way of special work. Mr. Chapin was for a number of years identified with the [illegible] Machine company of Hartford, after which he connected himself with the Waterhouse [illegible] firm sold out to the Westinghouse company. He was for several years the purchasing agent [illegible] company, and then he became [illegible] Alexander, Barney & Chapin [illegible] purchasing of electrical supplies for this firm. Although he has [illegible] the New York [illegible] of Warren [illegible] has already [illegible]. In a letter just received, this company states: "We are pleased with the service you have done us in purchasing our factory supplies, and will give you all the business in this line. We [illegible]

ness, which will increase our purchases." Mr. Chapin has located himself at rooms 417 and 418 Electrical Exchange building, New York.

BUSINESS.

A. K. Hussey & Co., 213 Randolph street, has just completed a very ingenious combination electric and speaking tube system for the new offices recently fitted up by the Edison General company at 173 Adams street, Chicago.

The Electrical Engineering & Supply company, Chicago and St. Paul, reports an active sale of the Packard lamp. This company has only recently secured the agency for the New York & Ohio company but it is expected the sales for December will reach twenty five thousand lamps.

Skeptics in regard to the practicability of electric heating would do well to peruse the "few (?) testimonials" reported in a circular just issued by General Manager Mason of the Electric Merchandise company, Chicago. Eighteen letters telling the same story ought to have some weight with thinking men.

The Central Electric company, Chicago, announces that its city trade has increased to such an extent that it has been obliged to put on a special delivery wagon. This company reports a splendid business in improved Candee weather-proof wire, and special Candee feed wire, for electric railways, made by the Okonite company.

The Orne Electric Construction company, 83 Randolph street, Chicago, has just finished a very complete speaking tube and electric system for the new *Herald* building on Washington street, Chicago. The Orne company succeeds to the business formerly carried on by E. T. Orne & Son, who are well known electricians and contractors. With its increased facilities the new enterprise will undoubtedly meet with success.

Julius Andrae, 225 West Water street, Milwaukee, has secured the contract for the complete electric installation to be placed in F. Kraus & Co.'s new malt houses in Milwaukee. The plant will consist of a 250-light Mather dynamo to furnish 250 lamps. In addition to this, Mr. Andrae has sold three one horse power motors, and wired T. A. Chapman's dry goods store for 175 electric lights, current to be furnished from the Edison central station.

A. M. Morse, until recently of the firm of English, Morse & Co., Kansas City, Mo., has removed to St. Louis, Mo., with offices in the Commercial Building, corner Sixth and Olive streets. The business will be conducted under the name of A. M. Morse & Co. The firm will handle steam engines, also improved boilers, steam pumps and other specialties. It will make a specialty of designing and furnishing complete steam power outfits for any service, also the improvement and extension of plants already established.

The Butman Furnace company, Chicago, is just now placing the Butman boilers setting and grates in the new Edison station at Riverside. This plant is of 150 horse power, and will be ready for use inside of ten days. The Butman furnace is in use by a large number of electric light people, in many instances the second and third order having been given. Among other users of this system are the following: Brush company, Detroit, 900 horse power; Chicago Arc Light & Power company, 2,500 horse power; Brush company, Cincinnati, 750 horse power; Hartman Electric company, Duluth, 300 horse power.

It is claimed by the Toronto Construction & Electrical Supply company, Toronto, that to it belongs the credit of being the first wholesale electrical supply house of Canada to canvass the entire Dominion by means of capable traveling representatives, each of whom carries with him several sample trunks filled with the latest and best novelties for electrical uses. At the present time one representative is in British Columbia, another in Halifax, N. S., and four others are at various points between the two first mentioned, which are nearly 4,000 miles apart. As a re- [illegible] policy the business of the company [illegible] with great rapidity.

The Heisler Electric company, Philadelphia, reports the [illegible] Carroll Electric Light Works, [illegible] 32 candle power lights; Rheubottom & Bond, Union City, Mich., (increase), 200 32 candle power; Merced Gas & Electric Light company, Merced, Cal. (increase), 400 32 candle power; [illegible] Kingman, Kan., (in- [illegible] Oil Stove com- [illegible] power; Cortright [illegible] power. The munici- [illegible] Heisler Electric com- [illegible] nearly completed.

[illegible] company, Newark, [illegible] ammeter which [illegible] for the [illegible] the well known [illegible] to meet [illegible]

facturing and construction concerns under his recently patented system of motor regulation. The basis of the license is a charge of $2.50 per kilowatt in the motor. The royalty charge is not an annual charge, but is paid once for all in each case. It may be stated in this connection that Wm. Sellers & Co. have taken a license under Mr. Leonard's patent on this basis. It is agreed to use the method upon all electric cranes the Sellers build in the future, during the life of the patent.

The new plant of the Ball & Wood company is so far completed that shipments of engines have commenced, and the works have been running night and day since October 1st. Orders for the improved Ball engines have already been received as follows: 150 horse power for the state house, Trenton, N. J.; two 150 horse power for the Edison Electric Illuminating company of Paterson, N. J.; 75 horse power for the Saugerties Electric Light company, Saugerties, N.Y.; 100 horse power for the Meriden Electric Light company, Meriden, Conn.; 75 horse power for the Edison General Electric company, Rockledge, Fla.; 100 horse power for the Leominster Worsted company, Leominster, Mass.; 150 horse power for R. H. Macy & Co., New York; two 75 horse power for the Four Seasons hotel, Cumberland Gap, Tenn.; 150 horse power for the Electric Light company, Madison, N. J.; 150 horse power for the Laconia Car company, Laconia, N. H.; 300 horse power cross compound for the Edison company, of Paterson, for street railway service.

The new firm of Sprague, Duncan & Hutchinson, limited, is ready to do the work of consulting electrical engineers. Frank J. Sprague is known as the inventor of the Sprague motor, and is one of the foremost pioneers of the electric street railroad, and an authority upon rapid transit by electricity. Mr. Sprague has resigned his office as vice-president of the Sprague Electric Railway & Motor company, and consulting engineer of the Edison General Electric company, and will devote himself to the new work. Dr. Louis Duncan's creative work in electricity made him the head of the electrical department of the Johns Hopkins University. Dr. Cary T. Hutchinson was Mr. Sprague's assistant in the Sprague Electric Railway & Motor company, and thereafter assistant to the chief engineer of the Edison General Electric company. Sprague, Duncan & Hutchinson, limited, will make municipal work a specialty, and will also act as consulting electrical engineers in general electrical work. Alfred Bishop Mason is manager of the corporation. The office of the firm is at 15 Wall street, New York.

The Astoria Electrical Manufacturing company has been orginized with a capital of $500,000 for the manufacture and sale of electrical machinery and apparatus, especially stationary and traction motors; and for that purpose has secured the ownership of United States patents issued to W. M. McDougall and John Boothby. The special advantages of the system controlled by this company are briefly as follows: But one motor applied to each car; the armature is geared directly to the axle; the gears are completely encased in iron boxes, excluding dirt and protecting the lubricants; the motors can be attached to almost all of the horse cars now in use, without alteration, beyond turning down the axle where the gears are fitted on, and in no case would alteration be necessary further than raising the car body two or three inches. The peculiar manner of suspending the motor insures uninterrupted connections and steady motion. The first car produced by the company was built for use with storage batteries, and has been placed on the Astoria and Hunters Point railroad. The officers of the new concern are: President, Conrad N. Jordan; vice-president, William Steinway; treasurer, Herman Ridder; secretary, Charles W. Spear; general manager, W. M. McDougall. The offices are at 14 Dey street, New York.

ELECTRICAL PATENTS.

Issued Dec. 8, 1891.

464,490. Electric Railway Signal. Charles E. Buzzell, Leaf River, Ill.

464,505. Conduit Conductor for Electric Railways. Walter H. Knight, New York, N. Y.

Claim seven reads:
"The combination, with an insulated supply conductor, inclosed in a conduit, of a safety device between two adjacent sections of said conductor, and an inclosing box outside of the conduit in which said device is contained."

464,510. Automatic Fire Alarm Telegraph. Morris Martin, Malden, Mass.

464,515. Electric Fire Recording System. Barton S. Molyneaux, Minneapolis, Minn.

Claim seventeen [illegible]
"The combination, with an electric receiving or recording apparatus, of a registering device of contacts corresponding to the [illegible] of the register, and means for closing a circuit between [illegible] contacts corresponding to the number indicated [illegible] the register and the recording apparatus whereby [illegible] automatically recorded."

464,5[illegible]. Spring Jack Switch. William R. Patterson, Chicago, Ill.

464,5[illegible]. Means for Preventing the Interference with Speech on Telephone Circuits by Induced or Other Currents. William Stanley, Jr., Pittsfield, Mass., and John F. Kelly, New York, N. Y.

464,[illegible]. Time Registering Device for Electrical Currents. William D. Wilder and Walter Cobb, Jr., [illegible] Mass.

464,[illegible]. Armature Winding for Dynamo Electric Machines. Craig R. Arnold, Philadelphia, Pa.

[illegible]

464,548. Cut Out. Craig R. Arnold, Sharon Hill, Pa.

464,557. Electric Railway System. Leon O. Dion, Natick, Mass.

The first claim reads:
"The combination of a car or other vehicle, a storage battery thereon, an elongated conductor or contact on the exterior of the car, extending lengthwise thereof, and consisting of an endless belt and loosely mounted pulleys, around which said belt is passed, and electrical connections between one of said pulleys and the battery, whereby when the contact belt touches a distributor of electricity the battery will receive a partial charge."

464,587. Carriage Actuating Mechanism. William H. Phillips, Jenkintown, Philadelphia, Pa.

464,595. Lightning Arrester. Elihu Thomson, Swampscot, Mass.

464,640. Transmitting Mechanism for Motor Cars. Charles W. Thomas, Jersey City, N. J.

464,643. Protector for Telephones. John L. W. Zietlow, Aberdeen, S. D.

464,655. Electric Track Signal. Homer A. Parrish, Jackson, Mich.

The third claim is given:
"In an electric track signal, the combination of a rail of the track, the tread bar adapted to yield laterally against a spring-resistance, said bar being provided with a metal face on the side next to the rail, and the circuit wire connected with said metal face."

464,665. Secondary Battery. Isaiah L. Roberts, Brooklyn, N. Y.

464,666. Electro Magnetic Motor. Nikla Tesla, New York, N. Y.

The first claim is quoted:
"In an alternating current motor provided with two or more energizing or field circuits, one of which is adapted for connection with a source of currents and the other or others in inductive relation thereto, the combination, with the secondary or induced circuit or circuits, of a condenser interposed in the same."

464,667. Electrical Condenser. Nikola Tesla, New York, N. Y.

464,671. Transformer Motor. Otto T. Blathy, Buda-Pesth, Austria-Hungary.

The essential parts of this motor are, an armature with coils or windings, closed upon themselves, which may also be regarded as composed of two armatures, the coils of which are severally closed upon each other, and two field magnets excited by two alternate currents, displaced in phase from one another, the coils of the two armatures being distorted with reference to each other.

464,673. Drill for Electric Railways. Harry P. Bradford, Little Rock, Ark.

464,676. Electrode for Secondary Batteries. William Morrison, Des Moines, Iowa.

464,677. Electrical Transformer. Arcadius Poleschko, St. Petersburg, Russia.

The second claim is given:
"2. An electrical transformer having a core composed of spaced radiating plates made up into a ring provided with a vertical slot within the core containing the primary coils, and a slot extending substantially at right angles to the first named slot and containing the secondary coils."

464,682. Electric Arc Lamp. Addison G. Waterhouse, Hartford, Conn.

The last claim reads:
"19. An electro-magnet composed of a coil conductor upon an insulating spool placed between two floors, which are rigidly connected together, but far enough apart to receive the said spool, said floors being provided with holes which will correspond with the opening through the center of said spool, in combination with a tube to be slid through said floors and spool, adapted for keeping the spool in place and also for receiving an iron magnet core or armature."

464,683. Electric Meter. Addison G. Waterhouse, Hartford, Conn.

464,691. Electric Body Wear. Lauritz Anderson, Chicago, Ill.

464,719. Incandescent Lamp Filament. Ludwig K. Boem, New York, N. Y.

The second claim is quoted:
"2. The herein described improvement in the art or method of making filaments for incandescent lamps, which consists in soaking carbonizable material in a solution of bicarbonate of calcium or magnesium, and subsequently carbonizing the same."

464,730. Electric Programme Clock. Charles Lester, Chicago, Ill.

464,770. Clamp for Electric Wires. John J. Green, Boonton, and George C. Brown, Elizabeth, N. J.

This is a device for supporting, clamping and holding electric conductors, particularly such as are provided with a coating of flexible or compressible material.

464,780. Trolley for Electric Railways. John W. Schlosser, Washington, D. C.

464,816. Ore Separator. William G. Conkling, Glens Falls, N. Y.

464,822. System of Distributing Electricity. Thomas A. Edison, Menlo Park, N. J. Filed June 26, 1882.

The last claim reads:
"In a system of electrical distribution, the combination of a main circuit extending to a distance from the source of electrical energy, and having a current of high tension, and a translation circuit with an intermediate secondary battery or condenser, a commutator throwing all the elements of such secondary battery or condenser together, and at the same time rapidly forming a series connection with the main circuit to a multiple arc connection with the translation circuit, and an electric motor for working such commutator."

464,897. Telegraph Key. Louis F. Robare, Au Sable Forks, N. Y.

464,93[illegible]. Process of Obtaining Metals from their Ores or Compounds by Electrolysis. Charles S. Bradley, Yonkers, N. Y.

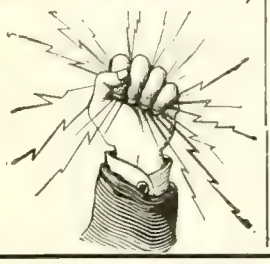
464,94[illegible]. Automatic Cut Out for Electric Motors. Schuyler S. Wheeler, New York, N. Y.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

RAILWAY FEEDER AND TROLLEY WIRE,
ELECTRIC LIGHT LINE WIRE,
Incandescent and Flexible Cords,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR **WIRES,**
FARADAY CABLES.



NEW YORK OFFICE, 10 Cortlandt Street.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

ESTABLISHED 18[illegible].

HEMINGRAY GLASS CO.,

Offices, Covington, Ky. Factories, Muncie, Ind.

STANDARD SCREW GLASS INSULATORS,
Glass Break Knobs, Floor Insulators, Battery Jars.
ARC LIGHT GLOBES FOR ALL SYSTEMS.

WORK ON SPECIAL DESIGNS SOLICITED.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, oxidize or crack, and is not affected by heat, cold, acid, alkali, or weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole soaked with Clark's Patent Compound, and is especially adapted for Underground and Submarine use. We have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and to a very great extent fireproof. This protection makes our wire especially durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph and Electric Lights from stock. Cables made to order. We are also prepared to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half-pound boxes, in strips about one foot long and five-eighths inch wide, and is ready for use by simply heating and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices are as low as those of any other first class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.
HERBERT H. EUSTIS, President and Electrician.

ELECTRICAL INSTRUMENTS

RECALIBRATED.—REPAIRED.

CHICAGO ELECTRIC MFG. CO., 73 W. Jackson St.

WANTED.

A practical electrician, thoroughly competent to plan and direct the electrical and mechanical construction of motors and dynamos. One who is theoretically and practically familiar with different types of machines. Answer by letter *only*, giving complete record, references and salary wanted. No personal applications considered. Address **"Chicago,"**
Care WESTERN ELECTRICIAN.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill — **10 So. 18th St., Philadelphia, Pa.**

See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

A GENTLEMAN,

Who has had three years' experience with T.-H. and Schuyler systems of Arc Lighting, and has been Superintendent of Gas and Electric Plant for 15 months, will be open for employment after January 1st.
Address **"Superintendent,"**
Care WESTERN ELECTRICIAN.

SOMETHING NEW!

An improved 4 or 6 volt Combined Storage Battery especially for Dentists' use at very low price. Purchasers can exchange discharged for charged cells, without extra cost, beyond expense for charging the batteries. Manufactured by

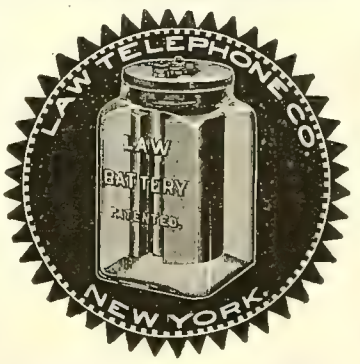
J. K. PUMPELLY,
Room 301, 205 S. Canal St., Chicago.

43 and 45 Franklin St.

For Sale Cheap, Second-hand Machinery, Arc and Incandescent. Also Motors. All Apparatus Guaranteed.

CHICAGO.

The Electrical Construction Co.



The Winner of 1890 will win again in 1891
Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,
85 John St., NEW YORK

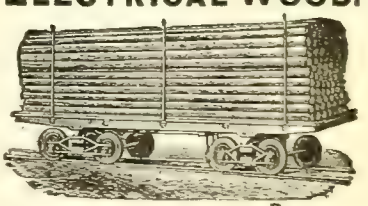
MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,
218 Water St., New York.

ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light
CROSS ARMS
POLES

OCTAGONAL PINE AND STEEL POLES.

C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

REPAIRS

Chicago Electric Motor Co.

Street Railway and Generator Armatures Re-wound.

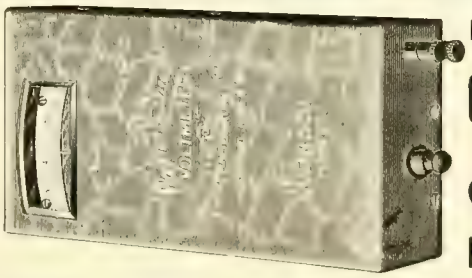
205 and 207 So. Canal St., CHICAGO, ILL.

BINDERS

For the WESTERN ELECTRICIAN,
—$1.00—

FOR DIRECT AND ALTERNATING CIRCUITS.

The WAGNER-QUEEN Portable Voltmeter.

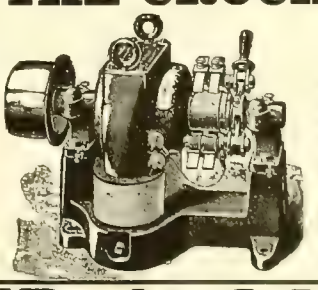


Made by QUEEN & CO., PHILA.

Send for Descriptive Circular No. 265.

THE CROCKER-WHEELER

PERFECTED MOTORS.



Very slow speed, full power, perfect regulation, forged fields let into base, self-oiling bearings, self-centering bearings, all sizes, both arc and incandescent, for all power purposes.

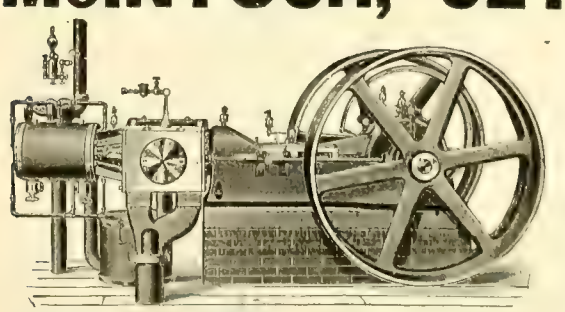
Acknowledged by the Leading Manufacturing Companies to be

THE MOST PERFECT MOTOR MADE.

Estimates and Plans Furnished for Electric Power Equipment. Correspondence Invited.

430--432 WEST 14TH ST., NEW YORK.

McINTOSH, SEYMOUR & CO. ENGINES.



SINGLE CYLINDER OR COMPOUND.

List of Engines under Construction July 1, for Delivery on or before September 30:

	SIZE.	H. P. OF EACH ENGINE.	DESTINATION
One	12½x12	80	Edison General Electric Co., Groton, N. Y.
Two	18½x17	400	Gloucester Street Railway Co., Gloucester, Mass.
One	13 and 23x17	240	T. H. International Electric Co., Rio Janeiro, Brazil.
One	11x12	65	Merchants & Miners Transportation Co., Baltimore, Md.
One	13 and 19x15	150	Portland Street Railway Co., Portland, Me.
One	11 and 19x15	150	Lawrence, Mass.
Two	13 and 23x17	240	Lawrence, Mass.
One	13 and 23x17	240	Fall River, Mass.
One	8x9	30	Isolated Dept. T.-H. Elec. Co., Boston, Mass.
One	13 and 19x15	150	G. A. Robins & Co., Chicago, Ill.
One	15 and 21x17	325	Somerville Electric Light Co., Somerville, Mass.
One	13x15	100	A. G. Weeks, Boston, Mass.
One	14½x15	125	Tonawanda & Wheatfield Electric Light Co., Tonawanda, N. Y.
One	18½x18	200	T.-H. Int. Elec. Co., Leeds England.
One	8x9	30	A. J. Wilkinson, Hyde Park, Mass.
Two	9½x10½	45	Presbyterian Hospital, New York City.
One	23x19	500	Chicago Edison Co., Chicago, Ill.
One	11 and 19x15	150	T.-H. Int. Elec. Co., Helsingfors, Finland.
One	11 and 19x15	150	Fritz Wilen, Helsingfors, Finland.
One	16x15	150	T.-H. Electric Co., Boston, Mass.
Two	14½x15	125	Cortland Forging Co., Cortland, N. Y.
One	1d and 23x17	215	West End Street Railway Co., Boston, Mass.
One	15 and 26x17	400	Baltimore Electric Refining Co., Baltimore, Md.
One	14¼ and 28x22	500	Georgia Electric Light Co., Atlanta, Ga.

For Particulars Inquire of

SARGENT & LUNDY, SELLING AGENTS,
339 Rookery Bldg., CHICAGO.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC

FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

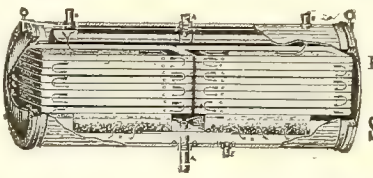
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

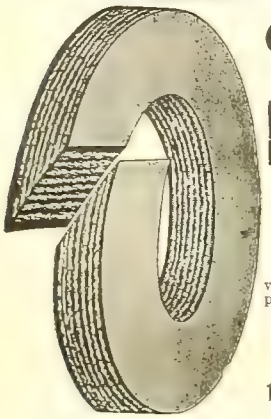
Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

HARD FIBRE

for insulation and mechanical construction is manufactured in Sheets, **Rods, Tubing, Washers, Discs** and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.



GIVEN AWAY!!

SAMPLE ORDERS OF

Buxton's Packing

At Only 50c. Per Pound.

"The Engineer's Favorite."
All Orders Guaranteed.

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

ESTABLISHED 1882.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

ELECTRICAL AND MECHANICAL ENGINEERING AND SUPPLIES.

REPAIRING

ELECTRICAL MACHINERY

The Electric Supply and Contracting Company,
S. E. Cor. Fifth and Sycamore Sts., (Nevada Building,) **CINCINNATI, O.**

OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.
FITCHBURG, MASS, U.S.A.

MANUFACTURERS OF **DYNAMOS** FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.

EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

A GREAT RAILROAD.

By the absorption of the Chicago & Atlantic Railway between Marion and Chicago, the ERIE has at last effected its entrance into Chicago, and now occupies the proud position of being the only line between Chicago and New York entirely under one management.

One result of this is the arrangement whereby all the through trains of the Erie are now run solid between Chicago and New York without change. Passengers holding through tickets, whether first or second class, are able to go from Chicago to New York without changing cars.

Pullman's most modern Sleeping Cars are run on all through trains via this line, and on their Vestibuled Limited, Pullman's Dining Cars. No extra fare charged on this train. In fact, the rates via the ERIE are lower than via any other route offering equal facilities.

ELECTRIC LIGHT AND BATTERY

CARBONS.

CLEVELAND, OHIO.

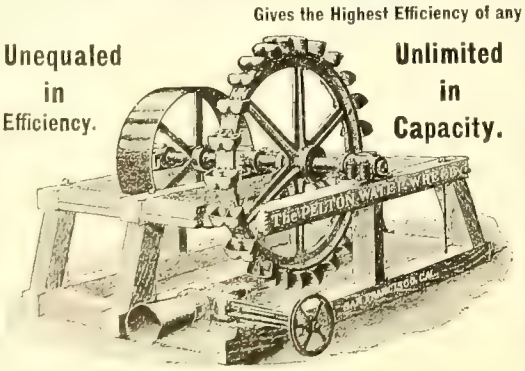
MOTOR BRUSHES.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 20 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

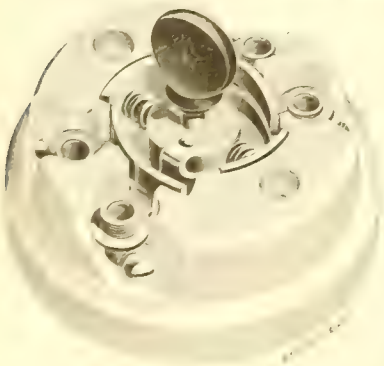
ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,
121-123 Main St., San Francisco, Cal., U. S. A.
143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.



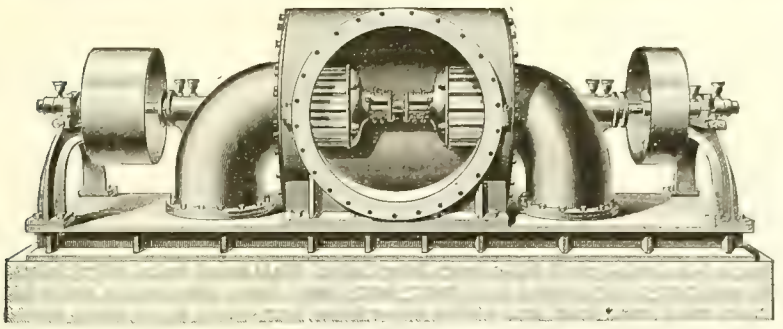
25 Ampere Double Pole SWITCHES 75c.

AND LESS!!

STAR ELECTRIX CO.,

641 North Broad St.,
PHILADELPHIA.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES ... CELEBRATED WATER WHEEL ... on account of its **remarkably steady motion, high speed and great Efficiency,** and **large Capacity** ... diameter, being **double the Power** ... by a number of the leading ... economical use of water it is without an equal, producing the highest per cent of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended ... and it can be belted directly to dynamo.

The accompanying engraving represents a pair of ... **VICTOR TURBINES** arranged on a ... Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast iron bed plate. These ... strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO., RAVENNA, OHIO.

MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215 — **136 Liberty St.,** NEW YORK.

$22.00

ANTIQUE FINISH DESK,

Four and a half feet long.

Send for complete catalogues of office fittings.

AMERICAN DESK AND SEATING CO.,

270-272 Wabash Avenue, CHICAGO

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),

DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

LINK-BELT MACHINERY CO.,

CHICAGO, ILL.

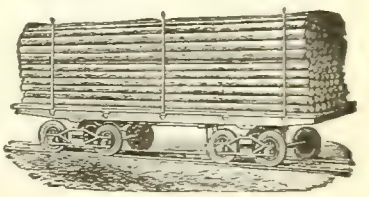
Manufacturers of

Elevators and Conveyors,

For the economical handling of Coal, Ashes, Sand, etc., etc. Send for reduced price list on Link Belting

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. NEW YORK.

VULCANIZED FIBRE CO.

ESTABLISHED 1873.

SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

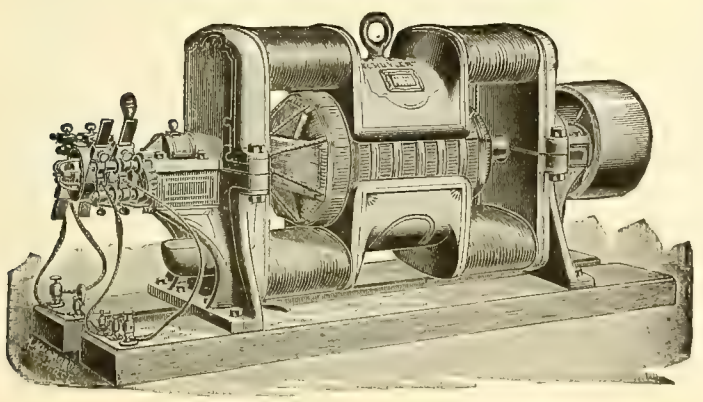
FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

IMPORTANT.

THE HEISLER SYSTEM IS THE

ONLY APPARATUS

MADE FOR LONG DISTANCE LIGHTING THAT IS

SELF-CONTAINED

AND PROVIDED WITH ABSOLUTELY

AUTOMATIC REGULATION.

Our Series Socket is **SAFE, RELIABLE,** and **DURABLE,** and is protected with **INSULATED** covering, notwithstanding the claims of monopoly of these features by other manufacturers.

Series Sockets and Lamps for Arc Light Circuits.

WE INVITE INVESTIGATION.

HEISLER ELECTRIC CO.,

DREXEL BUILDING,

PHILADELPHIA, PA.

C. & C. ELECTRIC MOTORS and DYNAMOS.

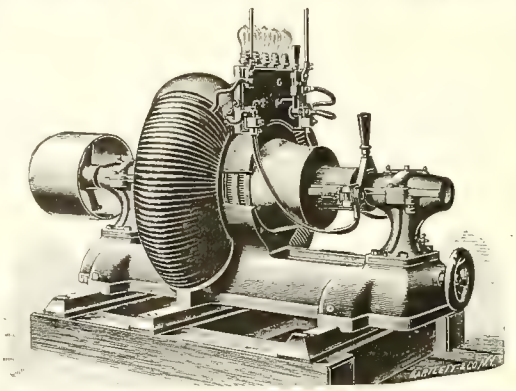
ELECTRIC MOTORS in all standard sizes, up to and including 100 H. P., for operating elevators, pumps, printing presses, and machinery for general manufacturing purposes.

POWER GENERATORS.

ELECTRIC MINING MACHINERY of all kinds, Hoists, Tram Cars, etc.

FAN OUTFITS, Electric Plants for pumping Church Organs.

We call the special attention of Station Superintendents to the fact that our machines are absolutely unsurpassed for economy of electric current.



DYNAMOS for isolated plants and the equipment of Mills, Banks and Office Buildings with Electric Lights.

ELECTRIC BLOWERS for ship ventilation. Have equipped 18 U. S. and foreign War Ships with ventilating apparatus.

NEW ENGLAND Office, 63 Oliver St., BOSTON.
PHILADELPHIA Office, 38 S. Fourth St.
CHICAGO Office, - Phenix Building.
SAN FRANCISCO Office, - 35 Market St.
ST. LOUIS Office, - - 421 Olive St.
NEW ORLEANS Office, 78 Customhouse St

THE C. & C. ELECTRIC MOTOR CO., 402-404 Greenwich Street, NEW YORK.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

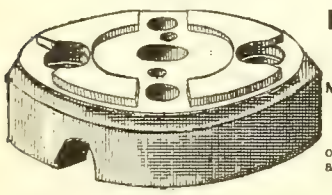
The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

NOW THEN! FOR SALE CHEAP!!

Six 400 light Thomson-Houston Incandescent Dynamos, 110 volts. Perfect order.
Three 25 light 2,000 candle power American Arc Dynamos. A 1 order.
Two 50 light 2,000 candle power Sperry Arc Dynamos. A 1 order.
700 Goose Necks, Sockets, Lamps, etc., complete, good.
50 miles No. 10 American Electric Co. Wire, good order, used one year. In ½ mile reels.
Two 400 light Thomson-Houston New Armatures.
70 American Single Carbon 2,000 candle power Arc Lamps. A 1 order.
Two 70 H. P., 700 volts, Edison Generators, used six months.
Ten 5 H. P. Sprague Motors, used six months.
Two Edison Electric Mining Rock Drills, used six months.
High Speed Engines and Full Station Equipments, Poles, etc.
Eighty 2,000 candle power American Double Carbon Arc Lamps, used three months.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street, NEW YORK.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

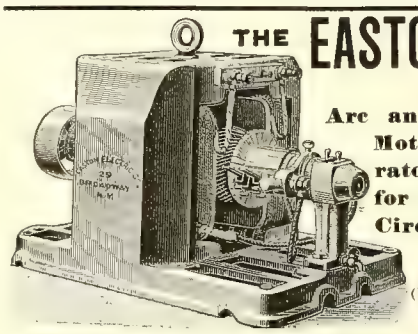
MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

TRUE HARD PORCELAIN.

THE EASTON ELECTRIC CO.,



—MANUFACTURERS OF—

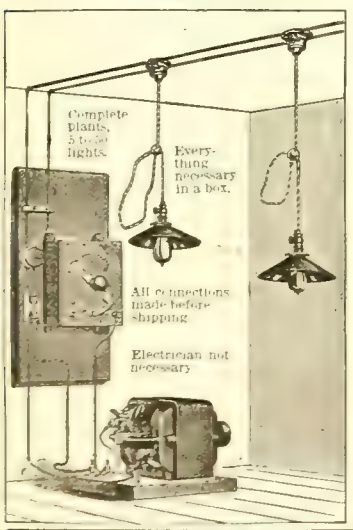
Arc and Incandescent Dynamos, Motors, Generators and Separators and Arc Lamps adapted for use on Arc or Incandescent Circuits.

ADDRESS:

643 Kent Avenue, BROOKLYN, N. Y.

(Near Roosevelt, Grand and East 23d Street Ferries from N. Y.),

For Circulars, Prices and Information.



You can Put It up Yourself.

Lights Are Standard And Full size.

Thoroughly Reliable And Practical.

Prices Reasonable.

Send For Illustrated Pamphlet.

BAIN ELECTRIC MANUFACTURING CO.,

47 So. JEFFERSON STREET,

CHICAGO.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS, ELBOWS, JOINTS, ETC., ETC,

All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,

78-80-82 Franklin Street,

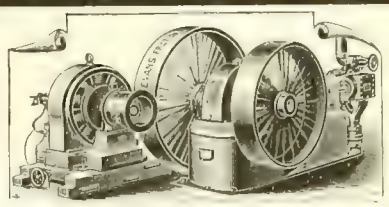
CHICAGO.

MAIN OFFICE, 649 and 651 Broadway, New York

Geo. H. Meeker, Western Manager.

NEW YORK INSULATED WIRE CO. NEW YORK MOISTURE-PROOF VULCA ELECTRICAL WIRE-DUCT NON-INFLAMMABLE TRADE MARK

AND CHICAGO.

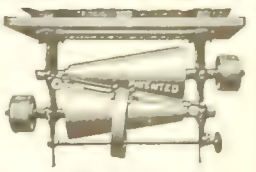


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES. | **CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.**

EVERYTHING IN
WIRE—FUSE— STRIPS.

MANUFACTURED BY
The Sperry Electric Mining Machine Co.,
39th St. and Stewart Ave., CHICAGO.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK. | MANUFACTURED BY **MILLIKEN BROS.** | 59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

Goodrich-Coleman Electrical Works,

NEW ELECTRICAL THEORIES DEVELOPED.
Manufacturers of Specialties and Novelties under Contract.
31 South Canal Street, - CHICAGO.

H. WARD LEONARD & COMPANY.

Secure bid from us for Electrical Apparatus or Construction before deciding. Railways, Lighting, Transmission of Power, Wiring, etc.
Electrical Exchange Building, NEW YORK CITY.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

CLEVELAND, OHIO.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K.K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

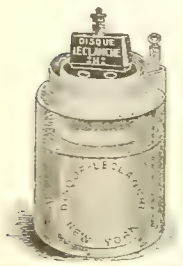
Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO,
Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

THOS. L. SCOVILL, New York Agent,
25 Park Place, NEW YORK.

HIRLIMANN BATTERIES.

Are Standard.—Only One that is Guaranteed.



The Regular, 1891 Style Disque Leclanche Battery, made by C. J. Hirlimann, the Original Maker of Leclanche Batteries in the United States.

CHAMPION BATTERY. Patented.

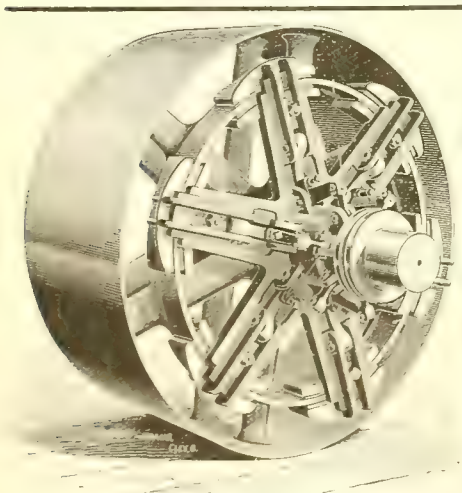
The Improved Patented Porous Cup Leclanche Battery.

SEND FOR CATALOGUE AND PRICE LISTS
BEFORE PURCHASING ELSEWHERE.

Manufactured by **C. J. HIRLIMANN, 117 Macdougall St., New York.**

AGENTS WANTED.

BRANCHES: 164 Summer St., Boston, Mass; 225 Pearl St., New York City. 129 N. Third St., Philadelphia, Pa; 60 W. Monroe St Chicago. | **St. Louis, Mo.**



HILL
Clutch Works,
CLEVELAND, O.

EASTERN OFFICE.
18 Cortlandt St., - NEW YORK.

Engineering Office: 146 Franklin St., BOSTON.

CHICAGO: 28 So. Canal St. MINNEAPOLIS: 305 Kasota Building.

KANSAS CITY: 1221 and 1223 Union Avenue.

ELECTRIC LIGHT PLANTS
Designed, Erected and Furnished.

Send for new Catalogue Power Transmission Machinery.

THE PIONEER LOW SPEED HIGH GRADE MACHINES.

PERRET ELECTRIC MOTORS.

ALL SIZES FOR ALL PURPOSES. **THOUSANDS NOW IN USE.**

PERRET - ELECTRIC - LIGHT - SYSTEM.

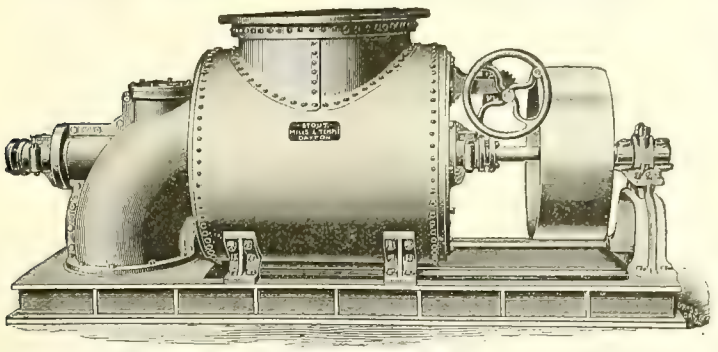
COMPLETE APPARATUS FOR ISOLATED PLANTS.

THE ELEKTRON MFG. CO., Springfield, Mass.

NEW YORK OFFICE, 89 Liberty Street.

SELLING AGENTS:
Washington, D. C., S. T. BURKETT & CO., 1409 N. Y. Avenue
New Orleans, La., GEORGE BAQUIE, 130 Gravier Street
Chicago, Ill., THE ELECTRICAL ENGINEERING CO., 320 Dearborn Street.
St. Paul, Minn., E. J. RENZ, 95 East 4th Street.
Philadelphia, Pa., PENNSYLVANIA MACHINE CO., 29 North 7th Street.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO,
SUCCESSORS TO
STOUT, MILLS & TEMPLE, DAYTON, O.

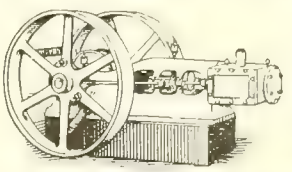
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.



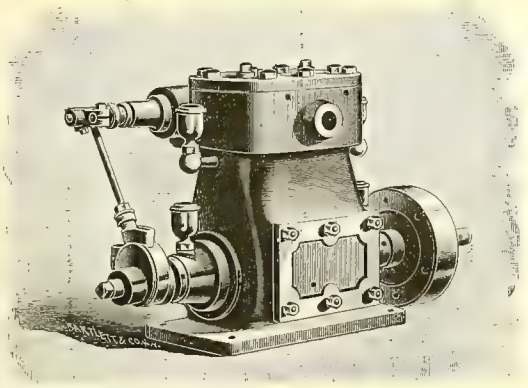
WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS', No. 417 North street, BALTIMORE, MD.

TO DENVER VIA
BURLINGTON ROUTE.
Only One Night on the Road

Leave Chicago [illegible] P. M., [illegible] A. M., or leave Chicago [illegible] P. M., [illegible] A. M. The finest Sleepers, Chair Cars and Dining Cars. All Express Trains run [illegible] Through Trains and Through Cars to Denver via Burlington Route. Leave Chicago [illegible] P. M., St. Louis at 5 P. M. and [illegible] P. M., and 8:00 P. M. Arrive Denver [illegible]

Additional express trains leave Chicago as follows: [illegible] Louis and Peoria at 8 P. M. Connecting Bluffs, Omaha, Cheyenne, Black Hills, Yellowstone, Kansas City, Houston and all points West, Northwest and Southwest.

WESTINGHOUSE ENGINES



THE ORIGINAL WESTINGHOUSE ENGINE,

BUILT A. D. 1880.

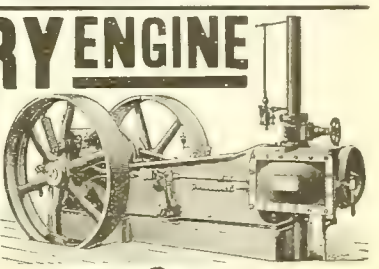
SIZE 3x3. 1,000 REVOLUTIONS.

Now preserved in the Offices of the Company, Pittsburgh, Pa.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
Catalogue sent on application.
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES { Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF PRINTING PLATES TRY BRAUN ILLUSTRATING CO. 334 DEARBORN ST. CHICAGO.

HALF TONE PLATES A SPECIALTY.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

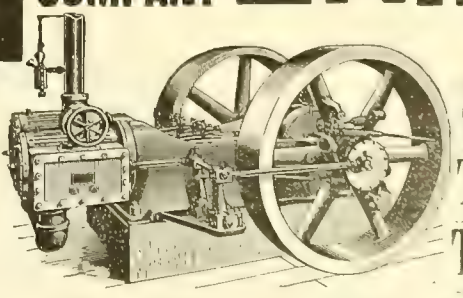
The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY,
ST. LOUIS. CHICAGO. KANSAS CITY.
OMAHA. DALLAS. SEATTLE.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE.



Simple.
Cross Compound.
Triple Expansion.
Tandem Compound

With New Improvements.
Unequaled Regulation.
Highest Economy, Durability,
Smooth and Quiet Running.

The BEST ENGINE for ELECTRIC LIGHTING, ELECTRIC RAILWAYS, ELECTRIC MINING, ELECTRIC WELDING, and General Manufacturing Purposes.

SELLING AGENTS { E. T. COPELAND & CO., 18 Cortlandt St., New York; J. W. PARKER & CO., 38 South Fourth Street, Philadelphia, Pa.; DRAVO & BLACK, 804 Lewis Block, Pittsburg, Pa.; NORTHWESTERN SUPPLY Co., Tacoma, Wash.; CROOK, HORNER & CO., Baltimore, Md.; E. G. GILBERT, Atchison, Kan.; COOLEY & VATER, 224 Washington Ave. South, Minneapolis, Minn.

BRANCH OFFICE, Room 506 Rookery Building, CHICAGO, ILL. ALBERT FISHER, Manager.

DID YOU SEE IT AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.,

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.

THE

CRESCENT DRY BATTERY.

IT

Is Smaller Than Any Other.
Has Great Strength.
Has Great Durability and Recuperative Powers.
Is Not Subject to Freezing.
Does Not Evaporate.
Is the Best Battery on the Market.

THOUSANDS IN USE.

We want every Bell Hanger and Construction Man to send us his name on a postal card. It will pay him to do so.

Perkins' Incandescent Lamps

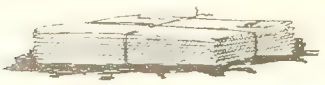
Never Disappoint You.

THE KNAPP ELECTRICAL WORKS,

MANUFACTURERS AND DEALERS,

54 and 56 Franklin Street,

CHICAGO, ILL.



"We are Advertised By Our Loving Friends."

Letters of Credit.

We print these letters from ENGINEERS who have used the Improved Brush.

CHICAGO ELECTRIC MFG. CO.,
73 W. Jackson Street,

DECEMBER 1, 1891.

THE ELECTRICAL SUPPLY CO., Chicago.

Gentlemen:—We are using your Patent Dynamo Brushes on our incandescent dynamo, and have been at some pains to observe their behavior. We find that as the load changes on our dynamo there is decidedly less tendency to spark with the use of these brushes, the practical result to us being that the dynamo runs with less time spent for attendance. The wear on the commutator appears remarkably small and even when absolutely neglected and allowed to spark, the sparking does not have the cutting effect which is usually the case.

Yours truly,

DICTATED BY IRVING USNER. CHICAGO ELECTRIC MANUFACTURING CO.

UNION LEAGUE CLUB,
CHICAGO, November 19, 1891.

TO THE ELECTRICAL SUPPLY CO., City.

Gentlemen:—After trying one set of your Patent Dynamo Brushes, I have put them on all three of our incandescent dynamos, and like them so well that I would not be willing to use the old style of brush again.

Yours truly,
D. B. RAMSEY, *Chief Eng. U. L. Club.*

THE COLUMBIA,
LEADING THEATER OF CHICAGO.

August 23, 1891.

THE ELECTRICAL SUPPLY CO.

Gentlemen:—The brushes are running with much less sparking than any I have ever tried. Evidently they are an improvement.

Respectfully, GEO. CARSON.

CHICAGO, August 22, 1891.

THE ELECTRICAL SUPPLY CO.
Michigan Avenue and Randolph Street, Chicago.

Gentlemen:—We have used a set of your Wirt Brushes on an Edison Dynamo, and have had no sparking and scarcely any attention required during that time. The brushes furnished by the makers of the same dynamo were always more or less troublesome, and required frequent resetting and dressing of the commutator. I would now consider it a hardship to be obliged to use the old brushes.

Yours truly,
(Signed) R. C. PAGE,
Engineer Libby Prison Museum.

CITY HALL, CHICAGO, August 27, 1891.

THE ELECTRICAL SUPPLY CO.

Gentlemen:—We have been running your brushes on our Edison Dynamo for two months and find they are a decided improvement.

HENRY MUNSTERMAN, *Chief Engineer.*

We invite correspondence from those who have dynamos which are at all troublesome at the brushes. The Wirt Brushes are somewhat higher in first cost than plain copper brushes, but they will pay for themselves many times over in saving of labor and commutator copper.

These brushes are manufactured to order, and can be furnished on short notice. When ordering please give dimensions of brushes in use.

The Electrical Supply Co.,

WESTERN OFFICE AND WAREHOUSES

Cor. Randolph St. and Michigan Ave.,

CHICAGO.

Eastern Office and Factories
Ansonia, Conn.

Enclose Business Card for Illustrated Catalogues.

THE INDIA RUBBER & GUTTA PERCHA INSULATING CO.,

— MANUFACTURERS OF —

VULCANIZED INDIA-RUBBER Cables, to any Specification up to 8,000 Megohms per mile.

ABSOLUTELY PURE RUBBER CABLES.

CONCENTRIC CABLES, any millage, FLEXIBLE CORDS, SILK, HEMP, COTTON, DYNAMO WIRES and CABLES, very pliable. Every variety of INCANDESCENT CORES.

HABIRSHAW

RUBBER COVERED

CABLES AND CORES.

THREE and TWO-WIRE CABLES, to any specification up to 8,000 Megohms per knot.

CABLES of High Insulation and Long Life, all milage

If you are not acquainted with the merits of Habirshaw Insulation we shall be pleased to send you samples upon application.

W. M. HABIRSHAW, Gen'l Mgr. OFFICE: 315 Madison Ave., Cor. 42d St., New York.

FACTORY: Glenwood, Yonkers, N. Y.

Western Agents: THE ELECTRICAL SUPPLY CO., Corner Randolph St. and Michigan Ave., CHICAGO, ILL.

TAKING THE LEAD.

THOUGH ONLY

ON THE

MARKET

—FOR—

SIX MONTHS,

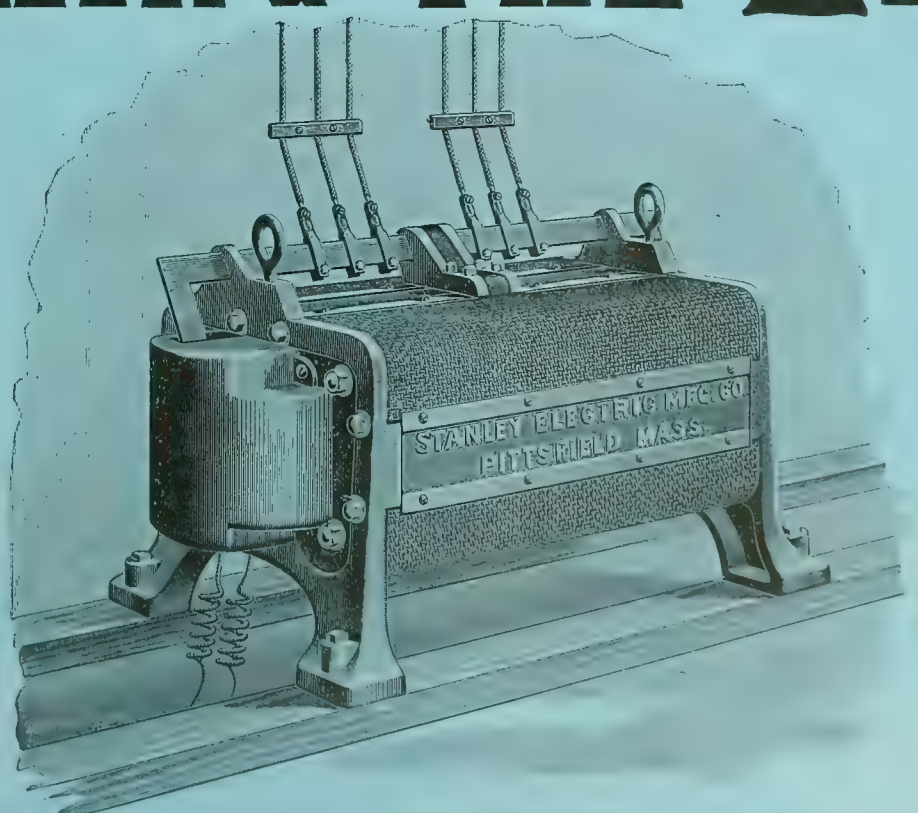
THE

STANLEY

—IS—

NOW KNOWN

—AS—



THE

BEST

Transformer.

CORRESPONDENCE

SOLICITED.

CUT OF 300 LIGHT TRANSFORMER.

STANLEY ELECTRIC MFG. COMPANY, PITTSFIELD, MASS.

WESTERN AGENTS: The Electrical Supply Co., Corner Randolph St. and Michigan Ave, Chicago, Ill.

FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

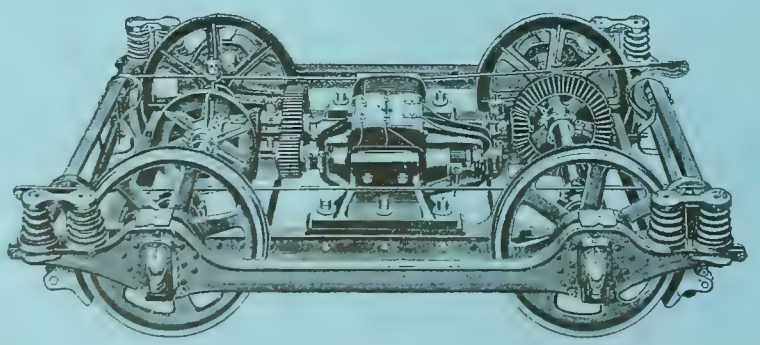
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

ONE MOTOR DRIVING BOTH AXLES

Of a street car, is the same principle as having all driving wheels of a locomotive connected, which is the AMERICAN SYSTEM.

Sizes:
15, 30 and 40
Mechanical
Horse Power.



One Heat
Proof Motor,
Driving
Both Axles.

This cut represents the latest construction of our Standard Apparatus equipped with our HEAT PROOF MOTOR. Attention is invited to the work being done by these equipments on the Merrimac Valley Street Railway, Lawrence, Mass.; Consolidated Street Railway Company, Grand Rapids, Mich.; and the People's Electric Street Railway, Springfield, Ill.; where, in each place, the two largest electric companies have put their latest equipments against them, with the result of proving our claims and strengthening the advantages derived from utilizing the full traction of the car, and driving all wheels simultaneously.

PATENTEES AND SOLE MANUFACTURERS:

DETROIT ELECTRICAL WORKS,

DETROIT, MICH., U. S. A.

Also Manufacturers of Electrical Power Machinery, Standard Line Appliances and General Electrical Supplies.

CORRESPONDENCE INVITED.

Western Electrician.

$3 per Annum. EVERY SATURDAY. 10 cents per Copy.

Vol. IX. CHICAGO, DECEMBER 26, 1891. No. 26

ELECTRIC RAILWAYS.

Plans and Specifications prepared, from which correct, uniform bids can be secured.
Contracts made for complete Steam Plants, using McIntosh & Seymour Engines.
Contracts made for complete Electric Railway installations.

SARGENT & LUNDY,
Mech. & Elec. Engineers,
339 Rookery Building. - - CHICAGO.

The Minnesota Brush Electric Company
HAVE JUST BOUGHT
82½ MILES
of Arc, Incandescent and Power Cables
INVESTIGATION PROVED IT THE BEST.
OF THE
Standard Underground Cable Co.,
New York, Pittsburgh, Chicago.

Insulated Wires and Cables.

DAY'S KERITE

The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

CELEBRATED KERITE TAPE FOR INSULATING JOINTS.

Electric Light and Power, Telegraph and Telephone, Railway and all other Branches of Signaling.
ALL SIZES *Lead Encased Wires.*
Aerial Use, Subterranean Use, Submarine Use. Concealed Wiring in all Locations.

WILLIAM H. ECKERT, Gen'l Agent, 16 Dey St., NEW YORK.
Western Electric Co., Chicago, Ill., Sole Agents for the West.

ALEXANDER, BARNEY & CHAPIN,
20 CORTLANDT ST., NEW YORK.
GENERAL ELECTRICAL SUPPLIES.

THE MOST POPULAR LAMP IN THE MARKET,
"A.B.C."

WRITE US FOR PRICES OF ALL GOODS.

THE E. S. GREELEY & CO.,

5 and 7 DEY STREET, NEW YORK,
MANUFACTURERS, IMPORTERS AND DEALERS IN
THE "CHAMPION" BATTERY,
Price, with Rod Zinc, $1.15 per Cell, with Corrugated Zinc, $1.35 per Cell.
THE TRADE WILL BE PROPERLY PROTECTED.

Complete Cell of Champion Battery. Carbon Reservoir and Cover of Champion Battery. Corrugated Zinc of Champion Battery. Rod Zinc of Champion Battery.

Electrical Supplies
Of all Descriptions.

Telegraph, Telephone, Electric Light and Power Appliances, Construction Tools and Line Material.

STANDARD ELECTRICAL MEASUREMENT APPARATUS.

PACKARD HIGH GRADE INCANDESCENT LAMPS

Manufactured by the
NEW YORK & OHIO COMPANY, Warren, Ohio.
AGENTS: J. W. PEALE, 1 Broadway, NEW YORK. ELECTRIC ENG. & SUPPLY CO., SYRACUSE, N. Y. ELECTRICAL ENG. & SUPPLY CO., 231 Rookery, CHICAGO, and ST. PAUL. ST. LOUIS ELECTRICAL SUPPLY CO., ST. LOUIS.

E. E. KELLER. F. E. DEGENHARDT.
Keller & Degenhardt, ELECTRICAL ENGINEERS,
542 Rookery Bldg., Chicago, Ill.
THE ONLY BUREAU OF ELECTRICAL INFORMATION IN THE WORLD'S FAIR CITY.

WILLARD L. CANDEE, H. DURANT CHEEVER, } Business Managers.
The International **OKONITE COMPANY,** LIMITED.
13 Park Row, New York.

OKONITE TRADE MARK

INSULATED
WIRES AND CABLES,
For Aerial, Submarine and Underground Use.
Candee Aerial Wires.
Manson Protecting Tape.
Okonite Waterproof Tape.

BRANCHES: Chicago, Boston, Philadelphia, Minneapolis, Cincinnati, Kansas City, Omaha, Louisville, St. Louis, San Francisco, London and So. America.

WRITE FOR PRICES ON
TROLLEYS, GEARS, BEARINGS AND GENERAL SUPPLIES.
R. D. Nuttall Company,
Allegheny, Pa. New York.

WM. ROTCH, Prest. CHAS. G. WINTER, Treas.
CHAS. E. BIBBER, Gen'l Manager
DO NOT
Equip your Switch-board with cheap Switches.
BUY THE
C. E. M. Jack-Knife Switch.
It is a Record Breaker and a reliable Circuit Breaker.
Manufactured Solely By
THE CONSOLIDATED ELECTRIC MFG. CO.,
Corner Congress and Franklin Streets, BOSTON.
ELECTRICAL SUPPLIES OF ALL KINDS.

IMPROVED BALL ENGINES,

BUILT BY THE BALL & WOOD CO., NEW YORK.

AGENTS:

The Thomson-Houston ELECTRIC CO.,

MANUFACTURERS OF THE HIGHEST QUALITY OF

DYNAMOS, LAMPS

And Every Necessary Appliance for the Construction, Maintenance and Operation of

Central Stations and Isolated Plants,

Arc, Direct Current and Alternating Current Systems,

MOTORS,

POWER GENERATORS.

100,000
Thomson-Houston Arc Lamps,

750,000
Thomson-Houston Incandescent Lamps

In Daily Operation October 1, 1891.

THOMSON-HOUSTON ELECTRIC CO.,

PRINCIPAL OFFICE,
620 Atlantic Ave., BOSTON, Mass.

WESTERN OFFICE,
148 Michigan Ave., CHICAGO, ILL

INDEX AND CLASSIFICATION OF ADVERTISEMENTS.

ALPHABETICAL LIST.

Abendroth & Root Mfg. Co ... xiii
Alexander, Barney & Chapin.....i
American Desk & Seating Co. .—
American Electrical Works.....xiii
Andrews & Co., A. H..... ... xii
Baggot, E xiv
Bain Electric Mfg. Co..... xvi
Ball Engine Co.....xix
Ball & Wood Co., The i
Beckerleg, Jas. G..... xiv
Beggs, J. E., Mfg. & Supply Co.xvi
Bernstein Electric Co..... xv
Braun Illustrating Co xix
Brownlee & Co..... xii
Brookfield, Wm..... xii
Brush Electric Co xvii
Bunnell & Co., J. H..... xii
Butler Hard Rubber Co..... xiv
Buxton, Geo. B xv
C. B. & Q. R. R.....x, xiv
C. & E. R. R.....xiv
C. & C. Electric Motor Co.... xvi
Central Electric Co..... ... v
Chicago Electric Mfg. Co xiii
Chicago Electric Motor Co.....—
Chicago Insulated Wire Co xvii
Colburn Electric Mfg. Co xiv
Consol. Elec. Mfg. Co., The..... i
Crocker-Wheeler Elec. Mo. Co..xiii
Day's Kerite Insulation i
Dayton Globe Iron Works Co..xix
Delaware Hard Fibre Co..... xiv
Detroit Electrical Works.....xxiv
Densmore Typewriter Co.....—
Eastern Electric Cable Co.....xiii
Easton Electric Co..... .....—
Edison General Electric Co.... vi
Edison General Electric Co., Cable and Wire Department..... vi
Electric Construction & Sup. Co..viii
Electric Merchandise Co..... x
Electric Secret Service Co..... x
Electrician Pub. Co.....x
Elec. Construction Co., The.....xiii
Elec. Eng. & Sup. Co., The..viii, xiii
Elec. Supply & Contracting Co.xvi
Electrical Supply Co., The... xxii
Elektron Mfg. Co..... xvi
Empire China Works..... ..xvi
Evans Friction Cone Co..... xvii
For Sale.....xiii, xvi
Foster, O. A..... —
Fort Wayne Electric Co..... xxiv
Gleason & Bailey Mfg. Co. Ltd. . x
Globe Carbon Co..... xv
Great Western Elec. Supply Co.. ix
Greeley & Co., The E. S.....i
Goodrich-Coleman Elec. Wks..—
Heisler Electric Co.....—
Hemingray Glass Co xiii
Hill Clutch Works.....—
Hirlimann, C. J .....—
Hine Elimnator Co..... xii
Holmes, C. H xiii
Holmes, Booth & Haydens..... ix
Ide & Son, A. L..... xiii
Illinois Metal Co..... xii
India Rubber & Gutta Percha Insulating Co..... —
Interior Conduit & Insulation Co.. x
International Okonite Co..... i
Kartavert Mfg Co..... xvi
Keller & Degenhardt..... i
Knapp Electrical Works xxi
Law Telephone Co xiii
Leonard & Co., H. Ward xvii
Link Belt Machinery Co.....xv
Loud, H. M. & Sons Lumber Co..xiv
Milliken Bros. xvii
Monitor Electric Co..... x
Mosher Arc Lamp Co..... xii
Munsell & Co., Eugene.....xiii
Murphy, T. J..... xv
National Carbon Co.....xiv
National Electric Mfg. Co.....xxiii
N. Y. Belting & Packing Co.... xii
New York Insulated Wire Co ..xix
New York & Ohio Co.....,i
Nuttall Company, R. D..... i
Ostrander & Co., W. R x
Paiste, H. T..... xiii
Page Belting Co..... .....—
Partrick & Carter Co.....—
Payne & Co., Geo. W .....—
Pearson & Co., W. B.....xix
Pelton Water Wheel Co.....xiv
Phoenix Glass Co.....—
Pond Engineering Co xix
Powell Co., The Wm.....xiv
Pumpelly, J. K.....xiii
Queen & Co.....xiii
Ries Elec. Specialty Co., The... x
Rockford Electric Mfg. Co....—
Royal Electric Co.....xii
Samson Cordage Works. xii
Sargent & Lundy..... i
Sawyer-Man Electric Co.....ix
Schawel & Co., Jas..... xii
Schieren & Co. Chas. A..... xii
Schoonmaker, A. O xii
Schuyler Electric Co..... xv
Security Insulator Co..... ix
Short Electric Railway Co xii
Shultz Belting Co..... —
Smith, Thos. G. Jr..... xvii
Sperry Elec. Mining Mach. Co. xvii
Sprague, Duncan & Hutchinson, Ltd..... ix
Standard Underground Cable Co....i
Stanley Electric Mfg. Co..... —
Star Electrix Co..... xviii
Stearns Mfg. Co.....xix
Sterling, W. C..... xv
Stilwell & Bierce Mfg. Co...xiv, xv
Sunbeam Incand. Lamp Co.....iv
Taussig, S... xiv
Temple, J. C..... xv
Thomson-Houston Elec. Co. 11, xx
Union Electric Works..... xii
Union Hardware Co..... xii
U. S. Electric Lighting Co...—
Van Nuis C. S..... —
Vulcanized Fibre Co..... xv
Wanted..... xiii
Wasatch Asphaltum Co..... —
Washington Carbon Co., The....vii
Western Electric Co..... iv
Westinghouse Elec. and Mfg Co. xi
Westinghouse Machine Co..... xix
Weston Electrical Instrum't Co..—
Williams Engine Works.....xix
Woodbridge & Turner Eng. Co. xv
Woodhouse & Rawson, Ltd....—
Worthington, Henry R.....—

CLASSIFIED LIST.

Accumulators.
Brush Electric Co.

Aluminum.
Goodrich-Coleman Elec. Works.

Annunciators.
Central Electric Co.
Electrical Construction Co., The.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co. W. R.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Arc Lamps.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
Brush Electric Co.
Easton Electric Co.
Electric Construction & Supply Co.
Fort Wayne Electric Co.
Great Western Elec. Supply Co.
Mosher Arc Lamp Co
Schuyler Electric Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Western Electric Co.

Arc Light Cord.
Electrical Supp y Co., The.
Knapp Electrical Works.
Samson Cordage Works.

Asphaltum.
Wasatch Asphaltum Co.

Batteries.
Central Electric Co.
Electrical Supply Co., The.
Foster, O. A.
Greeley & Co., The E. S.
Hirlimann, C. J.
Law Telephone Co.
Monitor Electric Co.
Partrick & Carter Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Battery Jars.
Central Electric Co.
Electrical Supply Co., The.
Hemingray Glass Co.
Hirlimann, C. J.
Law Telephone Co.
Partrick & Carter Co.
Pumpelly, J. K.
Queen & Co.
Western Electric Co.

Bells, Electric.
Central Electric Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Ostrander & Co., W. R.
Partrick & Carter Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.

Bells, Magneto.
Central Electric Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

Belting.
Evans Friction Cone Co.
Link Belt Machinery Co.
N. Y. Belting & Packing Co.
Page Belting Co.
Schieren & Co., Chas. A.
Shultz Belting Co.

Boilers.
Abendroth & Root Mfg. Co.
Pond Engineering Co.

Books, Electrical.
Electrician Publishing Co.

Braider Spoolers.
Payne & Co., Geo. W.

Brass Goods.
Powell Co., The Wm.

Burglar Alarms.
Central Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.

Cables.
(See Wire Insulated.)

Cables, Electric. (See Wire Insulated), **Copper, Sheet and Bar.**
Standard Underground Cable Co.
Western Electric Co.

Carbons, Points and Plates.
Brush Electric Co.
Central Electric Co.
Electrical Supply Co., The.
Globe Carbon Co.
Knapp Electrical Works.
National Carbon Co.
Washington Carbon Co.
Western Electric Co.

Clutches, Friction.
Hill Clutch Works.

Construction and Repairs.
Bain Electric Mfg. Co.
Chicago Electric Motor Co.
Electric Construction & Supply Co.
Electric Supply & Contracting Co.
Electrical Construction Co., The.
Knapp Electrical Works.
Leonard & Co., H. Ward.
Smith, Thos. G. Jr.
Temple, J. C.
Union Electric Works.
Western Electric Co.

Contractors, Electric Light, Engine Plants and Electric Railways.
Ball Engine Co.
Ball & Wood Co., The.
Bain Electric Manufacturing Co.
Brush Electric Co.
Chicago Electric Mfg. Co.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Ide & Son, A. L.
Keller & Degenhardt.
Leonard & Co., H. Ward.
Pearson & Co., W. B.
Pond Engineering Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Sargent & Lundy.
Short Electric Railway Co.
Smith, Thos. G. Jr.
Sprague, Duncan & Hutchinson, Ltd.
Temple, J. C.
Thomson-Houston Electric Co
Westinghouse Electric & Mfg. Co.
Westinghouse Machine Co.
Western Electric Co.
Williams Engine Works.
Woodbridge & Turner Eng. Co.

Copper Wires and Tapes.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co
Chicago Insulated Wire Co.
Edison General Electric Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Holmes, Booth & Haydens.
International Okonite Co., The.
Knapp Electrical Works.
Monitor Electric Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Cordage.
Samson Cordage Works.

Cross-Arms.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Cut-Outs and Switches.
Alexander, Barney & Chapin.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Knapp Electrical Works.
Paiste, H. T.
Partrick & Carter Co.
Star Electrix Co.
Van Nuis, C. S.
Western Electric Co.

Dynamos.
Brush Electric Co.
Bain Electric Mfg. Co.
Beggs, J. E., Mfg. & Supply Co.
C. & C. Electric Motor Co.
Colburn Electric Mfg. Co.
Detroit Electrical Works.
Easton Electric Co.
Electrical Eng. & Supply Co.
Fort Wayne Electric Co.
Heisler Electric Co.
Ide & Son, A. L.
National Electric Manufacturing Co.
Rockford Electric Manufacturing Co.
Royal Electric Co.
Schuyler Electric Co.
Thomson-Houston Electric Co.
United States Electric Lighting Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Electric Heating.
Electric Merchandise Co.

Electric Railways.
Detroit Electrical Works.
Edison General Electric Co.
Leonard & Co., H. Ward.
Sargent & Lundy.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.
Woodbridge & Turner Eng. Co.

Electrical Instruments.
Bunnell & Co., J. H.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Partrick & Carter Co.
Queen & Co.
Star Electrix Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co.

Electrical Intelligence.
Keller & Degenhardt.
Leonard & Co., H. Ward.

Electrical Specialties.
Ries Electric Specialty Co., The.
Star Electrix Co.
Sprague, Duncan & Hutchinson Ltd.

Electroliers and Combination Fixtures.
Baggot, E.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co., Ltd.
Thomson-Houston Electric Co.

Electro-Plating Machines.
Brush Electric Co.
Colburn Electric Mfg. Co
Edison General Electric Co.
Thomson-Houston Electric Co.

Elevators.
Link Belt Machinery Co.

Engines, Steam.
Ball Engine Co.
Ball & Wood Co., The.
Beggs, J. E. Mfg. & Supply Co.
Ide & Son, A. L.
Pearson & Co., W. B.
Pond Engineering Co.
Sargent & Lundy.
Smith, Thos. G. Jr.
Stearns Mfg. Co.
Westinghouse Machine Co.
Williams Engine Co.

Engravers.
Braun Illustrating Co.

Fan Outfits.
C. & C. Electric Motor Co.
Edison General Electric Co.
Electrical Supply Co., The.
Stanley Electric Mfg. Co.

Fibre.
Delaware Hard Fibre Co.
Kartavert Mfg. Co.
Vulcanized Fibre Co.

Fire Alarms.
Electric Secret Service Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Electric Works.
Western Electric Co.

Friction Cones.
Evans Friction Cone Co.

Gas Lighting, Electric.
Knapp Electrical Works.
Partrick & Carter Co.
Western Electric Co.

General Electrical Supplies.
Alexander, Barney & Chapin.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Electric Mfg. Co.
Consolidated Elec. Mfg. Co., The.
Detroit Electrical Works.
Edison General Electric Co.
Electric Supply & Contracting Co.
Electrical Eng. & Supply Co.
Electric Construction & Supply Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Knapp Electrical Works.
Ostrander & Co., W. R.
Partrick & Carter Co.
Ries Electric Specialty Co., The.
Star Electrix Co.
Thomson-Houston Electric Co.
Western Electric Co.

Globes and Electrical Glassware.
Baggot, E.
Brookfield, Wm.
Gleason & Bailey Mfg. Co. Ltd.
Hemingray Glass Co.
Phœnix Glass Co.
Security Insulator Co.

Hard Rubber Goods.
Butler Hard Rubber Co.

Insulators and Insulating Materials.
Alexander, Barney & Chapin.
Brookfield, Wm.
Central Electric Co.
Consolidated Elec. Mfg. Co., The.
Delaware Hard Fibre Co.
Edison General Electric Co.
Electric Merchandise Co.
Electrical Supply Co., The.
Great Western Elec. Supply Co.
Hemingray Glass Co.
Interior Conduit & Insulation Co.
International Okonite Co., The.
Kartavert Mfg. Co.
Knapp Electrical Works.
Munsell & Co., Eugene.
New York Insulated Wire Co.
Nuttall, R. D., Company.
Partrick & Carter Co.
Security Insulator Co.
Star Electrix Co.
Vulcanized Fibre Co.
Wasatch Asphaltum Co.
Western Electric Co.

Insulated Wires and Cables. Magnet Wire.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Insulated Wire Co.
Day's Kerite Insulation.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
Gleason & Bailey Mfg. Co. Ltd.
Holmes, Booth & Haydens.
International Okonite Co., The.
India Rubber & Gutta Percha Insulating Co.
Knapp Electrical Works.
Monitor Electric Co.
New York Insulated Wire Co.
Partrick & Carter Co.
Standard Underground Cable Co.
Sperry Elec. Mining Machine Co.
Western Electric Co.

Lamps, Incandescent.
Alexander, Barney & Chapin.
Bernstein Electric Co.
Brush Electric Co.
Central Electric Co.
Edison General Electric Co.
Electrical Supply Co., The.
Electrical Eng. & Supply Co
Gleason & Bailey Mfg. Co. Ltd.
Great Western Elec. Supply Co.
Greeley & Co., The E. S.
Heisler Electric Co.
Knapp Electrical Works.
New York and Ohio Co.
Sawyer-Man Electric Co.
Sunbeam Incandescent Lamp Co.
Thomson-Houston Electric Co.
Western Electric Co.

Lubricators.
Powell Co., The Wm.

Magnet Wire.
(See Insulated Wire.)

Medical Batteries.
Partrick & Carter Co.

Mica.
Munsell & Co., Eugene.
Schoonmaker, A. O.

Mining Apparatus, Electric
Bain Electric Mfg. Co.
Edison General Electric Co.
Thomson-Houston Electric Co.
Sperry Elec. Mining Machine Co.
Westinghouse Electric & Mfg. Co.

Motors.
Bain Electric Mfg. Co.
Brush Electric Co.
Crocker-Wheeler Electric Motor Co.
C. & C. Electric Motor Co.
Chicago Electric Motor Co.
Easton Electric Co.
Edison General Electric Co.
Electrical Eng. & Supply Co.
Elektron Manufacturing Co.
Foster, O. A.
Rockford Electric Manufacturing Co
Royal Electric Co.
Thomson-Houston Electric Co.
U. S. Electric Lighting Co.
Westinghouse Electric & Mfg. Co.

Name Plates.
Goodrich Coleman Elec. Works.

Office Furniture.
American Desk & Seating Co.
Andrews & Co., A. H.

Oils.
Taussig, S.

Oil Cups.
Powell Co., The Wm.

Patent Solicitors.
Woodhouse & Rawson, Ltd

Packing.
Buxton, Geo. B.
N. Y. Belting & Packing Co.

Pins and Brackets.
Central Electric Co.
Electrical Supply Co., The
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Western Electric Co.

Platinum.
Schawel & Co., Jas.

Poles.
Brownlee & Co.
Central Electric Co.
Electrical Supply Co., The.
Holmes, C. H.
Loud, H. M. & Sons Lumber Co.
Milliken Bros.
Sterling, W. C.

Publishers, Electrical.
Electrician Publishing Co.

Push Buttons.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Partrick & Carter Co.
Union Hardware Co.
Western Electric Co.

Railways, Electric.
(See electric railways.)

Regulating Sockets.
Ries Electric Specialty Co., The.

Separators, Steam.
Hine Eliminator Co.
Pond Engineering Co.

Slate.
Murphy, T. J.

Speaking Tubes.
Central Electric Co.
Electrical Supply Co., The.
Knapp Electrical Works.
Ostrander & Co., W. R.
Western Electric Co.

Speed Indicators.
Queen & Co.

Steam Pumps.
Worthington, Henry R.

Supplies, Electric Railway
Electric Merchandise Co.
Nuttall, R. D. Co.

Tapes, Insulating.
American Electrical Works.
Central Electric Co.
Chicago Insulated Wire Co.
Eastern Electric Cable Co.
Edison General Electric Co.
Electrical Supply Co., The.
India Rubber & Gutta Percha Insulating Co.
International Okonite Co., The.
New York Insulated Wire Co.

Telegraph Apparatus.
Central Electric Co.
Electric Secret Service Co.
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Monitor Electric Co.
Partrick & Carter Co.
Western Electric Co.

Telephones, Electric.
Western Electric Co.

Test Instruments.
Bain Electric Mfg. Co.
Bunnell & Co., J. H.
Central Electric Co.
Chicago Electric Mfg. Co
Electrical Supply Co., The.
Greeley & Co., The E. S.
Knapp Electrical Works.
Queen & Co.
Union Electric Works.
Western Electric Co.
Weston Electrical Instrument Co

Transformers.
Electrical Eng. & Supply Co
National Electric Manufacturing Co.
Stanley Electric Mfg. Co
Westinghouse Electric & Mfg. Co.

Trolley Cord.
Samson Cordage Works.

Trucks, Electric Car.
Edison General Electric Co.
Short Electric Railway Co.
Thomson-Houston Electric Co.
Westinghouse Electric & Mfg. Co.

Turbine Wheels.
Dayton Globe Iron Works Co.
Pelton Water Wheel Co.
Stilwell & Bierce Mfg. Co.

Type Writers.
Densmore Type Writer Co.

Valves
Beckerleg, Jas. G.

Wire, Bare.
American Electrical Works.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Supply Co., The.
Holmes, Booth & Haydens.
Knapp Electrical Works
Sperry Elec. Mining Machine Co.

NOTICE.

In view of the decisions in the cases of Western Electric Mfg. Co. vs. Chicago Electric Mfg. Co., reported in 14 Federal Reporter, 691, and Western Electric Co. vs. Electrical Construction Co., et al, reported in the WESTERN ELECTRICIAN of November 21, 1891, and a large number of cases in which injunctions have been granted on the Gray Patent No. 172,993, February 1, 1876, we claim as owners of said Gray patent the exclusive right to make, use and sell, or to license others to make, use and sell, apparatus covered by the claim of said patent, which is as follows:

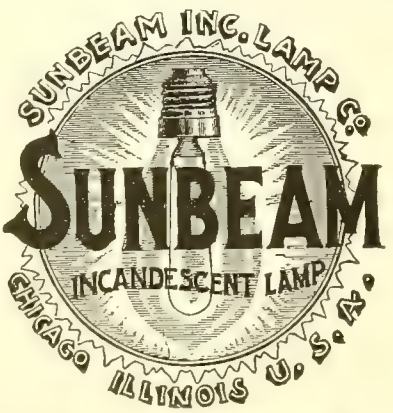
"The combination of a movable elevator car, the annunciator attached thereto and moving therewith, circuit closing and breaking signal keys on different floors, and mechanism whereby an electric current is maintained between the signal keys and annunciator without interruption by the movement of the car."

We have agents in all the principal cities who will install apparatus licensed by us and will guarantee the satisfactory operation of same.

All persons are warned against making, using or selling electric elevator annunciator apparatus not licensed by us.

WESTERN ELECTRIC COMPANY,

CHICAGO and NEW YORK.



THE SUNBEAM INCANDESCENT LAMPS

Can be furnished of any desired efficiency or life to suit our customers. **We make two standard styles of lamps, as follows:**

High efficiency lamps, from 3 to 3 1-3 watts, which maintain their rated candle power from 750 to 1,000 hours.

Long-lived lamps, from 3 6-10 to 4 watts, which maintain their rated candle power from 1,500 to 3,000 hours.

Each style will be found to give more light per dollar expended in current than similar lamps made by other manufacturers.

SUNBEAM INCANDESCENT LAMP CO.,

805 Chamber of Commerce Building, Chicago.

WHAT'S THE USE OF BUYING SWITCHES?

WE ARE GIVING THEM AWAY.

READ THIS.

We will for 30 days from the date of this notice, give away ten, five ampere, or nine, ten ampere Paiste switches to any one sending us an order for one hundred dollars worth of goods, accompanied by this blank filled in and signed.

CENTRAL ELECTRIC COMPANY,

November 23, 1891. CHICAGO.

Central Electric Company,
CHICAGO.

Please send with accompanying order .....ampere Paiste switches, for which you agree to make no charge.

Signed.....

.....1891.

A DEPARTURE IN CARBONS.

We are selling MOULDED Carbons, Chicago delivery at factory prices for FORCED Carbons.

THIS IS A DEPARTURE IN THE SUPPLY BUSINESS.

EVERY CARBON GUARANTEED

For straightness, brilliancy and life. A full stock of 7-16 and ½ inch plain or coated Carbons will hereafter be kept in our Warerooms, and prompt shipment assured. Save time and money by buying in Chicago instead of at the factories.

CENTRAL ELECTRIC COMPANY,

116 and 118 Franklin St., CHICAGO.

CONNECTED BY PRIVATE WIRE WITH POSTAL TELEGRAPH-CABLE CO.'S SYSTEM.

Edison General Electric Co.

EDISON BUILDING,
BROAD STREET,
NEW YORK.

PRESSURE INDICATOR.

THE EDISON PRESSURE INDICATOR is acknowledged the most Perfect Instrument for Indicating Pressure. It is at all times Reliable and Accurate.

Is easy of Adjustment, and always Remains in Circuit.

Its Accuracy can be Checked at any Time, without additional Instruments, the Indicator Containing within Itself the Means for Checking Its Own Readings.

The Scale can be Read at a Distance, indicating positively "Right," "High" or "Low," according to Pressure.

Years of Practical Operation Have Proven these Facts, and all Plants Desiring to Obtain Good Practice should Possess the Edison Indicator.

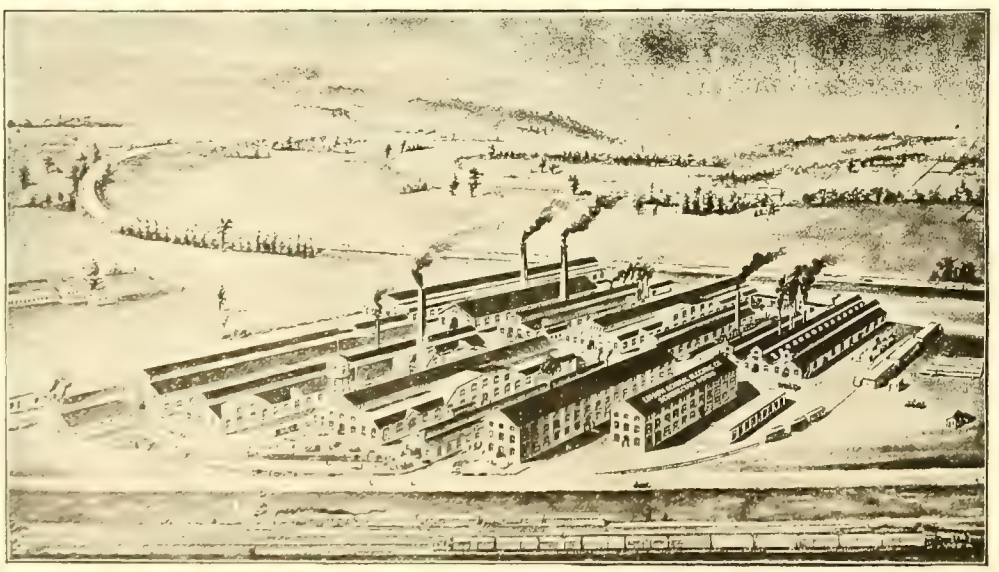
For Particulars, address nearest District Office.

DISTRICT OFFICES:

CANADIAN DISTRICT:
Edison Building, Toronto, Can.
CENTRAL DISTRICT:
173-175 Adams St., Chicago, Ill.
EASTERN DISTRICT:
Edison Building, Broad St., New York.
NEW ENGLAND DISTRICT:
25 Otis Street, Boston, Mass.
PACIFIC COAST DISTRICT:
Edison Building, 112 Bush St., San Francisco, Cal.
PACIFIC NORTHWEST DISTRICT:
Fleischner Building, Portland, Ore.
ROCKY MOUNTAIN DISTRICT:
Masonic Building, Denver, Colo.
SOUTHERN DISTRICT:
10 Decatur St., Atlanta, Ga

SIEMENS CABLES.

Submarine,
Telegraph,
Underground,



Telephone,
Interior,
Electric Light.

Schenectady Works, Edison General Electric Company.

Manufactured under Authority of SIEMENS & HALSKE,

BY

The Edison General Electric Company,

AT THEIR SCHENECTADY WORKS.

Estimates Furnished on Application.

Address, Cable and Wire Department, Edison General Electric Company,
EDISON BUILDING, BROAD STREET, NEW YORK, or Nearest District Office.

DISTRICT OFFICES:

Canadian District: Edison Building, Toronto, Can.
Central District: 173-175 Adams St., Chicago.
Eastern District: Edison Building, Broad St., New York.
New England District: 25 Otis St., Boston, Mass
Pacific Coast District: Edison Building, 112 Bush St., San Francisco, Cal.
Pacific Northwest District: Fleischner Building, Portland, Ore.
Rocky Mountain District: Masonic Building, Denver, Colo.
Southern District: 10 Decatur St., Atlanta, Ga.

THE

WASHINGTON CARBON COMPANY'S

WEEKLY BULLETIN TO ITS FRIENDS.

Last week we stated that the ***Carbon Trust*** proposed to drive us out of the business by monopolizing the supply of raw material. ***To this end IT is bending all ITS energies.***

MORE ABOUT TRUST METHODS:

A representative of the ***Trust*** visited people who supply us with raw material, and proposed the following:

"The Trust will buy raw material from YOU, if you will agree to charge outsiders twenty-five per cent. more than you charge the Trust."

This little scheme would have enabled the ***Trust*** to ***Advance the price of Carbons***

$2.00 PER THOUSAND,

but ***it failed.*** By ***"Outsiders" it*** meant ***The Washington Carbon Company. It is part of its creed that no one but the Trust has any right in the business.***

We are glad to be "outsiders." We propose to keep on being outsiders, for it pays, as our order books show.

We are very busy, but have time enough to keep an eye out for the ***Trust***, and have gathered much interesting matter, which we propose to deal out in weekly installments.

As we have arranged for an abundant supply of raw material, we are prepared to make contracts for carbons at fair prices for a term of years.

THE WASHINGTON CARBON COMPANY,

LOOK OUT FOR NEXT WEEK! Washington, Pennsylvania.

The "Packard" Lamp

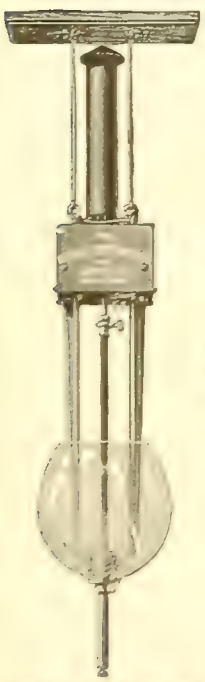
Agency has been transferred to

The Electrical Engineering and Supply Company

931 Rookery - Chicago, Ills.

The exclusive use of a strictly High Grade Lamp only will satisfy both patrons and Stockholders.

"WARD" ARC LAMPS.



The testimony of any one using one or two arc lamps may be valuable or not, according to their knowledge of arc lamps.

The "Ward" Lamp is the only lamp that is in use successfully, and in large numbers, on either central station or isolated plants.

EDISON ELECTRIC LIGHT & POWER CO.,
OF ST. PAUL, MINN.

ST. PAUL, MINN., August 28, 1891.

**Messrs. McDougall & Cummings, Western Managers,
The Electric Construction and Supply Co.,
Phenix Building, Chicago, Ill.**

DEAR SIRS:—We are using your arc lamps on our lines, and with great satisfaction both to ourselves and our consumers. They are the only arc lamps we are using, and in our opinion are the best lamp of the kind that have come to our notice. Our continued orders to you not only show our appreciation of their merits but also the fact that we find them a good paying investment. Very truly yours,

EDISON ELECTRIC LIGHT & POWER CO.,
G. H. FINN, General Manager.

EDISON LIGHT & POWER CO.,
OF MINNEAPOLIS.

MINNEAPOLIS, August 22, 1891.

**The Electric Construction & Supply Co.,
18 Cortlandt Street, New York City.**

GENTLEMEN:—Within the last eighteen months we have been installing a number of arc lamps on our incandescent circuits. We now have one hundred and ninety-six of your "Ward" lamps in operation, and it gives us pleasure to state that they give the very best of satisfaction, both to ourselves and our customers. We consider them a most excellent lamp. Yours truly,

EDISON LIGHT & POWER CO.

Lamps for direct current, alternating current, street railway circuits, focusing lamps, photo-engraving lamps, search lamps.

SEND FOR OUR NEW CATALOGUE.

ELECTRIC CONSTRUCTION & SUPPLY CO.,

Phenix Building,
CHICAGO, ILL.

Established 1881.

Telephone Building,
NEW YORK CITY.

CATALOGUES { No. 23, Electric Railway Supplies, No. 24, Electric Lighting Supplies,

JUST OUT. SEND IN YOUR APPLICATION.

GREAT WESTERN ELECTRIC SUPPLY CO.,

201-207 So. Canal Street, CHICAGO, U. S. A.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." PATENT "K.K." LINE WIRE TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

Agents for the WASHINGTON CARBON CO., Carbons for Arc Lighting.

THE GREAT WESTERN ELECTRIC SUPPLY CO., CHICAGO, Are our Selling Agents, and carry a line of Insulated and Bare Wires of our make.

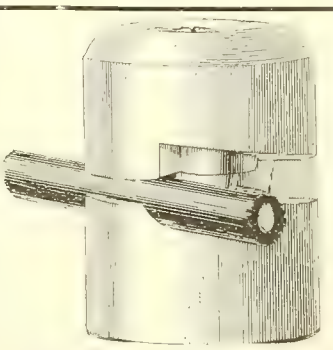
THOS. L. SCOVILL, New York Agent, 25 Park Place, NEW YORK.

SPRAGUE, DUNCAN & HUTCHINSON, Limited.

FRANK J. SPRAGUE,
LOUIS DUNCAN, Ph. D.,
ALFRED BISHOP MASON,
CARY T. HUTCHINSON, Ph. D.

CONSULTING ELECTRICAL ENGINEERS.

15 WALL STREET, NEW YORK.



The Latest Thing in Insulators.

MANUFACTURED BY THE

Security Insulator Co.

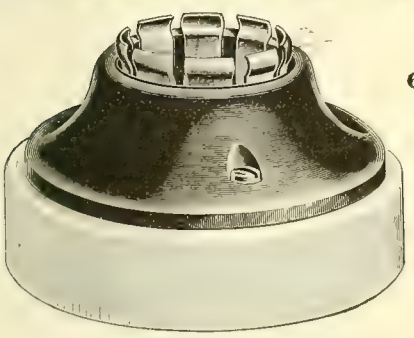
An Insulator that is easily and quickly adjusted, and will securely clamp the wire without injury to the Insulation, thus doing away entirely with tie wires, and effecting a large saving of time and labor in wiring. Wire from [illegible] to [illegible] of an inch may be used, thus allowing of a variation of [illegible] of an inch in size of wire. Made of the best Vitrified and Non Absorbent Porcelain.

Write for Price and Full Particulars.

SECURITY INSULATOR CO,
136 Liberty St., - NEW YORK.

SAWYER-MAN ELECTRIC CO.,

BOSTON, 620 Atlantic Avenue.
NEW YORK, 510-534 West 23d Street.
CHICAGO, 217 La Salle Street.



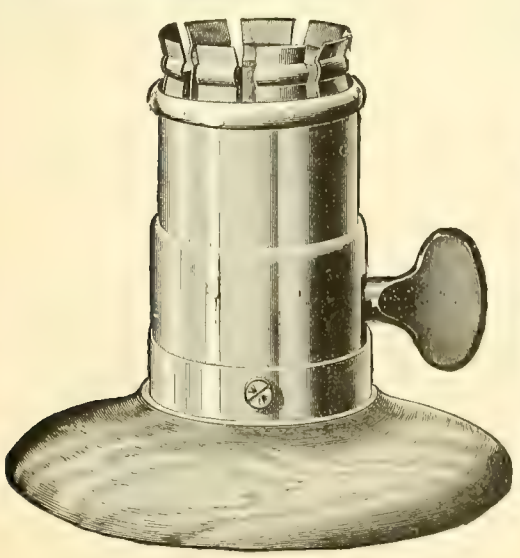
No. 135. All Porcelain Keyless Wall Socket.

INCANDESCENT LAMPS.

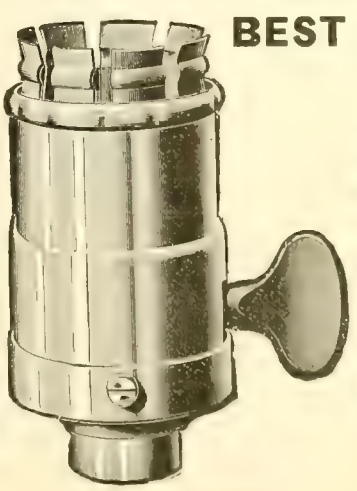
Orders Executed Correctly and Promptly.

SOCKETS.

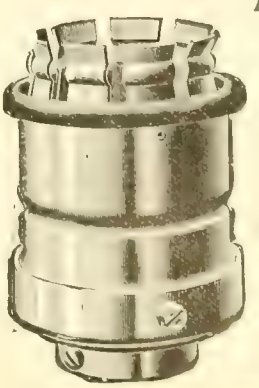
BEST AND CHEAPEST.



No. 125. Key Wall Socket—Porcelain or Wood Base.



No. 110. Key Socket.



No 120 Keyless [illegible] inch Socket.

ALSO—

No. 115. Keyless Socket, 1-3 in.

No. 130. Keyless Wall Socket—Porcelain or Wood Base.

No. 145. Keyless Socket for 75, 100 and 150 c. p. Lamps

No. 150. Waterproof Socket.

No. 140. Attachment Plug, with Fuses.

THE RIES REGULATING SOCKET

FOR ALTERNATING CURRENT INCANDESCENT LAMPS.

SOMETHING ENTIRELY NEW. Saves the Current, Regulates the Light. An Innovation in Electric Lighting. **SIMPLE, EFFICIENT, ECONOMICAL.**
INDORSED BY THE ELECTRICAL PRESS and prominent Electrical Engineers and Electricians.

NO RESISTANCE, OR ANY OTHER CURRENT-CONSUMING DEVICES USED.

The Price of our No. 1 Ries Regulating Socket (for lamps 16 to 25 C. P. 50 volts) is

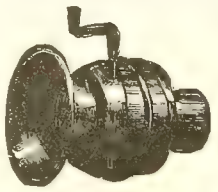
$1.27½ { $3.00 EACH LESS 57 1-2 PER CENT. DISCOUNT, MAKING THE NET PRICE $1.27 1-2 EACH, When Ordered in Quantities. } **$1.27½**

For particulars write to
THE RIES ELECTRIC SPECIALTY COMPANY, **SOLE PATENTEES AND MANUFACTURERS,**
BALTIMORE AND EUTAW STS., BALTIMORE, MD.

TO DENVER VIA
BURLINGTON ROUTE.
Only One Night on the Road

Leave Chicago at 1.00 P. M., or St. Louis at 8.25 A. M., and arrive Denver 6.15 P. M. the next day. Handsome Sleepers, Chair Cars and Dining Cars. All Railways from the East connect with these trains and with similar trains on Burlington Route to Denver, leaving Chicago at 6.10 P. M., St. Louis at 8.15 P. M., and Peoria at 3.20 P. M., and 8.30 P. M. Arrive daily.

Additional express trains, making as quick time as those of any other road, from Chicago, St. Louis and Peoria, to St. Paul, Minneapolis, Council Bluffs, Omaha, Cheyenne, Black Hills, Atchison, Kansas City, Houston and all points West, Northwest and Southwest.



SPEAKING TUBES AND WHISTLES.
Oral, Electric, Pneumatic and Mechanical
ANNUNCIATORS AND BELLS.
FULL LINE ALWAYS IN STOCK.

W. B. OSTRANDER & CO.,
195 and 197 Fulton St., New York.
Factory, 1461 and 1463 DeKalb Ave., Brooklyn, N. Y.
Send for NEW CATALOGUE. Out August 1st.

WE ARE
HEADQUARTERS
IN THE WEST FOR
ELECTRICAL BOOKS.
Send for Complete Catalogue.
ELECTRICIAN PUBLISHING COMPANY,
6 Lakeside Building, CHICAGO.

"WINTER SPECIALTIES."

BRAND'S STEEL WIRE TRACK BROOMS,
WARDWELL'S TRACK BROOM HOLDERS,
BURTON ELECTRIC HEATERS,

— AND —

ELECTRIC RAILWAY SUPPLIES

OF EVERY SORT—
FOR ANY SYSTEM.

ELECTRIC MERCHANDISE CO.,
W. R. MASON, Gen'l Mgr. **CHICAGO.** 11 Adams Street.

Gleason & Bailey Mfg. Co.,
(LIMITED.)

Manufacturers of, and Dealers in, a line of General

ELECTRICAL MERCHANDISE.

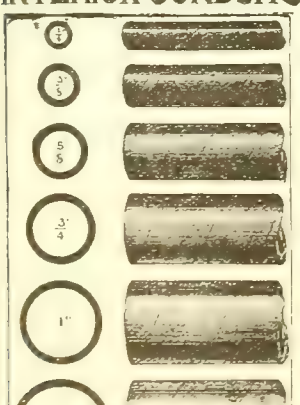
ALSO ELECTRIC AND COMBINATION FIXTURES AND GLASSWARE.

Rubber Covered Weather-Proof Wires and Lamp Cords.

233 Lake Street, CHICAGO, ILL.

It will pay you to get our prices and new catalogue.

INTERIOR CONDUITS



TRADE-MARK.

The Solution of the Problem of Safe Guarding
ELECTRIC CONDUCTORS
Wherever and for whatsoever purpose employed, is to be found in the
CONDUIT SYSTEM.

INTERIOR AND UNDERGROUND
CONDUITS
MANUFACTURED BY
INTERIOR CONDUIT AND INSULATION CO.,
WORKS: 527 to 531 W. 34th St., 526 to 528 W. 35th St.,
General Offices: 42 & 44 Broad St., New York.

Thos. Day & Co., 222 Sutter St., San Francisco, Cal.
Mountain Electric Co., Denver Colo.
American Electrical Supply Co., 226 Pearl St., Buffalo, N. Y.
Putnam, Gay & Co., 27 E. Main St., Rochester, N. Y.
Glover Elect. Co., 127 W. 8th St., Cincinnati, O.
Chas. Gabriel, Saginaw, Mich.
Southern Electrical Mfg. and Supply Co., 110 Baronne St., New Orleans, La.
Walker & Kepler, 531 Chestnut St., Philadelphia, Pa.
Electrical Supply & Construction Co., Pittsburgh, Pa.
Southern Electric Co., Baltimore, Md.

G. A. HARMOUNT,
MANAGER
MONITOR ELECTRIC CO.,
149 **WABASH AVE., CHICAGO, ILL.**
WHOLESALE DEALER IN GENERAL
ELECTRICAL SUPPLIES.
WESTERN AGENT FOR
ALFRED F. MOORE
(ESTABLISHED 1870.)
ELECTRICAL WIRES AND CABLES.
Electric Light, Annunciator and Office Wires. Incandescent and Battery Cords, in fact, every kind of Wire known to the Electrical Trade.

THOMAS STURGIS, Prest. Wm. C. LANE, Sec'y and Treas. C. P. MACKIE, Gen'l Manager. S. S. BOGART, Gen'l Agent.

ELECTRIC SECRET SERVICE COMPANY,

45 BROADWAY, NEW YORK.

INDIVIDUAL ARC LIGHT AND MOTOR CUT-OUT.

LAMPS OR MOTORS CUT IN AND OUT AT WILL FROM CENTRAL STATION WITHOUT DISTURBING OTHERS ON SAME CIRCUIT.

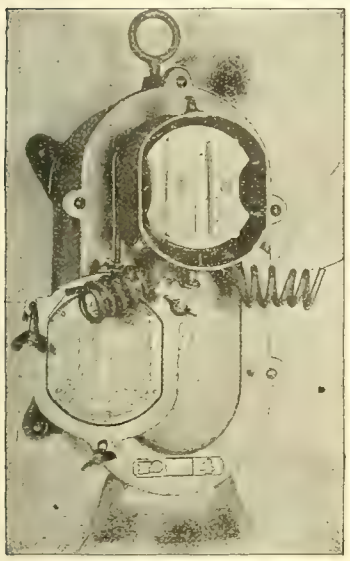
The Saving in Miles of Circuit Makes Scattered Business Profitable and Secures Payment for Every Hour of Light.

Westinghouse Electric & Mfg. COMPANY,

Pittsburg, Pa., U. S. A.

☛ **Makers of Electric Light and Power Apparatus for all Purposes.** ☚

PIONEERS OF THE ALTERNATING SYSTEM.



CONVERTER.

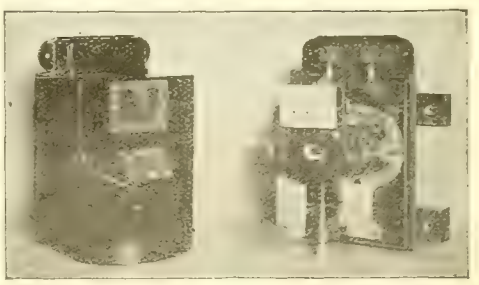
OUR **Converters** COMBINE

HIGHEST EFFICIENCY,
ABSOLUTE SAFETY,
PERFECT REGULATION,
LOW PRICES.

OUR **Meters** ARE

SIMPLE,
ACCURATE,
RELIABLE,
DURABLE.

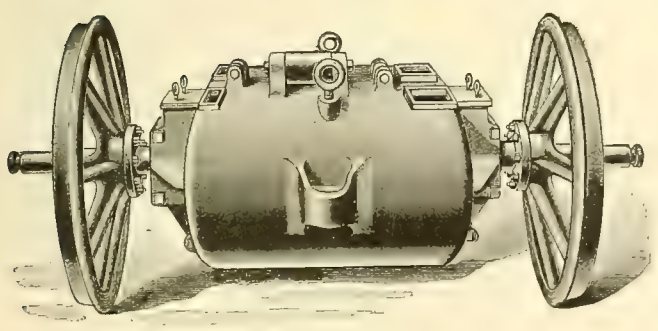
OVER **700,000** 16 C.P. Lights' Capacity of METERS IN USE.



METER.

The Westinghouse Meter is the only A. C. Meter which has been adopted as standard by the London (England) Board of Trade. Synchronous System for the Long Distance Transmission of Power in large units claims the attention of every one having available Water Power within twenty-five miles of a market.

RAILWAY DEPARTMENT.



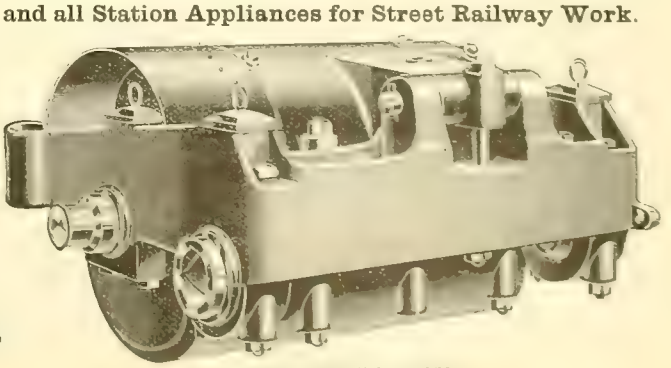
IRON-CLAD GEARLESS MOTOR.

YES, WE MANUFACTURE AND SELL GEARLESS and SINGLE REDUCTION

RAILWAY MOTORS,

MULTIPOLAR AND 2-POLE GENERATORS,

and all Station Appliances for Street Railway Work.



SINGLE REDUCTION MOTOR.

Percentage of increase in roads using our apparatus greater than that of any other company.

Send for Latest Catalogue.

OFFICES IN ALL OF THE LEADING CITIES. Correspondence Solicited.

Address,

WESTINGHOUSE ELECTRIC & MFG. CO.,

Pittsburg, Pa., U. S. A.

STANDARD SCREW GLASS INSULATORS

MANUFACTURED BY

WM. BROOKFIELD,

BUSHWICK GLASS WORKS. 83 FULTON STREET, NEW YORK.

BUY THE BEST!

The Mosher Arc Lamp.

DIRECT OR ALTERNATING INCANDESCENT CIRCUITS.

READ THE FOLLOWING TESTIMONIAL:

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis., October 5, 1891.

Mosher Arc Lamp Co., Chicago, Ill.

GENTLEMEN:—Replying to your inquiry of the 31 inst. we beg to state that the lamps you sent us some time ago are giving us better satisfaction than any other lamp we have ever tried to burn on an incandescent circuit. We inclose herewith an order for 10 of them to be shipped to Elgin, Ill. Yours very truly,

NATIONAL ELECTRIC MFG. CO.

Noted for Simplicity and Steadiness.

500 to 2,000 candle power, making superior lamp for photo engraving purposes.

Write for price, circular, and sample lamp.

MOSHER ARC LAMP CO., 125 Ontario St., CHICAGO,

Or to F. P. Little & Co., Buffalo, N. Y.; Creaghead Engineering Co., Cincinnati, O.; Chas. F. Lindner, San Francisco, Cal.

PLATINUM. JAS. SCHAWEL & CO., 29 JOHN ST., NEW YORK.

Importers and Melters. Sheet and Wire in any Gauge. Scrap Purchased.

OFFICE DESKS,

"Gem" and "Rugby" Folding Beds. Brass and Wire Work

A. H. Andrews & Co., 215 Wabash Ave., Chicago.

MICA. For all Electric Insulating Purposes East India Mica is the best on the market. I SELL NO OTHER.

Send for Samples and Quotations.

A. O. SCHOONMAKER,

158 William St., NEW YORK.

SOLID BRAIDED CORD.

Is the most durable for hanging Arc Lamps, Trolley Cord, Covering Field Magnets, Sash Cord, etc., etc.

Send for Samples and Prices.

SAMSON CORDAGE WORKS,

115 CONGRESS STREET, BOSTON.

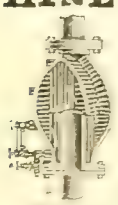
HINE'S ELIMINATOR.

THE ACKNOWLEDGED SUPERIOR OF ALL

Steam Separators and Oil Extractors.

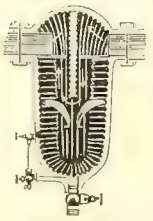
In twelve trials in the "Cornell" Separator test, it averaged 98.7.0 per cent Dry Steam. Outstripping all competitors.

Send for Circular and Cornell test report.



VERTICAL.

HINE ELIMINATOR CO., 106 Liberty St., NEW YORK.



HORIZONTAL.

This advertisement appears every other week.

—THE—

UNION HARDWARE CO.,

PUSH-BUTTON

SHELLS.

TORRINGTON, CONN.,

—AND—

95 CHAMBERS STREET, NEW YORK.

POLES CEDAR, OCTAGONAL PINE AND STEEL.

If you are in want of poles of any kind, it would pay you to write for our prices, before ordering.

BROWNLEE & CO., DETROIT, MICH.

Royal Electric Co.,

911 & 913 South Washington St., PEORIA, ILL.,

MANUFACTURERS OF

Alternating and Continuous Current Dynamos and Motors,

AND ELECTRIC MACHINERY.

THE MOST COMPLETE ALTERNATING SYSTEM NOW ON THE MARKET.

Agents Wanted for Exclusive Territory.

PATENT PERFORATED ELECTRIC LEATHER BELTING

Runs more Slack than Unperforated Belts, hence adapted to uneven power of Electric Railways and for Electric Power in General.

CHAS. A. SCHIEREN & CO.,

PATENTEES AND SOLE MANUFACTURERS,

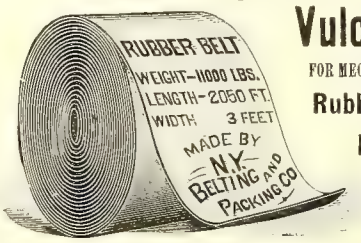
Also New York, Boston, Philadelphia. 46 SOUTH CANAL ST., CHICAGO, ILL.

NEW YORK BELTING & PACKING CO.

JOHN H. CHEEVER, J. D. CHEEVER, F. CAZENOVE JONES, WM. T. BAIRD, Sec'y. } Managers. (LIMITED.)

15 PARK ROW, NEW YORK.

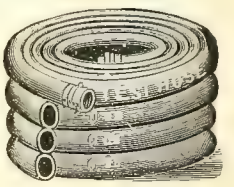
Oldest and largest Manufacturers in the United States of



Vulcanized Rubber Fabrics

FOR MECHANICAL PURPOSES,

Rubber Belting, Packing and Hose.



SALESROOMS:

PHILADELPHIA, 308 Chestnut Street.
BOSTON, 52 Summer Street.
CHICAGO, 151 Lake Street.
DENVER, 1601 1611 17th Street.
CHARLESTON, 160 Meeting Street.
GRAND RAPIDS, 4 Monroe Street.
MINNEAPOLIS, 28 South 2d Street.
CLEVELAND, 176 Superior Street.

SALESROOMS:

SAN FRANCISCO, 17 Main Street.
ATLANTA, 16 Decatur Street.
DETROIT, 16-20 Woodward Ave.
BALTIMORE, 12 North Charles Street.
BUFFALO, 124-128 Washington Street.
NEW ORLEANS, 8-12 North Peters Street.
KANSAS CITY, 1313 West 12th Street.
ST. LOUIS, 616 Locust Street.

$40 FREE.

How many words can you make, using only the letters in the words "HAT IDENTIFIER." 1st prize—Twenty-five dollars; 2d prize—Ten dollars; 3d prize—Five dollars; 4th prize—One dozen "Identifiers."

Send a dime for rules governing contest and sample "Identifier" to

ILLINOIS METAL CO.,

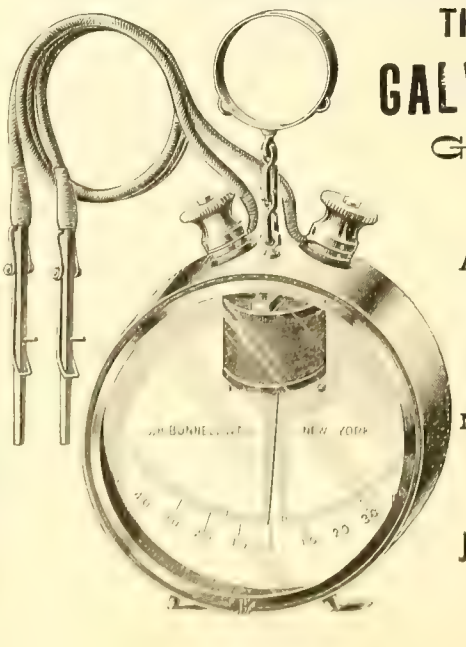
Royal Insurance Bldg., - Chicago, Ill.

THE SHORT DYNAMO.

Efficiency, 92 Per Cent.
From 75 to 500 Horse Power.
Flat Ring Armature.
Multiple Brushes.
Large Commutator. Independent Coils.
Perfect Ventilation.

THE SHORT ELECTRIC RAILWAY CO.,

CLEVELAND, OHIO.



THE BUNNELL

GALVANOMETER

GAUGE.

$9.00.

A thoroughly reliable Pocket Battery Gauge, Circuit Indicator AND Detector Galvanometer.

No Springs or Electro-Magnets.

Discount to the Trade.

J. H. BUNNELL & CO.,

76 Cortlandt St., NEW YORK.

Western Electrician.

EVERY SATURDAY.

Vol. IX. CHICAGO, DECEMBER 26, 1891. No. 26

Lighting Plant in the "Fair" Building, Chicago.

Chicago is a city of great buildings, and by no means the least pretentious is the structure whose electric lighting equipment forms the subject of the present sketch. The enlargement of the "Fair" building without, apparently, the slightest hindrance to the enormous business daily conducted in that establishment has been a marvel to many. An inspection of the electric lighting plant alone is sufficient to leave a favorable impression as to the thoroughness of the many improvements and conveniences introduced into the new home of this thriving enterprise. The "Fair" plant is a veritable central station, comprising, as it does, generators for the supply of 600 arc and about 1,300 incandescent lamps.

Steam for the engines and for heating is supplied by six boilers of the Excelsior Iron Works pattern, with Ritter & Burke smokeless furnaces, fired from above. With this type of furnace the firemen are not exposed to open furnace doors. The boilers are fed by Worthington pumps, from a Baragwanath feed water heater, condensation water from the steam heating apparatus of the building being used as much as possible.

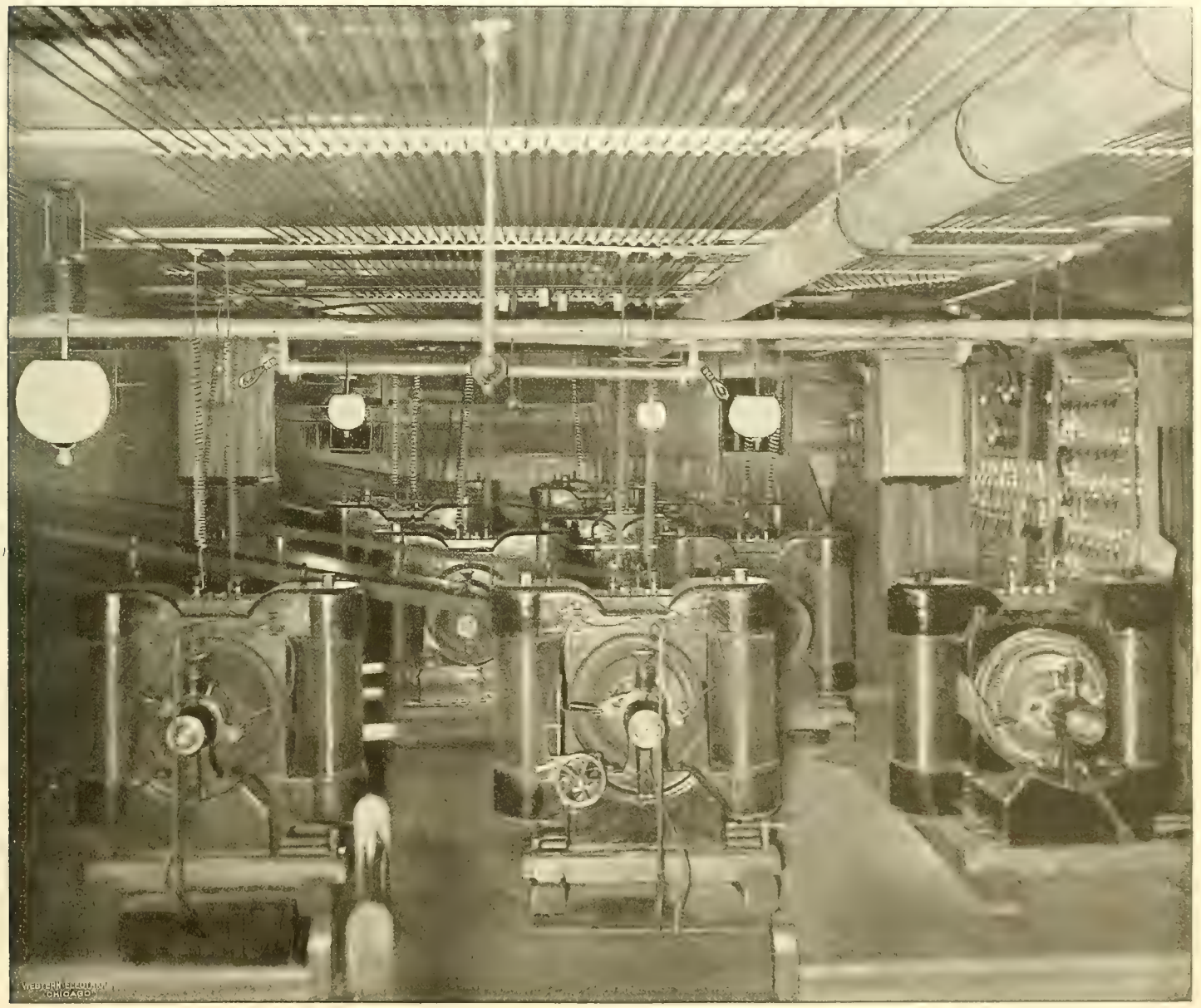
In the dynamo room, as seen in the view presented herewith, the engines and dynamos are set very closely together. The engines are three in number of the Dick & Church compound horizontal type, each being of 200 horse power. These engines are furnished with double fly-wheels, so that each one drives four dynamos tandem. The dynamo pulleys are leather faced.

The generating equipment is composed of dynamos of three different types brought out within the year 1891. These machines were built by the Standard Electric company, Chicago, on the designs of George Edensor Dorman. The arc dynamos have a capacity of 50 lamps, and operate with a current of $6\frac{6}{10}$ amperes. The armature of the arc machines is of the Gramme type, with certain modifications, and runs in a "Manchester" field. The unobstructed interior of the armature secures good ventilation. On each arc machine switch-board is a Loveridge & Vanderburg stopping switch.

The larger of the two incandescent dynamos, which are not yet running, is a six pole machine, with bent sectional fields, compound wound, and provided with a drum armature of a peculiar winding, already described in the WESTERN ELECTRICIAN, in connection with a power generator of the same type. The machine has [illegible] of carbon brushes, and is of [illegible] kilowatt capacity at 110 volts.

The smaller of the incandescent machines, 28 kilowatts in capacity, is of the Manchester type, compound wound, with abnormally heavy fields. The armature is a Siemens drum, wound with a cable formed of a number of insulated wires in parallel. Both the incandescent machines can be controlled by means of a pair of rheostats to run the lamps from red to above candle power. Wirt ammeters and voltmeters, and Lang's and Andrews' switches are used. A feature of the installation is the method of lubrication, built according to the ideas of J. G. Broman, chief engineer. Oil is supplied to a system of underground piping from an overhead tank. A standpipe at each machine and engine furnishes the oil as required to each of the sight feed lubricators. The drip passes into return mains and thence to a filter from which the oil is pumped back to the tanks.

The wiring was done by the Standard Electric company. There are 42 circuits, each circuit supplying about 15 to 17 lamps. On each floor are three or four circuits. The lamps employed are of the Pfluger type, with Parmly triple carbons. These lamps burn on an average 14 hours.



LIGHTING PLANT IN THE "FAIR" BUILDING, CHICAGO

The incandescent wiring is on the Interior Conduit & Insulation company's system.

The engine and dynamo room is tended by Assistant Engineer Barlow, with the help of a man and boy.

One of the Dynamos at the Frankfort Exhibition.

Among the various types of dynamos exhibited at Frankfort was one by the Maschinenfabrik, Esslingen. This machine, which is an eight-pole 60 kilowatt dynamo, is shown in Fig. 1. The dynamo is coupled directly to a horizontal compound engine, and gives, at a speed of 100 revolutions per minute, a current of 124 amperes, with a difference of potential of 480 volts. The armature is 111 centimeters in diameter, and has a drum winding, there being 694 conductors on its exterior, counting all around its periphery. The armature core is built up of iron plates, 1 millimeter thick, separated from each other by paper, and the whole is supported by a strong cast-iron centerpiece, keyed to the engine crank shaft. The commutator has 347 segments, insulated with mica, and the ring carrying it is secured to the armature casting above mentioned. It should be stated that this machine is

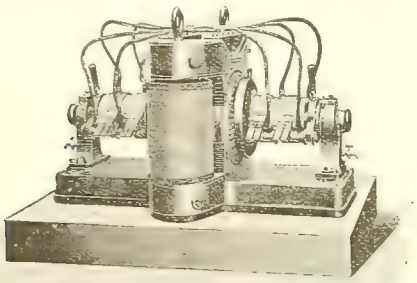


FIG. 1. ONE OF THE DYNAMOS AT THE FRANKFORT EXHIBITION.

quite exceptional in having mica between the commutator segments, the insulation used almost universally for German machines being of "presspahn," or cardboard made from wood pulp. The radial magnets are cast in one with the octagonal frame which supports them, the latter being joined vertically, as shown. Two sets of brushes, at 45 degrees angular distance apart, collect the current which flows through the 694 conductors in two parallels. The engine cylinders are 32.5 centimeters and 50 centimeters diameter, respectively, and the stroke is 60 centimeters. The working pressure is 8 atmospheres, and the steam is admitted by double beat valves in conjunction with trip gear, the point of cut-off being controlled by the governor. It is claimed that the combination exhibited gives for each kilogramme of steam a return of 71 watt-hours with, and 52 watt-hours without, a condenser. The exhibitors state to the machine terminals, while the three intermediate conductors are connected up to a compensating motor-dynamo Fig. 2. This compensator has a Gramme armature, with four distinct circuits connected up to four separate commutators. The magnet winding is a shunt to the two outside wires and the excitation is consequently constant at a potential of 480 volts. It will be seen from the diagram of connections that all the commutators are joined in series. When all the four circuits take through R_1, R_2, R_3 and R_4, the same current, the motor dynamo is driven by a small current flowing through the four armature windings, A, B, C and D, in the same direction. If in one of the branches, say R_2, the resistance is increased, the difference of potential between the two conductors 2 and 3 rises by a very small amount, while in the other three branches it falls.

The consequence is that while the armature increases in speed a little, the winding, B, between the wires 2 and 3 receiving current and acting as a motor, the other three windings, A, C and D are acting as generators, the current now flowing in an opposite direction through them, an electromotive force being added to the circuits, R_1, R_3 and R_4, with which they are connected. The compensator in this way keeps the difference of potential for each circuit constant, always running as a motor and taking power from the least loaded circuits to give it back, acting as a generator, and raising the potential of the circuits loaded more heavily. It is asserted that the compensator acts most efficiently, and that four voltmeters in the branches during operation will show no perceptible deviation from 120 volts.

Current may be taken direct from the terminals of the machine at 480 volts, or, if desired, from the middle wire and one outside one at 240 volts. At the former pressure it was supplied to a 50 horse power four-pole motor used to pump the water from the Main quay to the lake in the exhibition grounds. The other electromotors coupled to the system were supplied with current at 120 volts, as were also all the arc and glow lamp circuits. The cuts and description are from the *Electrical Review* of London.

Cable Roads in Chicago.

Residents of Chicago do not need to be told of the glaring inefficiency of the cable lines of this city. The cars do not begin to handle the traffic in the busy part of the day; annoying stoppages, sometimes of hours' duration, are frequent; and scarcely a day passes but that the newspapers chronicle accidents, often resulting in death, on some of the roads. The North and West Side companies are the greater offenders, but the lines on the South Side, also, furnish a service that is far from being even approximately satisfactory. The people and press of the city are clamoring for something better, and the companies, especially those on the North and West Sides, are bitterly denounced, one paper going so far as to style the former

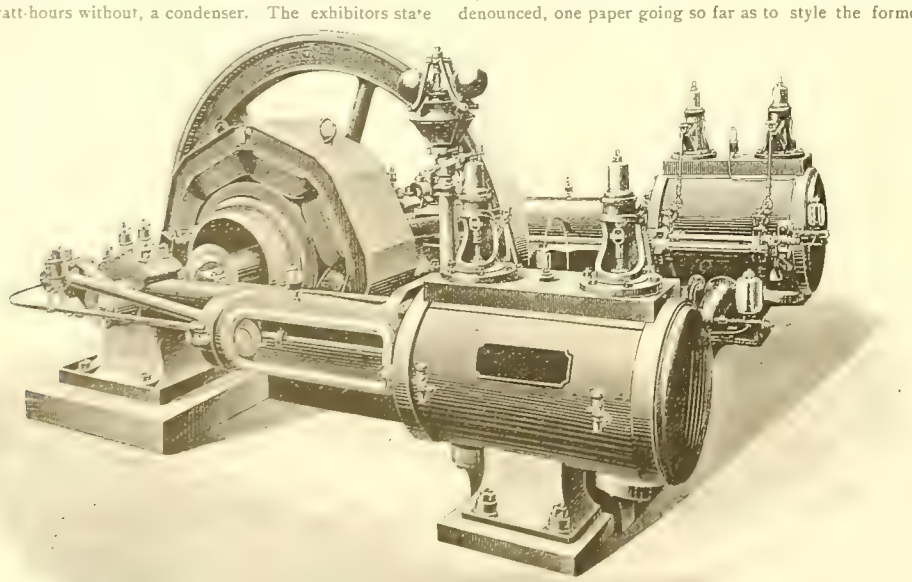


FIG. [illegible] THE EXHIBITION.

the "North Side Murder company." Various remedies in the way of aldermanic legislation are proposed, but with [illegible]

[illegible] cannot fail to be of interest to the advocates of electric traction, who have been told that the cable system is the only one capable of handling the great street [illegible] Chicago. The cable has been given an exhaustive trial and has proven a failure. This fact is now admitted on all sides. The *Railroad Gazette*, for instance, in an article on the subject of "Cable Road and Rapid Transit in Chicago," states that "The trouble in Chicago with the cable roads has reached a climax, and those who have been offering these roads as an example of what an ideal rapid transit should be, will have to find another illustration. The fact is, these roads have nearly reached their limit, and something more will have to be done." The conclusion of this article is as follows:

The railroad companies find themselves in a predicament. The rapid wear of the cables and the breaking of the grips make a limit beyond which they cannot go. For instance, when these cables were first put down they were made of a given size, the same as is used on nearly every cable road in the United States. The traffic has increased many times, yet the same size of cables is still used. To crowd more cars on to these comparatively small cables would only result in worse trouble from an increased number of break-downs. Scarcely a day passes in Chicago without a delay caused either by a broken grip or cable. These delays last from one to four hours, according to the extent of the damage, and they invariably happen at the busy hours when there is a heavy pull. The breakage of one grip or cable will stop the entire traffic on three or four miles of road at a time when the working people are hurrying to business. If this were only an occasional occurrence it would be forgiven with a true western spirit; but it happens frequently, as any one who reads the Chicago papers may notice.

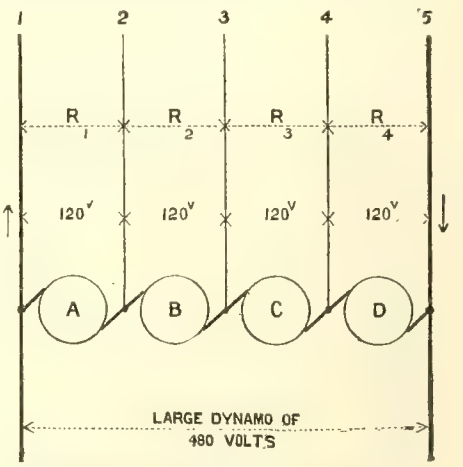


FIG 2. ONE OF THE DYNAMOS AT THE FRANKFORT EXHIBITION.

A conclusion from this is that cable roads are a considerable failure in Chicago as they are now managed. They are neither sufficient for the traffic nor comfortable for the passengers. There is a limit to the number of cars which a given cable can carry, and therefore a limit to the capacity of the road, which limit is not found, as it should be, in the least allowable distance between trains on the street. To use a larger cable is impracticable without an entire change in the diameters of the carrying pulleys, considerable changes in the engine house, and a renewal of the grips. The fact is that the cable now used is as large as is economical. A large cable wears more rapidly, offers a greater resistance to bending, and too large a percentage of power is required to drive the cable itself when the traffic is light. As it is no cables are run after 12 o'clock, and even the longest lines have to resort to half-hourly trips with horse cars.

One of the most serious troubles, and perhaps the most difficult to overcome, is the liability of a large percentage of all the cars on a cable to start at the same instant. If one starts and then another, and so on until all have started, the strain upon the cable is not more, perhaps, than it can withstand; but if 90 per cent. of all cars are starting at the same time, the accumulated stress is so great that the cable breaks. This concentration of loading is not generally understood, and many times when a breakage is explained by assuming that the cable is weak, the true cause lies in this simultaneous starting. The cables being almost exactly uniform from end to end, weak points are well nigh impossible to find.

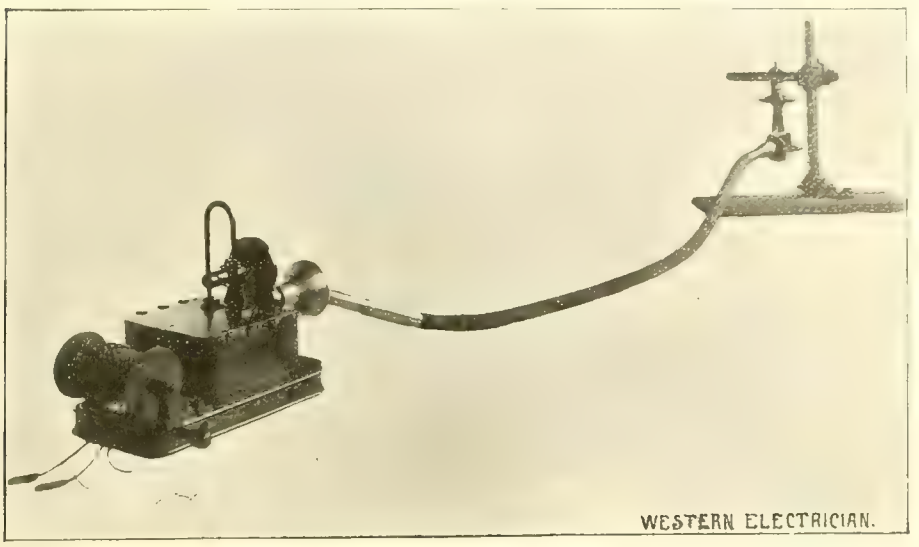
From a cursory examintion of the Chicago system, one must conclude that a cable road is useful only within narrow limits. It is not an economical road unless it has a large traffic, and yet it is not a convenient road if the traffic is too large. It cannot be crowded beyond a certain point owing to the limitations of the cable itself, and it is too expensive to run unless a sufficient number of cars can be operated to reduce the percentage of power required to drive the cable itself. Engineers who are enthusiastic defenders of cable systems have now a chance to show what is the matter in Chicago, and why it is that those roads cannot be operated more efficiently. The conditions there are such as have always been claimed to be most favorable to the successful operation of cables, yet the results are far from satisfactory.

This will be cold comfort for the promotors of the new cable road in Broadway, New York, but it is the truth nevertheless. The fact is that the merits of the electric system are becoming more and more apparent as improvements are made, while the defects of the cable, now at its highest point of usefulness, are more marked by contrast.

The Edco Electrical Drilling Machine.

This type of motor drill has been built in various sizes up to twelve horse power, and a number of them are in service in the Brooklyn navy yard, the great ship-building establishments of William Cramp & Sons of Philadelphia, the Union Iron Works of San Francisco and the Pennsylvania railroad shops at Altoona, besides in many other large iron working establishments. They have, it is stated, given universal satisfaction wherever they have been introduced.

The Edco drill motor is especially constructed for use in ship building and about machine shops. It is extremely light for the power developed, the weight of a motor which will develop two horse power by brake being only



THE EDCO ELECTRICAL DRILLING MACHINE.

one hundred and ten pounds. The gearing is of phosphor-bronze and iron, and is inclosed in an oil-tight brass case. The bearings are supplied with automatic oilers. These drills are geared for two speeds, and at these speeds the variation is less than ten per cent. when changing from full load to no load. The motor is also supplied with a switch by which the speed of the shaft clutch can be varied to run from any number of revolutions between two hundred and fifty and five hundred per minute. The motor is capable of developing not less than one horse power at any intermediate speed. The motor is supplied with a universal joint arranged to take a Stow flexible shaft, and the whole is inclosed in a light fiber casing so arranged as to permit the oiling of all moving parts. The insulation resistance is made very high, as the motors are adapted to be used in damp places. They are supplied with a windlass and one hundred feet of flexible conductor.

This machine is placed on the market by the Electro-Dynamic company of Philadelphia.

Elias E. Ries' Electric Riveting Patent.

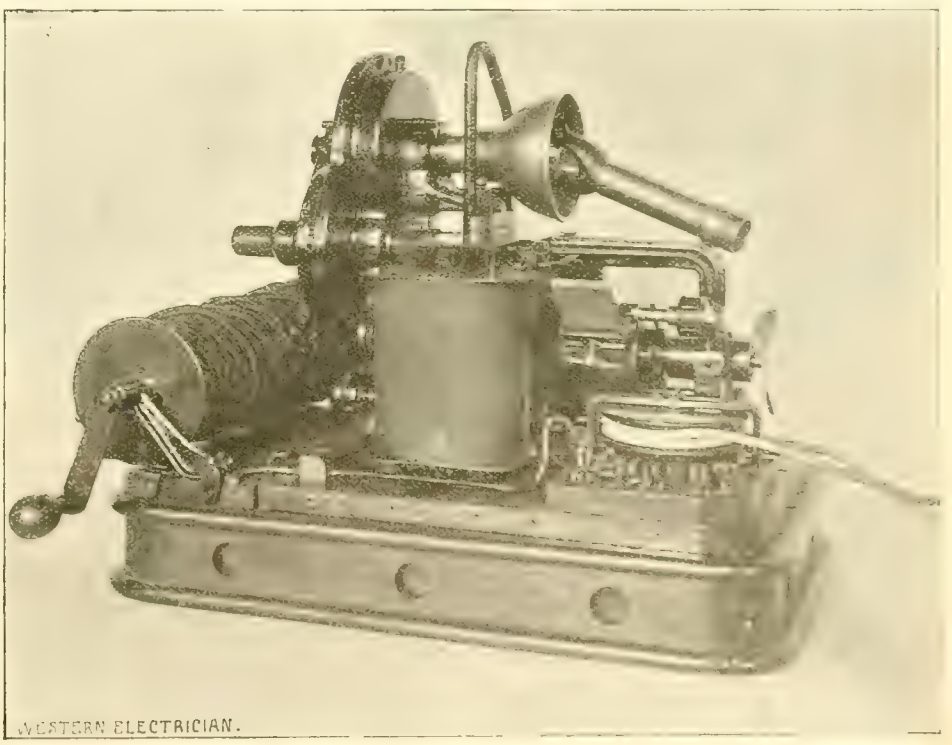
On December 15, 1891, letters patent No. 465,089 on "riveting by electricity" were issued to Elias E. Ries of Baltimore, Md. This patent is considered to be fundamental and has been involved in interference proceedings with another application by Prof. Elihu Thomson. With the view of enabling the readers of the WESTERN ELECTRICIAN to judge for themselves as to the strength of Mr. Ries' claims, the specifications and drawings of the patent are presented herewith.

My invention has reference to a novel process of riveting, in which the rivets are inserted into the holes in a cold state, are then heated to incandescence by the passage of an electric current through the same, and are maintained in that incandescent condition during the operation of heading, whereby the riveting process is greatly facilitated and is accomplished with greater perfection than by the processes heretofore employed for this purpose, as set forth in my application, Serial No. 285,555, filed September 15, 1888, of which this is a division.

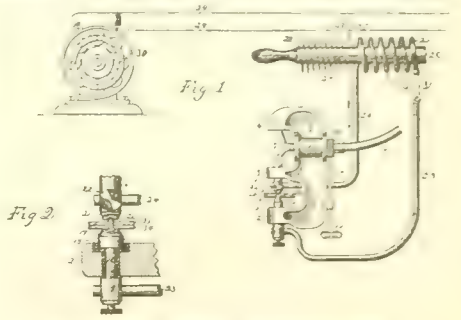
It is common to heat rivets to incandescence before inserting the same into the hole of the plate or plates, more especially when these rivets are large, as in the manufacture of steam-boilers and other like heavy structures; but by reason of the contact of those heated rivets with the cold boiler or other plates they cool down very rapidly, and the heading of the rivet is practically performed and more especially finished after the latter has cooled down to very nearly the normal temperature. This is due not only to the rapid cooling of the rivet when the same is in place in the hole of the cold plate, but also to the cooling of the rivet during the transfer from the furnace where it has been heated, and during the insertion into the hole. Such transfer and insertion occupies more or less time, according to the distance of the furnace from the work and according to the position of the hole in the article under process. It frequently happens that the rivet-bolt, after the same has been heated to the desired degree of incandescence in the furnace, has to be grasped between the cold jaws of blacksmiths' tongs, has to be carried some considerable distance to the work under process, passed from hand to hand unto the interior of the boiler or other structure, and then, by a series of awkward, uncertain, and time-consuming manipulations, it has to be inserted into the hole and a cold anvil placed against the head. Thus it happens that the facility of heading which is expected from the heating of the rivet becomes illusive, and, as before stated, the heading is practically done when the rivet has almost attained its normal temperature. By my improved process all this is avoided. The rivet is inserted into the hole while in a cold state with deliberation and comfort. It is then heated to any desired degree of incandescence and is maintained in that state of incandescence or at any other desired state of incandescence during the whole process of heading, so that the operation is performed upon the rivet while it is as soft as it can be made by heating.

This process may be practiced by means of a great variety of apparatus, and while I have shown one apparatus which is quite effective for the purpose of my invention it will be evident to those skilled in the art that other apparatus entirely different in form and construction may be employed. I am therefore not limited to any particular means in the practice of my invention, which is in the nature of an electro-mechanical process, pure and simple.

In the accompanying drawings, which form a part of this specification, I have illustrated in Fig. 1 an elevation of one form of apparatus by means of which my improved process may be practiced, and in Fig. 2 a detail view, upon an enlarged scale, of the riveting dies, and the insulation of one of these dies.



THE EDCO ELECTRICAL DRILLING MACHINE.



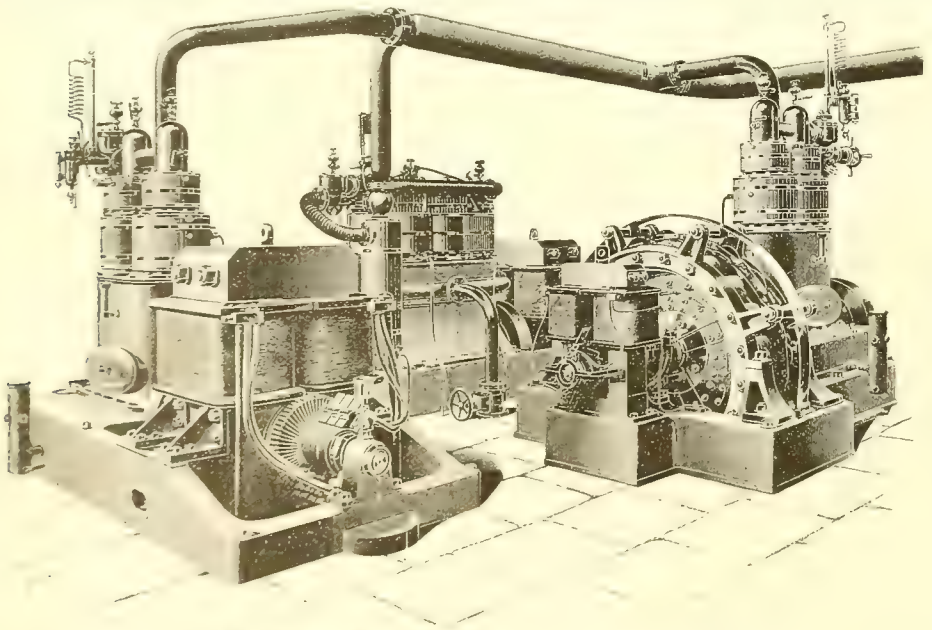
ELIAS E. RIES' ELECTRIC RIVETING PATENT.

screw 22 and this binding-post receives a conductor 24, as shown. The two conductors 23 24 lead to the terminals of a suitable generator, which furnishes a current of great quantity and low tension. It will now be understood that the current coming from the generator will pass by the conductor 24 through die and rivet, and then through the anvil back to the generator. The rivet offers a resistance to the passage of the current, and becomes heated thereby, according to the current employed, to any degree of incandescence, and this heating may be continued so long as the heading-die remains in contact with the rivet, so that the latter may be maintained in a soft plastic condition until the riveting process is completed and the heading-die removed; but before the heading-die is removed and when the heading of the rivet is nearly completed it will be found advisable to turn the current off gradually, so that the riveting process is practically completed when the rivet has lost all incandescence. This practice, however, may be changed, according to the material of the rivet and according to the nature of the joint which it is intended to produce.

Any suitable source of electrical current, including the direct low-tension current of a dynamo or of a secondary battery, may be used; but by preference I use the alternating currents of low tension and great quantity furnished by the thick-wire secondary coil 25 of a transformer 26, the fine-wire primary coil 27 of which is charged by alternating currents of high tension and small quantity by the circuit 28, 28, derived from a main circuit 29, 29, which in turn is charged by an alternating current dynamo 30.

The conductor 23 includes a switch-lever 31, which may be moved by hand to make contact with any one of a series of contact-plates 32, connected, respectively, to different points of the secondary coil, and it will now be understood that all or a part of the secondary coil may be placed in circuit with the conductors 23, 24, leading to the anvil and heading-die, and thus the current regulated or entirely cut off, as desired; or in place of regulating the current by the switch this may be done by moving the core 26' of the transformer within the coils, or I may use any other suitable means of controlling the current.

The whole process will now be readily understood. A rivet is placed with its head (if there is a head) or with the head end upon the anvil in the cavity provided for this purpose, and the plates 33, 34, to be joined by the rivet, are placed with the rivet-holes over the shank of the rivet, one above the other. The operator now manipulates the valve-rod 14 to open the valve 13 (more or less) to admit steam to the cylinder in front of the piston to actuate the toggle and depress the die until in contact with the rivet. The switch-lever is then operated to close the circuit and is moved until sufficient current is obtained to bring the rivet to the desired state of incandescence. More steam is



ELECTRIC LIGHTING AT THE ROYAL NAVAL EXHIBITION.

charging said circuit with an electric current or currents until the rivet is heated to the desired degree of incandescence, and then forcing the heading-die upon the rivet until the heading operation is completed, substantially as described.

6. The method or process of riveting which consists in heating the rivet preparatory to subjecting the same to the action of suitable heading mechanism and in maintaining the same in the desired state of incandescence during the operation of heading by the passage therethrough of an electric current having the requisite heating effect, substantially as described.

7. The herein-described improved method of riveting, consisting in heating the rivet or rivet-blank electrically while in place and then heading either or both ends of the

Electric Lighting at the Royal Naval Exhibition.

According to *London Engineering* nothing connected with the late naval exhibition was more uniformly successful than the electric lighting plant, owing, probably, to its rad-

Similarly the heading-die need not be actuated by a toggle which in turn is actuated by steam or compressed air or other machine-power, for it may be used like an ordinary blacksmith's heading-die, as a hand-tool, which is grasped by one hand and placed with the die-cavity over the end of the rivet-shank while the upper end of the die is struck with a hammer, as is well understood by those skilled in the art. In this case, however, the conductors 23,24, must be quite flexible, as will be readily understood; but owing to the very low tension of the currents which are employed in this process neither the anvil nor the heading-die need be insulated with special care. The most primitive insulating means will be sufficient.

In case of heavy work it is not absolutely necessary that the rivet should be inserted when in a cold state; but it may first be heated in the ordinary manner in the furnace, then inserted into the rivet hole, and the heat lost by radiation or conduction may then be supplied electrically in the manner hereinbefore described.

Having now fully described my invention, I claim and desire to secure by letters patent—

1. The method or process of riveting which consists in heating the rivet when inserted in the rivet hole or holes by the passage of an electric current through the same, and then heading the rivet, substantially as described.

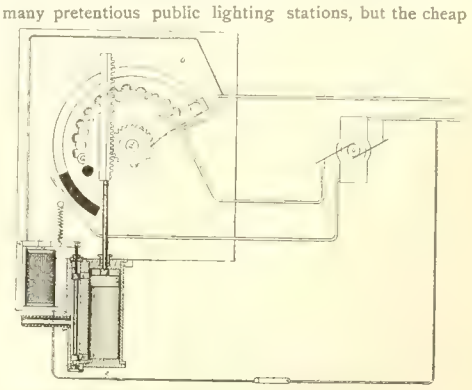
2. The method or process of riveting which consists in first inserting the rivet into the rivet hole or holes, then heating the rivet by the passage through the same of an electric current of comparatively great quantity and low tension, and then heading the rivet, substantially as described.

3. The method or process of riveting which consists in heating the rivet when inserted in the rivet hole or holes to the required degree of incandescence by the passage through the same of an electric current of suitable quantity and tension, then heading the rivet and maintaining the same in the desired state of incandescence by suitably regulating the current during the heading operation, substantially as described.

4. The method or process of riveting which consists in first inserting the rivet into the rivet hole or holes, then passing an electric current of comparatively great quantity and low tension through the rivet until the latter is heated to the desired degree of incandescence, then heading the rivet and at the same time maintaining the incandescence of the same by the continued flow of current, and finally gradually reducing and cutting off the current while the heading is completed, substantially as described.

5. The method or process of riveting metal structures together, which consists in first inserting a rivet into the rivet hole, then making electrical contact between the ends of the rivet and an anvil and the heading-die, respectively, which constitute the terminals of an electric circuit, then

vious occasion of a similar kind. It was the first public display of what may now fairly be called the English type of generating plant, consisting of large high speed engines coupled directly to the dynamos. The cut will give an excellent idea of the apparatus. There was no failure of the light throughout the whole period of the exhibition, and there was always an uneventful air about the engine room, which gained the approval of the engineering visitor as much as it repelled the ordinary sight-seer. The engine room contained a great deal more horse power than many pretentious public lighting stations, but the cheap



ARMSTRONG'S STARTING DEVICE FOR MOTORS AT A DISTANCE.

and diminutive shed which held so much was scarcely noticed by the ordinary visitor.

If the quietness and compactness of the three large Willans central valve engines, each of 300 indicated horse power, were the principal attractions to engineers, electricians were not less impressed by the dynamos of Siemens Brothers & Co. At the normal speed of 350 revolutions per minute these machines each gave an output of 1,500 amperes at 120 volts, with about 290 indicated horse power in the engine. After many hours' running, the rise in temperature was extremely small, and it was still unimportant when the machines were run up to 1,800 amperes, or 20 per cent. beyond their proper load. They are probably the largest high speed direct coupled machines in existence, and their performance goes far to explain the wide adoption of the two pole inverted horseshoe type in England. Shortly before the exhibition closed, the combined efficiency of the dynamo and engine together was found to be 84 per cent.; for each 100 horse power indicated in the cylinders, 84 horse power was given off in electrical energy at the terminals of the machines.

Armstrong's Starting Device for Motors at a Distance.

As constant potential motors are ordinarily installed, the rheostat is placed near the machine and is, as a rule, arranged so that it is worked by hand. But it is often desirable to be able to start an electic motor from a point at a distance, and also to provide means through which the motor may be automatically stopped and started. It is also important that the means employed for actuating a rheostat lever should impart a slow movement to avoid injury to the apparatus. To accomplish these objects, C. G. Armstrong of Chicago, closes the circuit through the motor by means of a fluid-motor operating the rheostat, the fluid-motor being itself capable of being controlled from a distant point.

The construction of the device and manner in which it operates will be better understood after an inspection of the cut.

Rigid upon the axis of the rheostat lever is a gear made of rawhide or other insulating material. This gear meshes with a rack upon the stem of the piston moving in a hydraulic cylinder as shown. This hydraulic cylinder has both upper and lower ports, and is supplied with water under pressure, the admission of the water to the cylinder being controlled by a double-headed valve moving in a casing connected with the cylinder by the ports. By moving this valve the water can be admitted to the under or upper side of the piston as required, and when admitted to one side exit is given to the water through the other ports.

It will be seen that if the lever be in its idle position and the valve be moved to the position shown in the drawing, so as to admit the water to the under side of the piston, the latter will be forced upward to the position given in the drawing. In thus moving upward the rack will actuate the pinion and carry the lever around over the series of contacts until it has reached the position indicated in which the current is unobstructed, and the motor energized to the utmost.

Any appropriate means may be used for operating the valve of the motor, is the movement necessary is but a slight one. One arrangement is indicated in the illustra-

tion, a magnet is placed in an electric circuit controlled as shown, by a switch located at any point in the circuit where the operator may be. It will be seen that if the circuit is completed by the switch, the magnet will be energized and its armature drawn down, thus bringing the valve to the position indicated, and causing an upward movement of the piston and an actuation of the rheostat lever with the resultant energizing of the motor. If it be desired to throw the motor out of operation, the magnet circuit is broken, and the armature then rises in obedience to the spring and moves the valve into such position as will admit the water to the upper side of the piston. The piston now moves downward and brings the lever around to its idle position, and the motor comes to a stop.

Electric Plant at Claus Spreckles' Sugar Refinery, Philadelphia.

Probably one of the most interesting installations in Philadelphia is that at the sugar refinery of Claus Spreckles, a view of which is presented in the accompanying illustration. This plant was installed two years ago when the refinery was in course of construction, and although the complete equipment was put in ten days after the contract was awarded it has since been operated without interruption. There are three Westinghouse alternating machines with a capacity of 4 500 lights. These dynamos are belted directly to three 150 horse power Westinghouse Standard engines. The construction work was done by M. R. Muckle Jr., & Co., of Philadelphia, the Westinghouse Electric & Manufacturing company and the Westinghouse Machine company furnishing the equipment. Owing to the rivalry between Mr. Spreckles and the sugar trust the greatest secrecy is maintained about all details of construction in connection with the refinery, so much so in fact that outsiders are not admitted to any part of the works, which cover nine acres of ground and contain buildings of from one to nine stories. These buildings of course, are lighted from the plant already described. In different parts of the buildings there are sixty-one Westinghouse engines.

At present Mr. Spreckles is making a comparative test of the efficiency of an electric crane which was built for handling sugar. The raw sugar is unloaded from the vessels at the covered docks, which are owned by Mr. Spreckles, and built for this purpose. On one side is a power hoist and platform traveling at the rate of eighteen feet per minute, and on the other is an electric crane and electric car to facilitate transportation to the refinery. Placed upon either conveyance the crude sugar requires handling but once, and no further attention until it arrives where it is needed. Both systems are entirely successful, and are in themselves a considerable factor in the economy of operation of the plant; but between them they are competitive and are to detetmine the character of similar mechanism for additional docks soon to be built. Neither plan must be considered in the light of an experiment, as the success of both was assured before their installation, but one will probably be found more convenient than the other and settle the type of conveyor for the new docks. Compared with the costly plan of laboriously rehandling many times by horse and man (which is in general use) neither of these methods suffers, and it would appear that the advantages of either would show better by contrast.

Municipal Lighting in Chicago.

The city law department of Chicago has been engaged several months in preparing an ordinance providing for the establishment of a distinct department to have charge of the public lighting. At present this part of the city business is divided into three parts, and these are under the direction of the city electrican, the gas inspector and the superintendent of oil lamps. Since the city has undertaken the lighting of the streets by electricity, the principal work has devolved upou Prof. Barrett's department. Recently, however, the city electrician has been endeavoring to have a separate department organized to take charge of the city lighting.

The most important work is that which is done by the city electrician, who could also attend to the duties of the other bureaus if permitted a proper force. During the next year there will be a considerable extension of the electric light plant. The appropriation for the present year is exhausted, but it is anticipated there will be a large appropriation for next year as the plant for the down town district will be completed, and there will be many extensions along the leading thoroughfares and boulevards. A reorganization of the bureau through the establishment of a new department will, it is hoped, secure uniformity, economy and efficiency.

National Electric Light Association Convention.

The fifteenth convention of the National Electric Light association will be held at the Iroquois Hotel, Buffalo, N. Y., February 23, 24 and 25, 1892. C. O. Baker, Jr., has been appointed general master of transportation with headquarters at 136 Liberty street, New York city. President Huntley announces that he has appointed George F. Porter, secretary of the association, to succeed J. W. Beane, resigned.

First Telegraphic Message.

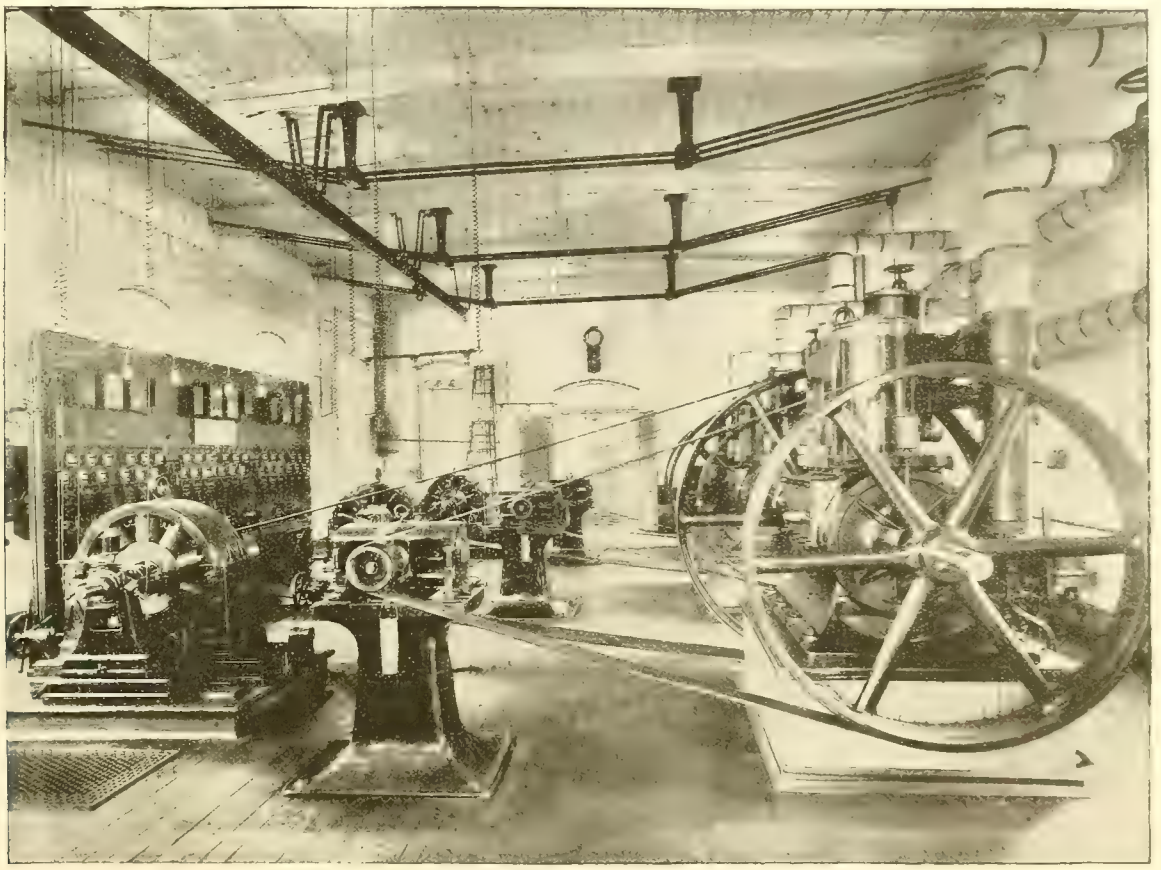
[illegible] and place of sending the first telegraphic message, the following, [illegible]

The Western Union Telegraph company is searching for the first telegram that ever went over a wire. It is believed that Major Stephen Johnston of Piqua has it, but he has not been able to find it among his papers.

In 1844, when Morse was experimenting in Washington with a wire that extended to Annapolis, he was visited by Major Johnston, who was among the delegates arriving in town on their way to the Whig convention in Baltimore. The experiments were incomplete, and in the course of explanation Morse said that he [illegible] friend who would try to send a message, and asked Johnston to wait. Soon the recorder began to tick. Morse read the message, in the characters that he had arranged, and gave the slip to Johnston, who, considering it the first complete sentence ever sent by telegraph, carefully preserved it. The message expressed the pleasure of the sender in reaching the inventor by wire.

In the most trustworthy description of the development of the telegraph, it is related that among the earliest messages, while the line was in its experimental state, was on from Baltimore on May 1st, 1844, announcing the nomination of Henry Clay to the Presidency by the Whig convention. On May 11th Morse sent to his assistant, Albert Vail, in Baltimore, "Everything working well," and that became historical.

The most impressive of the first messages was that sent at the public exhibition in the chamber of the United State Supreme Court in the Capitol on May 24th, 1844, to which Morse had invited his friends. Miss Annie G. Ellsworth, a daughter of Commissioner of Pensions, who had announced to Morse the passage of the bill granting the appropriation to build the line, selected this message from Numbers xxiii. 23, "What hath God wrought!" It was received by Vail in Baltimore, and sent back. The strip of paper on which the Morse characters were printed was claimed by Gov. Seymour of Connecticut, because Miss Ellsworth was a native of Hartford, and it is now in the archives of the Hartford Athenæum.



ELECTRIC PLANT AT CLAUS SPRECKLES' SUGAR REFINERY, PHILADELPHIA.

A St. Paul man sued the Western Union Telegraph company for $2,000 damages for failure to deliver to him a telegram announcing the death of his brother in Chicago. His allegation set forth that through this failure the plaintiff "was deprived of the satisfaction and pleasure of seeing his said brother and being present at the funeral."

The [illegible] in a recent issue, says that the three year contract between the city and the [illegible] Electric Light company will expire [illegible] and adds that the company will have to turn over several thousand dollars' worth of the city's property at that time, which it has held for the past three years, in as good condition as when it was turned over to the [illegible] The latter, for instance, agreed to take good care of the lamp posts formerly used by the streets now lighted by electricity. It is claimed that this has not been done, as many of the posts have been destroyed.

Western Electrician.

EVERY SATURDAY.

PUBLICATION OFFICES:

6 Lakeside Building, - - CHICAGO

Telephone 1746.

W. A. KREIDLER, ... Editor and Publisher

J. B. O'HARA, F. L. PERRY, W. E. KEILY, ... Associate Editors.

I. L. BAKER, ... Business Manager.

EASTERN OFFICE: 534 TEMPLE COURT, NEW YORK

W. F. OSBORNE, Manager.

Trade Supplied by Western News Co.

COPYRIGHT.—Not only the title, but the *entire contents* of each number of the WESTERN ELECTRICIAN are copyrighted. This paper is entered at the Chicago Postoffice as mail matter of the second class.

SUBSCRIPTION, in advance, postage prepaid, $3.00 for a full year of 52 numbers; in clubs of four or more, $2.50, with free extra copy for eight subscriptions; foreign countries, $5.00 a year; single copies, 10 cents. When change of address is requested, the old address as well as the new should be given.

CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only general electrical paper published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate, and will be promptly furnished on application.

CONTENTS OF THIS NUMBER.

PAGE

[illegible] Lighting Plant in the Fair Building, Chicago. Illustrated 369, 370

[illegible] Dynamos at the Frankfort Exhibition. Illustrated 370

Cable Roads in Chicago 370

The [illegible] Electrical Drilling Machine. Illustrated 371

[illegible] Electric Riveting Patent. Illustrated 371, 372

Electric Lighting at the Royal Naval Exhibition. Illustrated 372

Armstrong's Starting Device for Motors at a Distance. Illustrated 372, 373

Electric Plant at Claus Spreckles' Sugar Refinery, Philadelphia. Illustrated 373

[illegible] Chicago 373

National Electric Light Association Convention 373

[illegible] Message 373

Editorial 374

George F. Green's Electric Railway Patents. Illustrated 375

[illegible] Plant. Illustrated 375, 376

[illegible] Motors and Dynamos. Illustrated 376

[illegible] World's Fair 376

[illegible] Counting Points for Galvanometers. Illustrated 376, 377

The Telegraphers' Strike 377

[illegible] By M. I. P[illegible], Ph. D. (American [illegible]) Illustrated ...... 377, [illegible]

[illegible] ...... [illegible]

[illegible] ...... [illegible]

[illegible] ...... [illegible]

DEPARTMENTS.

[illegible]

[illegible] upon the business [illegible] presents an attractive [illegible] during the [illegible] improvements and [illegible] required. [illegible] system of [illegible]

[illegible] with attacking the commissioners' propositions through his [illegible] meetings, called to protest against the adoption of any method of transportation which would interfere with the [illegible] mathematical calculations of late, and it would appear that [illegible] scarcely necessary to add that the delusion is shared by very few people depending upon the "L" road service.

CONSTERNATION was caused in the office of the Long Distance Telephone company in Rochester, N. Y., a few days ago, when it was discovered that the line would not work, and that communication with New York was cut off. Investigation disclosed the fact that three of the poles in the adjoining village of Pittsford had been cut. The damage was repaired as quickly as possible, and the line was soon in working order. The instructive part of the incident, however, is that, under the New York laws, the offenders are liable to a fine of $250 each or one year's imprisonment, or both fine and imprisonment. It is believed that the telephone company will have the men who cut the poles prosecuted. Had the wires been dead or not in use the poles might, it is said, have been destroyed without involving the penalty.

IN a recent issue of *Power* the statement was made that one might safely predict at the commencement of any month, that before its close at least eighteen or twenty boilers would explode, and anywhere from a dozen to thirty lives be lost in consequence. The same paper now recalls this statement in connection with the report for October, which shows that during that month "there occurred in the United States thirty-four boiler explosions, resulting in the immediate death of forty-four persons, and the serious injury of seventy-one others." Four of these explosions were on locomotives and resulted in the death of eight persons. In addition there were sixteen persons injured. The people have become so accustomed to these accidents that they do not pay much attention to them, yet when there is an accident due to an electric wire, a howl is immediately raised about the so-called "deadly" wire.

ATTENTION has already been directed to the report cabled from Chicago to the London papers and copied extensively in the electrical journals of Europe to the effect that the foundations for the electricity building at the World's Fair had been condemned. It was pointed out at the time that there was not the least shadow of truth in these statements. We are glad to see that London *Engineering* has taken up the subject and emphatically denied the report. James Dredge, the publisher of the paper, is a member of the British Royal Commission, and recently visited Chicago as a special commissioner to the Exposition. In refuting the misstatement Mr. Dredge says: "No more unfortunate example could have been selected. In the first place, the Electricity building is not erected, and, in the second, it possesses no engineering features that could have caused the slighest difficulty or risk."

SELDOM has a daily newspaper presented a more inaccurate and garbled misstatement of facts than did the *Chicago Tribune* on Friday and Saturday of last week, when it published two articles evidently referring to the future plans of the Chicago Edison company, although the "Edison Electric Lighting company" was given as the name of the corporation spoken of. The only item of news in the two articles was the fact that the company contemplates the building of a new and larger station soon, and this was published in the WESTERN ELECTRICIAN months ago. With this slender basis of fact a ridiculous tissue of blunders was built up regarding the company's operations and its future plans. Nearly every statement made was inaccurate, as may be judged from the fact that the very name of the company was totally incorrect. The number of arc lamps operated by the company, as given, was ten times larger than the number actually in use, while the figure for incandescent lights was much too small. And so it went on. It is needless to say that "news" of this sort is hurtful both to the object of such ill-directed praise, and to the journal publishing it. It is surprising that such a ridiculous mess of stuff should have crept into the columns of a newspaper of the standing of the *Tribune*.

CHICAGOANS were informed by the press dispatches last Sunday that the officials of the Illinois Central Railroad company were contemplating the introduction of electricity upon that company's suburban lines. The reason suggested was the rapidly increasing passenger traffic on the South side, Chicago, and the fact that the dirt, soot and flying cinders from the passenger trains were becoming so obnoxious to the people that it was feared if something was not done at once the people would give the railroad company trouble. It has been known for some time that the [illegible] of the Illinois Central has been desirous of [illegible] for [illegible] its suburban service, [illegible] the approach of the World's Fair has increased the desire of the officials to introduce electricity upon its suburban line. This railroad company furnishes excellent service at present, and passes through the choicest suburban district of Chicago. Moreover, it hopes to carry the bulk of the traffic to the World's Fair, and at present it is the only steam railroad company that has any facilities for doing so. But the people are getting tired of the smoke and dirt and cinders incident to the steam locomotive, and they may express their displeasure so forcibly that the railway company may find it to its interest to listen to their protests. This is certainly to be hoped for. In the meantime exploiters of underground conduit systems of electric railways shou'd realize that the South Side cable service is not satisfactory, and that the introduction of an efficient electric system on the State street and Wabash avenue lines is not yet entirely despaired of by the residents of the South Side.

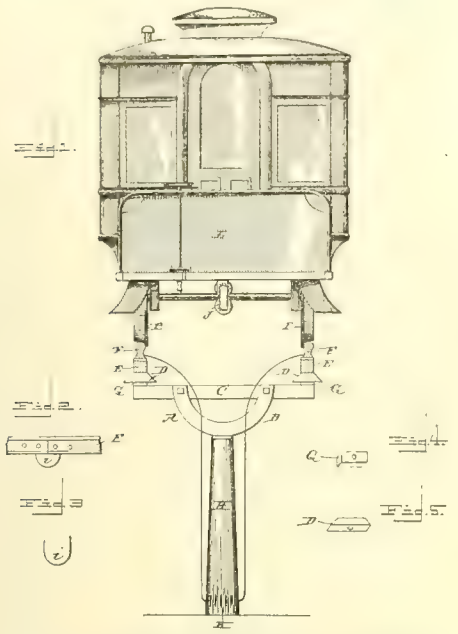
ELSEWHERE we present a copy of a circular issued by an association of gas men in Philadelphia calling on manufacturers to use their influence with their representatives in Congress to defeat the proposed loan of $5,000,000 by the government to the World's Columbian Exposition, on the ground that the gas interests had been neglected in favor of electricity at the World's Fair. This is an unpleasant exhibition of sulkiness, and is sure to defeat its own ends. Electricity was chosen as the agent for illumination at the World's Fair grounds, not as one of several possible methods, but as the only possible method. The managers could not do without it, and have a fair worthy of this age and of this nation. Every fair-minded person must recognize this. There was no discrimination against gas whatever, as the latter was never seriously considered as a general illuminating agent for the grounds and buildings. With this fact in view, the fit of spite in which some of the gas manufacturers and supply men see fit to indulge themselves seems childish. These gentlemen are railing at the inevitable. In trying to embarrass the work of the World's Fair, they bring to mind the story of the doughty English dame who endeavored to push back the stormy Atlantic with a mop when it threatened her flower-beds with destruction.

There will undoubtedly be a great display of gas-using appliances at the exposition, but it will not be brought about by the plan of the Philadelphia gentlemen who propose to attack the fair. On the contrary the desired result can only be attained by co-operation with the management and by good hard work.

CALIFORNIA presents the most favorable conditions in this country for the operation of street railway lines by the cable. The operating expenses are much less than in other parts of the country where the climate is more severe and subject to greater changes. The absence of frosts and the comparatively light loads that are carried in San Francisco explain why the cables last so much longer than in Chicago where one grip is used to drag a train of cars. It will be readily understood that in the latter city the wear and tear are very great, and the cable requires constant attention. Moreover, during the winter season an additional strain is put on the cables as on horses. The narrow slot through which the cable is reached contracts sometimes and holds the iron bar of the grip so tightly that the cable tears itself from the grip. At such times a strand of the cable is almost certain to part, and then careful splicing is necessary. The grip of a car may catch the end of a loose wire and unravel a strand for a thousand feet, causing a hopeless tangle and delaying traffic along the line. These objections are common to other cities in which the cable is operated, and even in San Francisco some of these drawbacks are felt. The recent accidents in San Francisco, described by our correspondent in this week's letter, will give some idea of the unreliability of the cable. In no other method of propelling cars is there so much real danger as in the cable system. This is due largely of course to the fact that the gripman cannot control the car as readily as the motorman in the electric system, or the engineer in the steam locomotive. Such an instance as that related by our correspondent would not occur in an electric system. Much is said and written every year about the danger of electric wires in the streets, but it can safely be said that the electric railroad has furnished no such chapter of accidents as that which the San Francisco cable has presented. Promoters of cable systems, especially in New York, should carefully consider the lesson taught by these accidents. A runaway cable car in Broadway during the busy portion of the day would be capable of incalculable damage to property, and would probably endanger more lives than a similar accident in any other thoroughfare in America. In view of this fact the responsibility assumed by the street railway company and the city officials should not be considered too lightly.

Geo. F. Green's Electric Railway Patents.

Word comes from Washington that there has been issued two patents which will be of considerable interest to exploiters of electric railways. The original application of one of the patents was filed, it is stated, on Aug. 17, 1879, and the patent thereon was issued pursuant to a recent decree of the Supreme Court of the District of Columbia, overruling the Commissioner of Patents in rejecting the application. The inventor is Geo. F. Green, a resident of Kalamazoo, Mich., and at the time of filing his application, it was alleged, was too poor to employ an attorney to assist him in its preparation and prosecution. Owing to his unfamiliarity with patent matters, the application prepared by himself did not meet all the requirements of the



GEORGE F. GREEN'S ELECTRIC RAILWAY PATENTS.

patent office, principally on account of his failure to use technical terms and language in describing his invention, and as a result he has been twelve years without his patent. His invention was pronounced patentable, but after a long period of suspension, awaiting his turn to be placed in interference with applications of Prof. Thomas Ball and Stephen D. Field of Massachusetts, Thomas A. Edison and Prof. Siemens of Berlin, claiming the same invention, they refused to admit his application to the interference for technical reasons, and a new application was required. The interference, it is said, was also decided against him on a narrow construction of the issue, and a patent was issued to Field covering what the patent office construed to be the specific patentable matter. But Green's claims, covering the broad matter, were persistently prosecuted by way of appeal to the Supreme Court of the District of Columbia, and the latter tribunal overruled the patent office, thus securing to Green the claims for which he had been so long contending.

Among the patents issued under date of December 15, 1891, are two allowed to George F. Green. The application for one, No. 465,432, was filed May 15, 1886, but there was another, No. 465,407, dated December 15th, the application for which was filed September 15, 1879. It is to be presumed that the last mentioned patent is one of those referred to in the dispatch. As the readers of the WESTERN ELECTRICIAN will be curious to know something definite as to Mr. Green's claims, there are presented herewith the drawing, a part of the specifications, and one of the few claims allowed in this patent, No. 465,407, also one of the claims in patent No. 465,432. Portions of the specification for No. 465 407 read as follows:

"The object of my invention is to propel cars rapidly and easily without the annoyance and difficulty of transmitting the source of energy whereby the cars are propelled. I therefore locate my source of electrical energy or means of electrical supply at the end of the track or at any convenient points along the track and let the engine travel only with the cars. Independent conductors may be used; but I prefer to employ the track-rails for conductors, the cars feeding their engine from the tracks as they travel along. The required electricity may be produced by any of the known methods. * * * * *

"*H* is a post or proper support for the railway-track, and C is one of the cross-ties whereon the string-rails E are mounted.

"*A B* are proper braces for the structure.

"*F F* are the metallic rails mounted on the string pieces *E* and *E*, and *G* are insulators to prevent the escape of the electric charge.

"*K* is a stationary source of electric energy or means of electric supply in electrical connection with the rails F F or other insulated stationary conductors.

"*L* is a car the wheels *l* whereof are adapted to travel on rails *F*, and *f* is an electric motor mounted upon the car and supplied with electricity by a metallic connection with the track-conductor. Through this motor, which is of any of the common forms in practical use and well known in the art—such, for instance, as that described in my patent, No. 184,469, dated November 21, 1876—the electric current flows continuously, and the coils of said motor are constantly excited (except at that instant of time when the current through said coils is being reversed) so long as the poles of said motor are in circuit with the electric generators, whereby a positive and continuous propelling force is transmitted to the driving-wheels of the car. When the common form of uniting the ends of the track-rails is found insufficient to make good metallic connection from one rail to the other, I use U-shaped loop *i* of metal, as seen in Figs. 2 and 3, and secure its ends to the rail by solder or otherwise. The projecting U-shaped surface on the block *D* prevents the insulator *G* from becoming wet, because an electric current will run across a wet surface and escape. The upper side and under side of the block *D* can be covered with a varnish, rubber, or other non-conducting substance.

"*L* is an ordinary railway car; but this will be understood to be merely typical. The engine *f*—an ordinary electric motor which furnishes the motive power—is attached to the car in some proper manner. The electrical current from the stationary source of energy or means of electric supply charges and traverses one of the rails F, and passes thence to the engine or motor by means of the car wheels F. After passing the engine or motor the current is circuited back to the battery by way of the opposite wheel and rail.

Claim 1 reads:

"The combination, substantially as set forth, of a railway track, one or more stationary means of electric supply, electrical conductors extending from said means of electric supply along the lines of said track, and consisting wholly or in part of the rails thereof, vehicles moving along said track, electro dynamic motors whose coils are constantly excited so long as the poles of said motor are in circuit with the means of electric supply fixed upon said vehicles for imparting motion thereto, and wheels supporting said vehicles upon the track, and also serving to maintain continuous electrical connection between said means of electric supply and motors, substantially as described.

The third claim in patent No. 465,432 reads:

"3. The combination of one or more sources of electric supply, a railway-track, a wheeled vehicle moving upon or along said track, a conducting-circuit composed wholly or in part of insulated conductors extending along the line of travel of said vehicle, one or more rotating electric motors mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit-controller placed on said vehicle, and also included in said circuit of conductors, substantially as described."

"Chicago News" Electrical Plant.

Chicago newpapers are nothing if not progressive, and it is therefore natural that the latest developments of electrical appliances should be taken advantage of in their establishments. One of the most complete installation of this character is that in the new *News* building, which is herewith illustrated.

The plant is located under the stereotyping room, adjoining the press room, and consists of two 60 kilowatt Edison dynamos running tandem from a countershaft driven by two vertical engines, which also operate the presses. The space allotted for the dynamo plant being necessarily small, great care was required in the arrangement of the dynamos and switch-board apparatus to obtain a successful working plant, and reference to the accompanying cut, Fig. 1, will show the compactness of the design. A view of the switch-board is shown, and the two dynamos are partly revealed.

There are distributed throughout the building 650 incandescent lamps, 24 Ward arc lamps and 50 horse power in Eddy electric motors of various sizes. The handsome and spacious press-room, with its mosaic floor and its five huge Hoe perfecting presses, is lighted by Ward arc lamps, while the working parts of the presses are illuminated by 50 incandescent lamps, wired with lead cable and fastened to the body of the presses, so arranged as to give a flood of light on every part of the paper during the entire journey

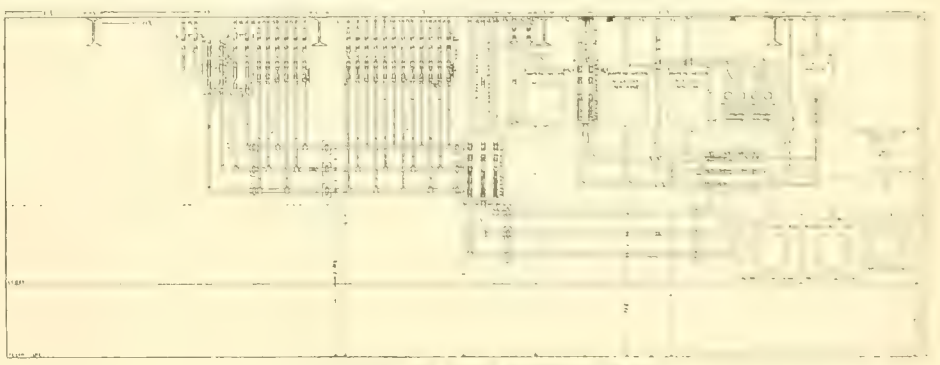


FIG. 2. "CHICAGO NEWS" ELECTRICAL PLANT.

with power for the motors from the Chicago Edison company's central station mains on Fifth avenue.

[illegible] mains to the *News* switch-board, one for the incandescent and arc lighting and one for power for the motors. This arrangement, together with the switching devices, shown in the diagram given in Fig. 2, enables the engineer at the *News* establishment to feed the lights within the building from the central station mains and the motors from the 60 kilowatt dynamos or vice versa, or still further to operate the entire system from the central station mains or the 60 kilowatt dynamos [illegible] load is light enough to warrant it he may also operate the incandescent and arc lights upon the two-wire system from a 15 kilowatt dynamo not shown in Fig. 1.

The two 60 kilowatt dynamos are connected in series on

FIG. 1. "CHICAGO NEWS" ELECTRICAL PLANT.

the three-wire plan and feed into the left hand side of the triple pole, 250 ampere transfer switch on the extreme right of the board, Fig. 2. To the opposite sides of this switch are connected the rods from the 15 kilowatt dynamo, so arranged that when the switch is turned to the right the wiring of the incandescent and arc lights in the building changes from the three to the two wire system.

To the center points of this 250 ampere transfer switche are connected the main dynamo bus bars for the incandescent and arc lighting, which run across the bottom of the board and connect to the under side of a triple-pole 250 ampere transfer switch. To the upper side of this switch the central station feeders for lighting are connected so that by the throwing of this switch the building may be lighted from the central station mains instantaneously. From the center points of this switch the main bus bars connect through the triple-pole knife switches and cut-outs of special designs with the six feeders for the incandescent lighting. The two-wire feeders for the arc lights also connect to these bus bars, but through double-pole knife switches, one of which is a transfer switch so connected as to act as a pole changer when the lighting is done on the two wire system, thus keeping the upper carbon of the arc lamp always positive.

To the dynamo bus bars, before they enter the triple pole transfer switch on the extreme right, are bolted two bars, which feed into the under side of the double pole 250 ampere transfer switch. This switch controls the power circuit to be operated from the central station mains. The two transfer switches, the one for the lighting and the one for the power, are placed [illegible]

[illegible] so that one man standing between them can easily operate both at once and thus throw the entire lighting and power system of the building from the isolated plant to the central station mains or vice versa without allowing the lights to lose their [illegible] or the motors their speed.

It will be seen that the arrangements of the switching devices, although at first glance they may appear complicated, [illegible] as to preclude accident or harm from inexperience or [illegible] manipulation, for it is impossible to feed central station current into the dynamos or vice versa, neither is it possible to deliver less than 220 volts at the motors, although the lighting system may be operated upon the two wire-plan.

The Western Union Telegraph company is now contemplating running a feeder from the [illegible] switch board

FIG. 1. THE RIKER LOW SPEED MOTORS AND DYNAMOS.

to its motor and dynamo plant, so that in case of accident to the Chicago Edison mains it could receive power from the [illegible].

This interesting switch-board is built of quarter-sawed oak, matched and headed, and highly polished. The conductors used upon the switch-board and ceiling are of polished copper bars and rods, held in place by brass cleats mounted upon insulating slate bases. All switches and cut-outs are of polished brass composition, mounted upon slate bases, and especially constructed for this installation, the minimum amount of space requiring compactness in design. The switch-board was constructed with an especial view to ease and dispatch in its operation, and is one of the most complete, in detail, arrangement and flexibility of operation in Chicago.

The entire plant was installed by the Chicago Edison company, and was designed by Louis A. Ferguson, the company's electrical engineer, who is rapidly acquiring an enviable reputation for the general excellence of his work.

The Riker Low Speed Motors and Dynamos.

In the cut Fig. 1, is shown the Riker low speed motor with rated capacity of two actual horse power at 770 revolutions per minute. This machine when wound as a dynamo

[illegible]

respectively from ½ to 3 horse power in motors, with speeds of 750 to 800 revolutions. The small bi-polar dynamos run at 850 revolutions, and are furnished in sizes which will supply respectively from 8 to 50 lamps. The field magnets of all the Riker machines are laminated, made from the best Norwegian iron and magnetically insulated from the base. All the machines are fitted with carbon brushes and extra large commutators, and are over-compounded to the extent of 2 per cent.

One of the exhibits that attracted a great deal of attention at the American Institute Fair was a complete isolated plant composed of Hartig's improved 2 horse power gas engine and a Riker low speed 16 light dynamo. This outfit is shown in the accompanying cut Fig. 2. The gas engine employed has two cylinders, which make its operation steady, doing away with the flicker which is so noticeable in the electric light when run by engines in which the speed is not exactly uniform. The dynamo is compound wound, and runs at the low speed of 810 revolutions per minute, the gas engine making 185 revolutions per minute. This plant took an award of excellence at the fair. Mr. Hartig does not claim the highest efficiency for his engine, but guarantees it to run at a uniform speed, particularly applicable for lighting work. Some interesting tests of this little plant have been made, with results which point to a decided economy of operation.

Electricity at the World's Fair.

Each of the big iron trusses that are to support the roof of the electricity building weighs eighteen tons. There are forty of these trusses, 115 feet high and they span 110 feet. The trusses are now being placed in position.

The gas men of the country are waking up to the importance of the World's Fair, and appear to think that they must bestir themselves if they are to make a showing that will not be completely cast in the shade, literally as well as metaphorically, by electricity. The American Gas Light association has appointed a World's Fair committee to secure space for a display. This committee recently held a meeting in Chicago, and presented a formal request for a separate gas building. It is thought that by co-operation among the manufacturers a creditable display may yet be made. It is to be regretted, however, that some of the gas people seem to be jealous of the electrical interests, thinking, apparently, that the latter have in some way conspired to injure them. Thus, in a circular recently issued by the Gas Appliance Exchange of Philadelphia, through W. E. Barrows, general manager, the following statements and threats occur:

The writer, representing the gas appliance exchanges and through them a large majority of the manufacturers of gas utilization appliances, has endeavored to get from the World's Columbian Exposition authorities some idea as to what provision has been made for the gas industry, stating to them that as there were over four hundred millions of dollars invested in this business, it was reasonable to expect some special provision would be made for it. From all the sources which I have at my command I have been gathering information, and I am firmly of the opinion that the electrical industry has absorbed all of the interest of the management of this department of the fair, and has convinced them that it is not necessary to have any gas on the ground for any purpose. We understand that Congress is to be asked, immediately upon its organization, for a loan of $5,000,000, or more, to aid the authorities in carrying on their fair, and we hope that both you and your stockholders will inform your representative in congress that you object to taxation without representation, and ask them to see to it that no further appropriation is made by Congress until assurance has been given that gas will have the same opportunity of representation as an industry, as has any other industry of the same magnitude.

It is certain that the gas men will gain nothing by showing their teeth in this manner. They may better follow the course outlined by *Light, Heat and Power*, which, in reproducing a statement in the WESTERN ELECTRICIAN relating to the money to be spent for electricity at the World's Fair, says:

It is not intended that the faith of the exposition managers in electricity shall be disturbed or lessened, but it is intended that they shall have faith in something else, and that an industry representing $600,000,000 of vested capital shall not be shunted on a siding.

[illegible] the trifling discrepancy of $200,000,000 in these two statements, regarding the amount of money [illegible] it may be stated that the electrical [illegible] pursuing the even tenor of its way, and has not the slightest disposition to use any influence it may [illegible] at the fair.

[illegible] reported charge for space at the [illegible] the English commission proposes to [illegible] which is far from being [illegible].

[illegible] desirable [illegible] that Great Britain should be well represented at Chicago, it follows that the government—the conditions being manifestly so adverse—should not merely be content to refrain from throwing obstacles in the path of English exhibitors, but should actively encourage them. The hostile tariff and the distance are a sufficient discouragement, without the super-addition of a tax of from 2s. 6d. to 5s. per square foot of floor space. It is the meager government grant of £25,000 which necessitates this charge; and if it be good policy for us to exhibit at all, it is worth while to substantially increase the sum in order to avoid this obnoxious tax.

Herr Vogel, the representative of Siemens & Halske, has left Chicago for New York, but will return shortly. The committee on electricity considered the application of this firm at some length at last week's meeting. In addition to the requests already noted in this paper, Herr Vogel asked leave to construct a tunnel under the mining build-

FIG. 1. FREY'S COMPENSATING SHUNTS FOR GALVANOMETERS.

ing, to show electric mining machinery, but the character of the soil is such that it may prove impossible to grant this request. Permission was granted the firm to install a generating plant in the central station at Machinery Hall, although no particular location was promised. Herr Vogel has withdrawn the request for a separate building.

Frey's Compensating Shunts for Galvanometers.

When the current to be measured in any circuit is too large for the ordinary galvanometer, tests may be made by passing a known fraction of the current through the galvanometer, the remainder being sent throught a shunt circuit. But as the introduction of this shunt circuit lessens the resistance between the terminals of the galvanometer, and, therefore, the total resistance used in the experiment, the main current is increased. It is obvious, then, that in order to maintain a uniform current when a shunt is employed, a resistance must be introduced in the battery circuit which

FIG. 2. FREY'S COMPENSATING SHUNTS FOR GALVANOMETERS.

will decrease the current to the same extent to which it was increased by the introduction of the shunt. This result may be brought about by means of a compensating resistance. A rheostat of conventional pattern can of course be introduced into the battery circuit and adjusted so as to perform the functions of a compensator, but a far better arrangement is to combine the compensating and shunt coils in a manner so as to permit their simultaneous introduction. This can be conveniently accomplished by the use of the shunt box illustrated in the cuts. This instrument consists essentially of three shunt resistances of the usual proportion, 1-9, 1-99, 1-999. In addition suffi

cient extra resistance is employed for the compensating coils. Fig. 1 indicates the resistance and the manner in which the galvanometer and battery are connected. The compensating resistance is connected at one end with the insulated binding post B^1, while the other end is attached to the nearest block marked $C K$. The compensator for the 1-99 shunt is formed in part by using the 1-9 compensator with sufficient extra resistance added, etc. The preferred shunt coil together with the appropriate compensator are together thrown in circuit by the insertion of a single plug. Removing the plug entirely opens the circuit; placing the plug between B and B^1 short circuits the battery with the galvanometer left open; placing it, the plug, at F cuts out the shunt and compensator, and leaves the galvanometer in circuit at maximum sensitiveness. When tests are concluded, the placing of the plug between G G^1 short circuits the galvanometer and leaves the battery circuit open. This instrument is the latest invention of Charles P. Frey, electrician for the E. S. Greeley & Co., New York.

The Telegraphers' Strike.

There has been a good deal of talk in telegraph and railroad circles during the last month of a strike among the telegraph operators on several western lines. It was expected that the dissatisfied operators would decide upon a plan of action. A dispatch from Albuquerque, N. M., says that the operators on the Atlantic and Pacific left without giving the manager an opportunity to communicate with headquarters. Later dispatches announce that the strike was declared off when the manager received his orders to accept the terms of the men.

Reports from San Francisco announce the collapse of the movement. A press dispatch of December 15th says:

"The telegraphers' strike, which was expected to-day, didn't occur. Only seven men went out. Chief Comstock of the brotherhood says he is assured that nearly every telegrapher on the Southern Pacific system will go out when an order is issued, but the railroad people say this is absurd and that he cannot control a hundred men. It has been found that Comstock issued on Sunday a formal order to strike to-day, but yesterday he appeared at the railroad offices and wanted to compromise. Comstock now claims he is awaiting orders from Grand Chief Thurston, but the general impression here is that Comstock is responsible for the fizzle of the strike by his mismanagement. All operators on the desert on the Southern Pacific and Atlantic & Pacific are out, but the railroads will swiftly fill their places." The next day's dispatches announced that the men were seeking reinstatement.

The telegraphers' view of the situation is presented in the following dispatch from St. Louis, dated December 15th:

"D. G. Ramsey, assistant chief telegrapher of the Order of Railroad Telegraphers, who is attending the federative council of railway employes' organizations, and who is assisting in the management of the telegraphers' strike, stated this afternoon that he had telegrams notifying him that 300 men in the employ of the Southern Pacific left their keys at 10 o'clock this morning, and that not a car, either passenger or freight, is being moved on the Atlantic & Pacific.

"Grand Chief A. J. Thurston, of the Order of Railway Telegraphers, was in the city to-day conferring with the delegates from the different railway organizations throughout the country. After relating to the delegates the nature of the strike, Grand Chief Thurston asked for their moral and financial support. The meeting at 2 P. M. took a recess without action. Mr. Thurston has received telegrams from different points on the Southern Pacific and Atlantic & Pacific railroads in which it was stated that the men were united in their demands, and would remain out until they were acceded to by the company."

On December 21st the following statement was issued by Chief Thurston, from Vinton, Ia:

The cause of the trouble upon the Southern Pacific is the attempt of that road to compel our members to make an affidavit that they will withdraw from the order and never unite with it while in the employ of the road. This the men would not do, and struck. There are 500 men out. Our men are very firm and will remain out until this infamous order is recalled. It is a fight not only against ourselves, but all organized labor, and all classes of railway employes are interested. The Atlantic & Pacific trouble is settled. The trouble on the Atchison, Topeka and Santa Fe is not recognized by this organization. I am informed that two of our men on the Fremont, Elkhorn and Missouri Valley have been requested to withdraw, but I do not believe it will be sanctioned by the Chicago & Northwestern management. Two years ago such an order was made, and recalled, and since that our order had been friendly to that road. If any further action is taken on the Northwestern, of course we should resist to the best of our ability, but I feel there will be no necessity for any such measures.

Our order is very conservative and prefers peace rather than war, but if it is crowded too much of course we will defend our just rights to the bitter end. Our order is in a very prosperous condition, and we are receiving large amounts of money from our membership in the support of the order, and I have every reason to believe that in the Southern Pacific fight we will be able to protect our members and in the end justice will triumph.

On Polyphasal Generators.[1]

By M. I. Pupin, Ph. D.

Few will deny the importance of the polyphasal current systems; none the fascination of their study. This belief induced me to present the following brief essay before the Institute.

The experimental researches in this new and promising field of electrotechnics are not yet numerous; but still the results already obtained are of so decisive a character as to leave no doubt whatever as to the extremely high practical importance which is attached to electrical generators, motors and transformers constructed according to requirements imposed upon us by this new method of combining a set of variable electromotive forces. For who among us does not thoroughly appreciate the beautiful inventions of Nikola Tesla and the completeness of the success which Dobrowolsky and Brown obtained by the practical application of these inventions?

The exact quantitative relations involved in the polyphasal system of currents are not, I venture to say, quite as well known as its practical results. To give an impulse to further inquiry in that direction is one of the principal aims of this modest investigation. For the present I propose to confine myself to the polyphasal generators in general, and particularly to polyphasal generators whose system of electromotive forces is capable of producing a rotary magnetic field of constant strength. The last point seems to me to be one of the vital points in this new method of electrical distribution. It is in this particular point that Mr. Dobrowolsky claims his system to be superior to that of Nikola Tesla.

Let us consider the theoretically simplest form of a polyphasal generator, as shown in Fig. 1. A non-magnetizable ring with n open equal coils at equal distances from each other rotates uniformly through a perfectly homogeneous magnetic field. Let PP' be the neutral plane of the field. At the instant when coil 1 is at the angular distance ϑ from the neutral plane PP' the electromotive force generated in the various coils will be

$$e_1 = K \sin(\vartheta + \alpha)$$

$$e_2 = K \sin\left(\vartheta + \alpha + \frac{2\pi}{n}\right),$$

$$\cdots\cdots\cdots\cdots\cdots\cdots$$

$$e_n = K \sin\left\{\vartheta + \alpha + (n-1)\frac{2\pi}{n}\right\}.$$

Where K is a constant depending, as is well known, on the field intensity, the speed of rotation, the number of turns in the coil and the area of the plane of a turn; α is the angular width of one-half of the coil.

Since

$$\sin(\vartheta + \alpha) + \sin\left(\vartheta + \alpha + \frac{2\pi}{n}\right) + \cdots + \sin\left\{\vartheta + \alpha + (n-1)\frac{2\pi}{n}\right\} = 0$$

it follows that

$$e_1 + e_2 + e_3 + \cdots + e_n = 0 \quad \ldots\ldots (1).$$

That is to say, the sum of electromotive forces generated in the various coils which are on one side of the neutral plane is numerically equal and of opposite sign to that of the coils on the other side of this plane. This result is well known and self-evident. It is, however, far from self-evident that relation (1), which I shall call the relation of continuity for the electromotive forces, will be satisfied by every magnetic field.

Close each coil separately by conductors of equal resistance and self-induction. Let $c_1, c_2, \ldots\ldots c_n$ denote the currents in the n separate circuits. It is evident that

$$c_1 = \frac{K}{J}\sin(\vartheta + \alpha - \varphi)$$

$$c_2 = \frac{K}{J}\sin\left(\vartheta + \alpha + \frac{2\pi}{n} - \varphi\right)$$

$$\cdots\cdots\cdots\cdots\cdots\cdots$$

$$c_n = \frac{K}{J}\sin\left\{\vartheta + \alpha + (n-1)\frac{2\pi}{n} - \varphi\right\}$$

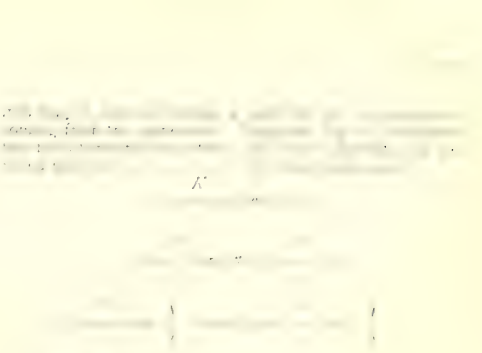
Where J is the impedance in each circuit, and the angle of retardation. Hence, we have

$$c_1 + c_2 + \cdots + c_n = 0 \quad \ldots\ldots (2).$$

That is to say, the relation of continuity is satisfied for the currents also.

Let the wires $aA, bB, \ldots nN$ (Fig. 2) represent a part of each of the n conductors of this system. Then, according to relation (2), the sum of the currents in these n linear conductors being always zero, if we joined them all into one conductor there would be no current in this wire, but the currents in the n circuits would circulate exactly the same as before. In fact, the common juncture is useless, and can and should be cut out.

The diagram, Fig. 3, represents this method of connecting for a three phase system. Consider, now, n equal coils distributed at angular distances of $\frac{2\pi}{n}$ over a laminated



and therefore

[illegible] the angle of retardation; but this change is evidently the same for all coils. The correctness of this statement might, perhaps, be questioned, if we supposed that the system of n variable currents was at any moment strong enough to saturate the iron ring. I therefore suppose that the intensity of magnetization in the ring is [illegible] shall presently see that in the case of a properly built generator the saturation of the iron ring will not vitiate the correctness of the above statement in the slightest.

Let s be the number of turns in each of the n coils. Relation [illegible] gives

That is to say, the relation of conductivity will be satisfied by the magneto motive forces.

[illegible]

Relation (4) translated into physical language means that the magnetization in the iron ring is due to two equal magneto-motive forces working in multiple arc. The magnetic field produced is perfectly symmetrical with respect to the ring as indicated by the dotted lines in Fig. 4[1].

Consider now n iron ring cores of exactly the same dimensions and made of the same material. Let ζ be the reluctance of each ring. Let each of the n coils be interlinked with one of the iron rings; we shall have n homogeneous magnetic circuits and as long as the magnetization of these rings is considerably below the saturation point we shall have

[illegible]

That is to say the magnetic induction in the n magnetic circuits obeys the same law as the n electric currents. We can therefore employ the method of polyphasal connection for the magnetic circuits, also, and we obtain what the Germans call a Verkettung der Magnetischen Ströme, which may be translated in English by a more accurate expression: Polyphasal Coupling of magnetic circuits. A transformer constructed on this principle may be called a coupled transformer.

A simple consideration will show that the field rotates around the axis of the ring B synchronously with the rotation in the generator which produces the impressed electromotive forces. Consider the armature of the generator. Since the ampere turns on one side of the neutral plane is always equal and opposite in sign to the ampere turns on the other side of this plane, it is evident that the magnetic field due to the ampere turns in the armature is fixed in space and perfectly symmetrical with respect to the plane of symmetry PP^1. We can therefore say that this field, though fixed in space, rotates with respect to the armature with the same angular velocity with which the armature rotates in space. The distribution of the ampere turns over the stationary ring B being at any moment the same as that over the armature ring, it follows that the magnetic field of B also rotates with respect to B synchronously with the rotation in the armature. An inspection of the diagram in Fig. 4 will show that when the rotation in the generator is reversed the rotation of the field B will also be reversed.

The strength of the rotating magnetic field will vary in strength because the strength of the two equal magneto-motive forces which are working in multiple arc will vary. The following simple consideration will show us the law of this variation. Two cases must be considered separately. Firstly, when n is an [illegible] secondly when n is an even number.

Case 1.

A simple definition will save me the tedious repetitions of long sentences. I define the sum of all the electromotive forces generated in all the turns which are at any moment on the same side of the neutral plane of the generator as the resultant impressed electromotive force at that moment. The magneto-motive force of the rotating field will evidently vary according to the same law as the resultant impressed electromotive force. To find the law of variation of the resultant impressed electromotive force, consider the armature of the generator when the angle θ of coil 1 is zero. To make the reasoning shorter, I make now the [illegible] that the n coils completely cover the ring, which makes [illegible] this [illegible] consideration will show [illegible] am about to deduce, will be exactly the same. In the position [illegible]

[1] Read before the American Institute of Electrical Engineers, Dec. 16, 1891.

coil on the same side of the neutral plane, whereas coil $\frac{n+1}{2}$ will be just half on one side and half on the other side of this plane. There is no electro-motive force generated in this coil. As the above mentioned angle ϑ begins to increase from zero, coil $\frac{n-1}{2}$ begins to contribute to the resultant impressed electromotive force, but this con-

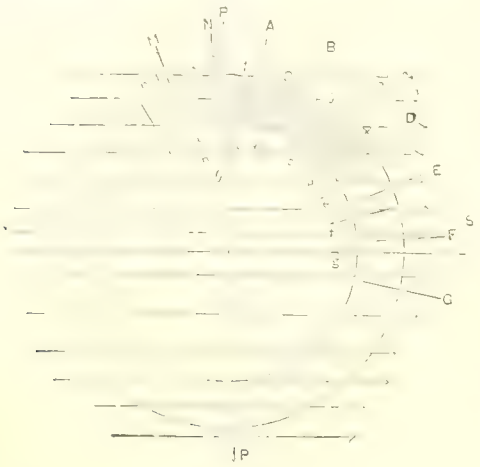


Fig. 1.

tribution is just counterbalanced by the loss due to the entrance of coil n into the opposite region of the neutral plane. The variation in the resultant impressed electro motive force is therefore due solely to the change of position of the turns in the coils 1, 2, 3, ... $\frac{n+1}{2}$, or on one side and the corresponding turns on the other side of the neutral plane. This will be the case until coil $\frac{n-1}{2}$ has completely passed to one side of the neutral plane and coil n is just bisected by it. During this interval ϑ has increased from zero to $\frac{2\pi}{n} - \frac{\pi}{n}$. The value of the resultant impressed electromotive force at any moment during this interval is easily found. Denote it by E, then

$$E = \left\{ \sin\pi - \sin\left(\theta - \frac{\pi}{n}\right) + \sin\left(\theta - \frac{2\pi}{n}\right) + \ldots \right.$$

$$\left. \sin\left\{\pi - \frac{(n-1)}{2}\frac{2\pi}{n}\right\} + \sin\left\{\theta - \frac{(n-1)}{2}\frac{2\pi}{n}\right\} \right\}$$

$$= \left\{ \sin\theta + \sin\left(\theta - \frac{2\pi}{n}\right) + \ldots \right.$$

$$\left. \sin\left\{\theta + \frac{(n-3)}{2}\frac{2\pi}{n}\right\} + \sin\left\{\theta + \frac{(n-1)}{2}\frac{2\pi}{n}\right\} \right\}$$

$$= \sin\frac{\pi}{n} \left\{ \sin\left(\theta + \frac{n-1}{2}\frac{2\pi}{n}\right) + \sin\left(\theta + \frac{n-3}{2}\frac{2\pi}{n}\right) + \ldots \right.$$

$$\left. \sin\left(\theta - \frac{n-1}{2}\frac{2\pi}{n}\right) \right\}$$

$$= \frac{\sin\frac{\pi}{n}}{\sin\frac{\pi}{n}} \sin\left(\theta - \frac{n-1}{2}\frac{\pi}{n}\right) = A \sin\left(\theta - \frac{n-1}{2}\frac{\pi}{n}\right)$$

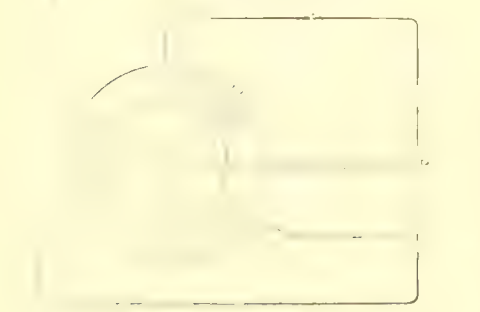


Fig. 3.

equal to A, it has a minimum both when $\theta = 0$ and when $\theta = \frac{\pi}{n}$, each of these minima equals $A \cos\frac{\pi}{2n}$. The ratio of the minimum to the maximum value equals $\cos\frac{\pi}{2n}$. For a three-phase system this ratio is .866, and it diminishes very rapidly as n increases. It is evident that after θ has reached the value $\frac{\pi}{n}$ the armature is, as far as it concerns the resultant impressed electromotive force in exactly the same position as at the start when $\theta = 0$. We conclude therefore that E has $2n$ equal maxima and $2n$ equal minima during each revolution of the armature. In diagram Fig. 5 these fluctuations of E for a three-phase system are represented graphically.

CASE 2

The same relations hold good when n is even. The maxima take place when $\theta = 0, \frac{2\pi}{n}, \frac{4\pi}{n}, \ldots$ The minima when $\theta = \frac{\pi}{n}, \frac{3\pi}{n}, \frac{5\pi}{n}, \ldots$ and the ratio of any minimum to any maximum is $\cos\frac{\pi}{n}$. Since the magneto-motive force varies according to the same law as

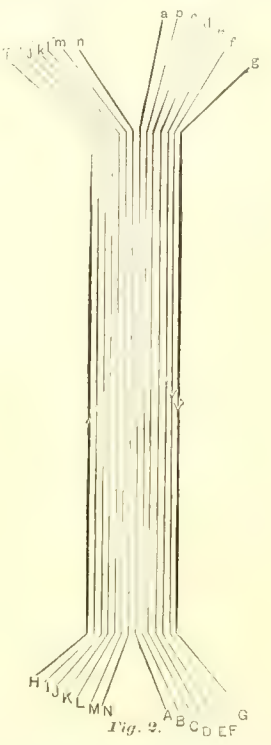


Fig. 2.

the resultant impressed electromotive force, it follows that the strength of the rotary magnetic field fluctuates periodically, having 2n equal maxima and $2n$ equal minima during each revolution, and the ratio of any minimum to any maximum equals $\cos\frac{\pi}{2n}$. That is, when n is odd, but when n is even then there are only n maxima and n minima and the ratio of any minimum equals $\cos\frac{\pi}{n}$.

A polyphasal generator of this kind would produce a rotary magnetic field of constant strength only when $n = \infty$. For a three-phase system the maximum variation would be nearly 14 per cent. of the maximum value, This agrees perfectly with Mr. Dobrowolsky's calculations, but I fail to see how these calculations could justify any one to assume that they hold good for all types of polyphasal generators.[1] The generator which we have considered could be actually constructed, but its output would be so small in proportion to its size that we may dismiss it at once as an impracticable machine. We can make it practicable by substituting for the non-magnetizable ring which carries the armature coils a laminated iron ring and for the uniform magnetic field the magnetic field of a well made field magnet with its pole pieces placed with respect to the armature coils in any one of the various ways sanctioned by practical experience. But in a generator of this kind the resultant impressed electromotive force will no longer vary according to the law which I have pointed out a little while ago. To be sure, we shall still have the same number of maxima and minima, as may be inferred readily from our knowledge of the shape of the electromotive force curve of a continuous current dynamo. We all know that the curve is not in general a sine curve, but in such case having as many maxima and minima as there are sections on the commutator. But the ratio of the maxima to the minima is no longer an

[illegible] Dec. 11th, 1891, p. 581.

a priori calculable quantity. If we know the mathematical relation between the intensity of the field at any point of the armature surface and the co-ordinates of this point with respect to the neutral plane, then we could calculate that ratio, but the amount of experimental and practical work involved in this problem would be very great. A much easier and practically much more important problem is to determine the conditions which must be fulfilled in the construction of a polyphasal generator, in order that it may be capable of producing a rotary magnetic field of constant intensity in the simplest possible way, that is without the application of brushes and commutators. Mr. v. Dolivo-Dobrowolsky seems to think that a three phasal generator is incapable of doing that, for he distinctly says that such a generator necessarily produces a rotary magnetic field whose strength varies 14 per cent. He also states that (evidently to obviate these fluctuations) the Allgemeine Electricitaets Gesellschaft employ a method of transmitting currents of smaller differences of phase than one-third of the period through three wires. In this point

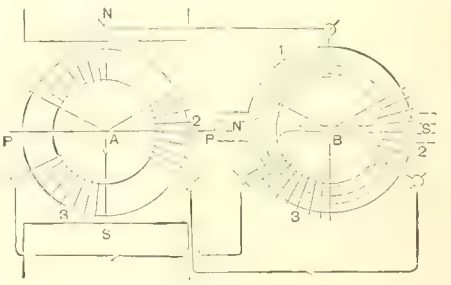


Fig. 4.

they claim to be ahead of Tesla, Bradley, Haselwander and Wenstrom. In fact, if one is not exceedingly careful in the perusal of Dobrowolsky's discussions of this subject he will be led to believe that the rotary field in some of Tesla's motors varied as much as 40 per cent., and certainly not less than 14 per cent. I do not think that Mr. Dobrowolsky wishes to be understood as holding that opinion; for neither he nor anybody else excepting Tesla himself can know what these variations were. The number of phases employed tells us nothing definite about the range of these variations.

A polyphasal dynamo which is capable of producing a rotary magnetic field of constant intensity must be constructed in such a way that its resultant magneto motive force must remain constant as long as speed and the magnetic field of the field magnets remain constant. As long as the variable electromotive force developed in each coil follows the law of a simple harmonic that result can never be accomplished by a finite number of phases, but it may, perhaps, be accomplished by producing in each coil of the generator a variable electromotive force which varies according to some definite complex harmonic law. In a well made commercial machine the electromotive forces developed in the various turns of the armature always vary according to some such a law. The form of this complex harmonic law depends on the form of the magnetic field of the field magnets, and also on the distribution of the coils over the armature. The problem that remains to be investigated consists therefore of three parts: 1st. What must be the particular form of the complex harmonic electromotive force developed in each coil of a polyphasal generator, in order that both the condition of continuity be fulfilled, and also that the resultant impressed electromotive force be continually constant? 2d. What form of the magnetic field of the field magnets will be capable of producing such an electromotive force? 3d. Can a continually constant resultant electromotive force produce a rotary field of constant strength?

1st. The first part of this problem is purely mathematical. In a paper read before the New York Mathematical society I indicated a method of discussing this part in a general way, and worked out completely two particular cases, namely the cases of a three and four phasal system. The paper is given in the appendix.

2d. For a three phasal system the form of the complex harmonic electromotive force given in Fig. 7 will satisfy all the conditions. The form A, B, C, E, F, given in

Fig. 5.

Fig. 5, is only a particular case, and ought to be aimed at in the construction of the machine.

When there are only three turns within a space through which the armature moves with respect to the field during the time that corresponds to a complete period as in the case of the Lauffen generator (see Figs. 11 and 12), then the field of the field-magnets must be constant in intensity during an angle which corresponds to one-sixth of the period. I have indicated that in the diagram Fig. 9. In

the case of bi-polar three phasal generators, as indicated in the diagram Fig. 10, where we have six coils, the diametrically opposite pairs being connected in series, the pole faces must have an angular width of 120 degrees, and the field must be constant in intensity within the region bounded at any moment by the armature and the pole faces. This is a practical problem offering no serious difficulties, judging from the experimental results obtained by S. Thompson, Isenbeck, Mordey and others, and also from the experimental results obtained lately by a graduate of our school, Mr. Freedman, John Tyndall, Fellow of Columbia College.

The curve of impressed electromotive force, which must be produced in the case of a four phasal generator, is given in Fig. 13, and needs no further commentary. Larger number of phases offer no special advantages, whereas the disadvantages arising from employing a large number of phases are self evident.

3d. When a coil in which a simple harmonic electromotive force is developed is closed by a resistance, whether self-inductive or non-self-inductive, the current which is set up in the closed circuit will be a simple harmonic, having therefore all the characteristics of the impressed electromotive force. This, however, is not necessarily the case when the impressed electromotive force is a complex harmonic. A complex harmonic electromotive force is composed of a large number of simple harmonic electromotive forces of different frequencies, all the higher frequencies being multiples of the fundamental frequency. When, therefore, a coil in which a complex electromotive force is generated, is closed by a conductor, and the current is started, the current will be also a complex harmonic, each simple harmonic component of the complex harmonic electromotive force producing its own simple harmonic

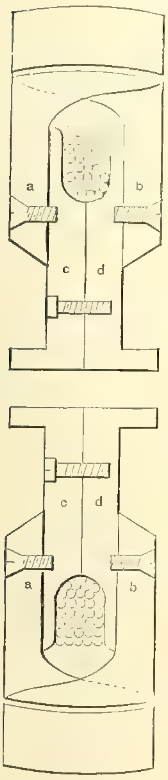


Fig. 11.

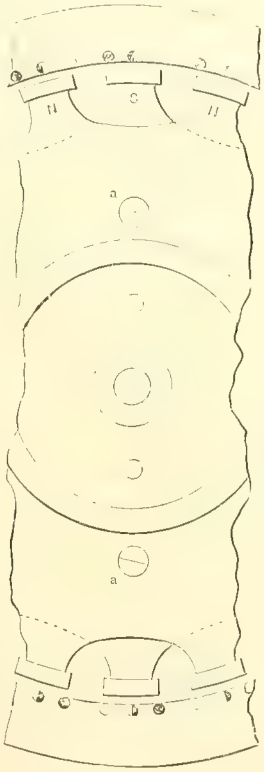


Fig. 12.

current, which is a component of the resultant complex harmonic current. But since the component simple harmonic electromotive forces have each a different frequency, it follows that they will have a different impedence and the shifting of phase will be also different for each component current, currents of higher frequency having a larger shifting in phase and also the ratio of the amplitude of any one of the component currents to the amplitude of any other component of lower frequency being smaller than the ratio of the amplitudes of the corresponding component electromotive forces. In this respect the propagation of the complex harmonic current wave resembles very much the propagation of a complex harmonic sound-wave or a complex harmonic light-wave through an absorptive medium like air. The component simple harmonic waves of light and sound will in general suffer the less through the transmision the longer their wave-length. Just as the sound and light-waves, after such a transmission, lose a great many characteristics of the original vibration which produced them, so an electric wave in its transmission through a conductor possessing ohmic resistance and electro-magnetic, not to speak of the electro-static inductance, will lose a great many characteristics of the impressed electromotive forces.

To put this into simple symbolic language of mathematics,

Let L be the coefficient of self-induction of the circuit,

" R be the total resistance,

" $K\sum_{1}^{\infty} a_m \sin m p t$ be the complex harmonic impressed E. M. F. where $p = 2\pi \times$ fundamental frequency,

" x be the value of the current at any moment t.

We shall have, then,

$$L\frac{dx}{dt} + Rx = K\sum_{1}^{\infty} a_m \sin mpt$$

The solution of this differential equation gives

$$x = K\sum_{1}^{\infty} \frac{a_m}{\sqrt{R^2 + m^2p^2L^2}} \sin(mpt - \phi_m)$$

$$\text{where } \tan\phi_m = \frac{mpL}{R}$$

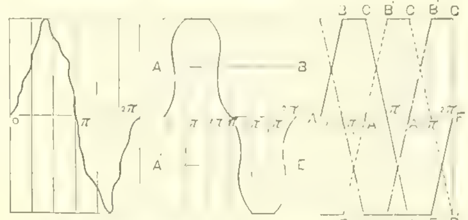


Fig. 6 *Fig. 7.* *Fig. 8.*

The current x is a complex harmonic, its component simple harmonic currents being

$$x = x_1 + x_2 + \ldots\ldots + x_m + \ldots\ldots \textit{ad infin.}$$

$$\text{The current } x_\alpha = \frac{K a_\alpha}{\sqrt{R^2 + \alpha^2p^2L^2}} \sin(\alpha p t - \phi_\alpha)$$

$$\tan\phi_\alpha = \frac{\alpha p L}{R}$$

Let E be the impressed electromotive force, then

$$E = e_1 + e_2 + e_3 + \ldots\ldots + e_m + \ldots\ldots \textit{ad infin.}$$

The component simple harmonic electromotive force e_α is given by

$$e_\alpha = a_\alpha \sin \alpha p t$$

These relations give an exact quantitative expression to the preceding physical description.

These considerations made me hesitate at first in taking as granted that a polyphasal generator producing complex electromotive forces, such as I deduced mathematically in the course of my paper, would be capable of producing a rotary magnetic field of constant intensity. But I was glad to find out that my hesitation was groundless.

Consider the three phasal generator whose diagram is given. Take, now, another *well-laminated* armature wound in a similar way as the armature of the generator. Connect the three pairs of coils of the generator to the three sets of coils in armature 2. We shall have three separate circuits, the ohmic resistance and the self and mutual inductance in each circuit being the same. Denote by $E_1\ E_2\ E_3$ the three complex harmonic electromotive forces in the three circuits. Let x, y, z be the currents at any moment. Then we shall have

$$L\frac{dx}{dt} + M\frac{dy}{dt} + M\frac{dz}{dt} + Rx = E_1$$

$$L\frac{dy}{dt} + M\frac{dx}{dt} + M\frac{dz}{dt} + Ry = E_2$$

$$L\frac{dz}{dt} + M\frac{dx}{dt} + M\frac{dy}{dt} + Rz = E_3$$

But since $E_1 + E_2 + E_3 = 0$ for all values of t it follows that

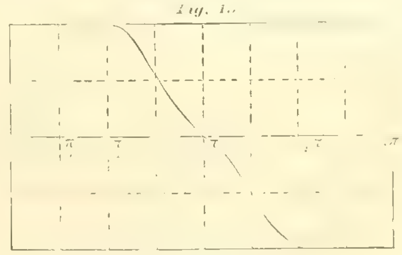
$$L\frac{d}{dt}(x + y + z) + 2M\frac{d}{dt}(x + y + z) + R(x + y + z)$$

$= 0$ for all values of t. This can be true only if

$$x + y + z = 0$$

for all values of t. That is to say, the currents fulfill the condition of continuity. We can therefore employ the

Fig. 13.



method of polyphasal connection. Substitute now in the first of the three differential equations

$$z = -(x + y)$$

and we obtain

$$(L - M)\frac{dx}{dt} + Rx = E_1 = K\sum_{1}^{\infty} a_m \sin mpt$$

The solution of this equation gives

$$x = K\sum_{1}^{\infty} \frac{a_m}{\sqrt{R^2 + m^2p^2(L - M)^2}} \sin(mpt - \phi_m)$$

Similarly

[illegible]

[illegible]

In the [illegible] are pretty small when [illegible] circuits are near the [illegible] small, and [illegible] L even for large [illegible] very high. Also, since

tan [illegible]

ϕ_m is exceedingly small [illegible] have for moderate frequency generators.

$$x = \frac{K}{R}\sum_{1}^{\infty} a_m \sin mpt$$

and similarly for y and z. The same method of reasoning may be easily applied to any number of phases. The mathematical operations will be considerably larger, but still the same results will be deduced without much difficulty.

That is to say, the curves for the currents are the same complex harmonics as those of the impressed eletromotive force. The currents therefore, produce a rotary magnetic field of nearly constant intensity; this is evidently true even if these currents produce a saturation in the iron part of the magnetic circuits.

The resemblance between a polyphasal generator and a continuous current dynamo, which these relations bring into view, is exceedingly striking and instructive.

The advantages gained from a polyphasal generator capable of producing a rotary magnetic field of constant intensity would be very much diminished indeed if it should turn out that it is impossible[1] to devise a simple and efficient method of transformation by means of which the polyphasal system of currents producing a rotary field of constant intensity (a constant rotary field system) can be transformed any number of times without losing its distinguishing characteristic. I intended to discuss this problem also this evening, but having been disappointed by the mechanician who is constructing several pieces of apparatus illustrating this problem, I decided to postpone this discussion to some other time. To sum up:

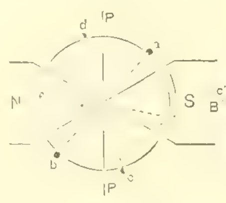


Fig. 9

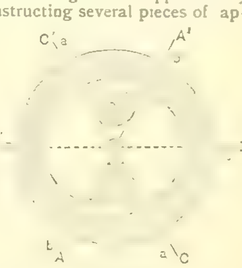


Fig. 10.

1st. The consideration of simple harmonic impressed electromotive forces, does not tell the whole story of the polyphasal generators.

2d. The law of variation of the strength of the rotary magnetic field which a polyphasal generator can produce is not as simple as Mr. D. v. Dobrowolsky thinks.

3d. Polyphasal coupled transformers must be worked at low magnetizations and low frequencies, otherwise they will not satisfy the condition of continuity. It follows, therefore, that they will probably be very large for the output which they can give.

4th. It is very probable that nearly constant rotary magnetic fields can be produced in practice by a small number of phases, perhaps not more than three, by properly shaping the curve of the impressed electromotive force.

An Insulating Material.

A new form of insulating material of a wholly mineral and inorganic character is being introduced into the electrical market. This material is one of the many hydro-carbons of eastern Utah, variously termed Uintaite, Grahamite or Gilsonite.

Analyses by Professors Blake and Wurtz, show the mineral to be from [illegible] pure. It is crystaline in character, extremely friable, and breaks with a brilliant conchoidal fracture. In color it is black. It is 2½ in the scale of hardness, has a specific gravity of [illegible], and fuses readily in the flame of a candle, becoming plastic while warm, but returning to its friable condition immediately on cooling. This is the condition in which it is mined by the Wasatch Asphaltum company of Salt Lake City, which is producing it. A specimen analyzed by Messrs. Bristol & Lawyer yielded as follows: Carbon, 80.88; hydrogen, 9.76; nitrogen, 3.30; oxygen, 6.05; ash, 0.01; total, 100.00 parts.

In this condition it would be of little value as an insulator, because of its extreme friability. But the Wasatch company prepares it in an elastic form under the name of "Wasatch Jet." Under the influence of moderate heat, this product can be drawn into filaments so fine as to be scarcely visible to the naked eye, and of almost any length. The deposit of gilsonite from which the insulat-

1. [illegible]

ing material referred to is made, is in a fissure a mile or two in length. This substance has as a rule been sold as mined, to varnish makers for the manufacture of baking japans, and other black varnishes. Its insulating properties, though, will undoubtedly open for it another profitable field.

Franklin Experimental Club.

The Franklin Experimental club of Newark, N. J., has changed its regular meeting night from the second and fourth Tuesdays of the month to the second and fourth Saturdays of the month. There has been a considerable increase in the membership of late, and a committee has been appointed to look for larger and more suitable quarters, the club having outgrown its present facilities. Among the subjects that have been taken up at the recent meetings are "Induction," "Construction of Transformers and Applications of Alternate Currents," and "Vibratory Phenomena." A series of talks illustrated by experiments is now being given upon the last named subjects by several members, showing in a most interesting way the phenomena of sound, light, heat and electricity, and their corelation.

The Chicago Electric Club.

At the last meeting of the Chicago Electric club on Monday, December 21st, the paper of the evening, entitled "Rapid Transit for Great Cities," was read by St. John V. Day. The attendance was good, considering the weather and the nearness of Christmas. After Mr. Day had finished his lecture T. Graham Gribble of London was introduced. Mr. Gribble's address was supplementary to Mr. Day's description of the rapid transit scheme now being exploited by the Day Construction company.

After the literary programme had been completed, C. C. Haskins read a copy of the letter which, as the committee of one appointed at the last meeting of the club, he had sent to Prof. Elisha Gray, asking that the question of the standardizing of safety fuses be brought before the coming Electrical Congress. A notice was read to the effect that thirty days from date a motion would be made before the club to change Section 1, Article III., of the constitution and by-laws to read:

"Resident members shall pay an entrance fee of $25, and annual dues of $40."

The entrance fee at present is $50, and the annual dues are $40.

The next paper will be read by J. P. Barrett, chief of the department of electricity, January 4th. Prof. Barrett has announced the subject of his paper as "Electrical Exhibitions During the World's Columbian Exposition."

CORRESPONDENCE.

New York Notes.

NEW YORK, December 19.—There has been considerable talk of late in New York financial circles with Henry Villard as the subject. Rumor said that Mr. Villard had been asked to resign the presidency of the Edison General Electric company, and that at the forthcoming annual meeting a determined effort would be made to oust him. The man mentioned as the possible successor was Carl Schurz. It is claimed by some that Mr. Villard and his following have been such bears on the stock as to have systematically depressed its price, and to have thereby injured the company. It is pointed out that the Edison company's is an 8 per cent. dividend paying stock, and that the Lake Shore, [illegible] for 125 while the Edison stock is only quoted in the nineties. Of course all this [illegible] and it should be mentioned therefore that Mr. Schurz announces that as far as his connection with the story is concerned it is untrue.

[illegible] been on for a week or so has [illegible] in favor of the New [illegible] Exchange had [illegible] Telegraph [illegible] common [illegible] peremptory order [illegible]

An aggressive policy is all right in its way, but when fraud and deception are resorted to in order to introduce the trolley system, the hard work of the electric exploiter is liable to excite enmity rather than to develop favorable feeling. Brooklyn property owners are now charging that consents have been obtained by underhand means. These charges are made particularly against the De Kalb avenue line, or the Brooklyn City and Newtown company, and the complainants are men like David M. Stone, Police Commissioner Hayden and Alanson Tredwell. As it is thought by many that the advocates of the overhead system will win in the end it is to be regretted that an opportunity should thus be offered for sneers and remarks about "jobbery," etc.

The official reports of the last electrical execution were filed on Wednesday. Warden Brown makes affidavit that the execution was conducted according to law, and this affidavit is followed by the report to the warden, signed by Drs. MacDonald and Samuel B. Ward. These experts on electrical execution state that there were a series of four brief contacts, occupying in all fifty-two seconds. The first lasted fifteen seconds, the second eleven seconds, the third fifteen and one-half, and the last ten and one-half seconds. There were brief intervals between the contacts to permit the wetting of the electrodes. The readings from the voltmeter indicated a pressure of 1,7.6 volts with nearly seven amperes. The statement of the autopsy says there were no discolorations, except at the knee where the electrode was applied, and that was superficial. No indications of violence to the muscles were seen.

W. F. O.

Kansas City, Mo.

KANSAS CITY, December 19.—Mayor Hannan of Kansas City has promptly and effectually killed the proposition to sell the plant of the Consolidated Electric Light company in that city for $300,000. He found numerous objections to the ordinance passed by the council and vetoed it emphatically. He declared that the proposed purchase price was enormous, and of itself sufficient reason for vetoing the ordinance. He also found that the date for the election to vote on the proposition had not been set far enough ahead to enable the city to comply with the laws regulating notices and publication of election. It is probable that the matter will never come up again.

In its turn the Kansas City, Kan., council has defeated the ordinance renewing the purchase of the Thayer-Enright Electric Railway company. The company's first purchase expired without a thing being done to utilize it. Amendment after amendment was offered. The proposed route was almost entirely charged. Electric lights were to be placed on each pole erected by the company. The space between the rails was to be paved as well as a certain space outside and adjoining the rails. The wires were to be put under ground under certain conditions, and in the event of the storage system proving practicable it was to be adopted. Transfer arrangements were to be made with all other street railways which the line might cross. By this time the representatives of the company had left the council chamber in disgust, and then the ordinance, as amended, was defeated. It is probable, however, that the company will make a second effort to secure a renewal of its franchise. It has secured the money to build the line, and the people living along the proposed route favor it.

Two ordinances have been introduced in the Kansas City, Kan., council granting franchises to electric light companies. One ordinance was presented by Charles B. Edom and the other by Thomas Wolfe. Both ordinances were referred to the committee on franchises. Mr. Edom wants the right to construct and operate a plant in Kansas City, Kan., and he agrees to furnish arc lights to private consumers at the rate of $[illegible] a month and incandescent lights at the rate of 80 cents a month. He also agrees to furnish thirty incandescent lights to the city free of charge. The Wolfe franchise provides for the construction and operation of an electric light plant without conditions.

Judge Kener of the United States Circuit Court at Topeka has signed the decree in foreclosure proceedings against the Topeka Rapid Transit Railway company, the judgment, with interest, aggregating $[illegible]36,37[illegible]. The mortgage upon which proceedings were brought was given to the Metropolitan Trust company of New York and covered the [illegible] railway line and all its appurtenances. A [illegible] stay of execution has been allowed, before the expiration of which time it is believed that a compromise of [illegible] will be effected. The road has been in the hands of a receiver for several months.

The city council of Independence, Mo., a suburb of Kansas City has entered into a contract with the Citizens' Electric Light company for twenty-five arc lights for one year, to be distributed throughout the city at a cost of $1,800 a year.

L. G. Beir has been awarded the contract for wiring the new county courthouse, and Thomas F. Clohesey has been awarded a contract for similar work on the new city hall. The work of wiring has already been begun and will be completed in a short time. The wire will be placed in conduits, composed of an asbestos piping, coated with a waterproof paint.

Prof. Lucien I. Blake, Ph. D., professor of physics and electrical engineering at the State University of Kansas, has arranged a series of lectures to be delivered before the Kansas City society for university extension. The course, as arranged at present, is as follows:

Scientific Conception of Energy. Its possible transformation into heat, light, etc. Measurements of work and of energy. Sources of available energy. Conservation of energy. Degradation of energy.

The Electro Current. Its electromotive force. Resistance. Current. Electrical units: Volt, Ampere, Ohm, Watt, Joule.

The Electro Magnet. 1. Theory. Its lines of force and magnetic field. Rules for small electro magnets. Rules for large electro magnets. 2. Applications. Call-bells, Annunciators, etc. Morse telegraph.

Electro Dynamics of Current. Its magnetic lines of force. Mutual action between magnets and currents. Permanent magnets.

Ampere's Theory of Measuring Instruments of Electric Current. Voltmeters. Ammeters. Absolute tangent galvanometer.

Theory of Electro Magnetic Potential. Electro magnetic induction. 1. Its Laws. Electro magnetic unit, Secohm, Henry. 2. Its Application. Magneto. Dynamos. Motor. Bell Telephone. Blake Transmitter. Train Telegraphing.—Phelps' system.

Alternating Current. 1. Theory. Joule's Law. 2. Application. Incandescent Lamps. Arc Lamps. Electric Welding. Thermic Vol meters.

Electro ch mics. Electrolysis. 1. Its Theory. Clausius. 2. Application. Primary batteries. Secondary. Electroplating. Electrotyping.

Static Induction. 1. Theory. Laws of specific inductive capacity. 2. Applications. Static induction machine. Topler Holtz. Wimshurst. Submarine cables. Train telegraphing—Wiley Smith-Edison system. Radiant matter. Geissler tubes. Radiometer. Crooke's experiments.

Electrical Radiation. Hertz experiments. Electro magnetic theory of light. Modern view of electricity and magnetism. Faraday's magnetic rotation of plane of polarization. Ether stresses and vertical whorls.

G. M. P.

San Francisco, Cal.

SAN FRANCISCO, December 12.—The cable roads of San Francisco, in all their alleged perfection, have furnished three illustrations in as many days of the inherent defects of the system. The first accident occurred on the Jones street branch of the California Street Cable Railway company. The Jones street line is a cross-town road that has been in operation only a few months, and for this reason it crosses nearly all the other North-of-Market street lines and is obliged to give the right of way to all other roads. In many places in the line the hills are steep and the cars in crossing other roads are obliged to let go the cable and pick it up again on the other side of the crossing. In accident No. 1 a Jones street car had dropped the rope while on the hill above Geary street and the gripman was unable to hold the car on the grade, doubtless because of a heavy rain that was prevailing which rendered the brakes ineffective. As a result the car smashed into the dummy of a Geary street car that was passing under its right of way. The dummy on the Geary street car was badly wrecked, the grip broke off and clung to the rope, and traffic was suspended for the rest of the day. The trailer was crowded with passengers, but owing to the storm no one but the gripman was on the dummy. Accident No. 2, which was similiar to the preceding in some respects, occurred yesterday afternoon at the corner of Polk and Sutter streets. Fire engine No. 3 was tearing along Sutter street to a fire when a Sutter street car came down the hill and collided with it. Two of the firemen were seriously and one was perhaps fatally injured. Cause: the car was not under sufficient control.

The most characteristic accident to cable roads was that which also occurred yesterday to one of the Market street cars. At Twenty fifth street the Valencia street road crosses the Southern Pacific company's Monterey line, and as a passenger train was pulling into the Valencia street station, cable car No. 24 of the Valencia street line came to the crossing. In vain the gripman endeavored to let go the rope and bring the car to a standstill, but a broken strand had caught in the grip and to release it was impossible. The car moved on rapidly and in a moment it crashed into the rear coach of the passenger train. The cable car was almost demolished, but through unusual good fortune there was not a passenger in the car and the gripman and conductor escaped uninjured. In the passenger coach,

however, a number were injured by broken glass and flying bits of broken iron and wood, and one sustained a fractured ankle. The *Chronicle*, in commenting on the accident, says: "The cable became worn and frayed in places, and even constant inspection and repairing cannot prevent the breaking of strands. When one of these loose bits of wire strikes a grip the cable car is entirely beyond the control of the gripman, and the only thing to do is to stop the rope or go ahead and risk a smash-up."

New Yorkers will deplore the advent of their cable road after a few "stuck" cable cars have plowed their way two or three times through a blockade down on Broadway.

S.

PERSONAL.

It was reported in New York last week that Cyrus W. Field was dying. His physician says he has lost all hope for Mr. Field's ultimate recovery.

H. K. Gilman of the Great Western Electric Supply company, Chicago, returned on Thursday from a hurried trip to New York and other eastern points.

Geo. A. McKinlock, of the Central Electric company, Chicago, has returned home after an absence of a year spent in European travel. Mrs. McKinlock and a little daughter born in Paris, accompany him.

NEW INCORPORATIONS.

Hornellsville Electric Railway company, Hornellsville, N. Y ; capital stock, $50,000, to operate a street surface railroad.

Electric Supply & Engineering company, Detroit, Mich.; capital stock, $25 000; manufacture of electrical machinery and goods; E. F. Wood, Detroit, Mich.

Colchester Electric Light & Power company, Colchester, Ill.; capital stock, $6,000; to furnish electricity for fuel, lighting and power; S. D. Mills, Colchester, Ill.

Newark Chandelier Works, Newark, N. J.; capital stock, $25,000, to manufacture gas and electric light fixtures of and description; L. F. Mergott, Newark, N. J.

Newville Electric Light, Heat & Power company, Newville, Pa.; capital stock, $5,000, furnishing light, heat and power to the borough of Newville, Pa.; Robt. McCachran, Newville, Pa,

Everett Light & Power company, Everett, Washington; capital stock, $50,000; general electric light and power business in Everett and elsewhere; Brown & Brownell, Tacoma, Wash.

Neversink Light, Heat & Power company, Reading, Pa ; capital stock, $50,000; supplying light, heat and power or any of them by electricity to the public of the city of Reading; Geo. F. Baer, Reading, Pa.

Akron Electric Light, Heat & Power company, Akron, Ohio; capital stock, $300,000; supplying electricity for light, heat and power; supplying illuminating and fuel gas and oil, dealing in power apparatus, etc.

Nebraska Power company, Omaha, Neb.; capital stock, $250,000; to own, control, sell and lease certain inventions by one Whitcomb L. Judson; to construct street railways in towns in Nebraska and Council Bluffs, Ia.

State Electric Light, Heat & Power company, Jersey City, N. J.; capital stock, $100,000; to construct, maintain and operate works for the generation, supply and distribution of electricity; Wm. S Baker, Jersey City, N. J.

Waseca Light & Power company, Waseca, Minn.; capital stock, $50,000, to operate a plant for manufacturing electricity, furnish and supply electricity for light, heat and power, and business incident thereto; F. L. Benjamin, 76 Winifred street, St. Paul, Minn.

Fairbury Electric Light and Power company, Fairbury, Neb.; capital stock, $30,000; to contract for construction of lines of wire for transmission of electric currents for lighting and power purposes; to act as electrical engineers in the construction of all kinds of electric works, etc.

National Electro Therapeutic Alarm company (incorporated in W. Va.,) Washington, D. C.; capital stock, $100,000; manufacturing and buying electro alarm and electro therapeutic apparatus or any other system of electro alarms and controlling and owning patents relating thereto; Jos. Ruffner, Charleston, W. Va.

Sprague, Duncan & Hutchinson (Limited) New York city, N. Y., (Incorporated in Florida), capital stock, $50,000, promotion, construction, management, purchase, sale, etc., of electrical undertakings and securities of all kinds, and such other business as may be incidental thereto; J. R. Parrott, Jacksonville, Fla.

White Bear Electric company, White Bear, Minn.; capital stock, $10,000; to construct, maintain and operate a plant for manufacturing electricity, deal in and furnish electricity for light, heat and power, and to do all business connected with manufacturing, generating and distributing electricity; manufacture and repair all necessary appliances necessary in said business; lease, buy and sell real and personal property; H. C. Levis, 403 Sibley street, St. Paul, Minn.

Noblesville Light & Ice company, Noblesville, Hamilton county, Ind.; capital stock, $25,000; to construct and operate in the city of Noblesville, an electric light and ice plant for the purpose of manufacturing and furnishing electric lights and power to said city and the residents thereof, and for manufacturing ice and furnishing cold storage, and to provide proper engines and boilers, machinery, fixtures and appliances necessary for the full and complete management of said light and ice plant; J. L. Peck, Noblesville, Ind,

ELECTRIC LIGHTING.

Mascoutah, Ill., is now lighted by electricity. Fifty street lights and upwards of 200 commercial lights are used.

A stock company will be incorporated for the purpose of erecting an electric light and power plant in Catonsville, Md , to be operated by water power.

The Fayetteville, Tenn., ice factory and the Fayetteville Electric Light company have been consolidated. The company will put new machinery in and otherwise improve both plants.

The Electric Light company of New Britain, Conn., has been awarded the contract for furnishing the city with 96 lamps of 2,000 candle power each at $91 per night for a periodof two years.

An ordinance has been introduced in the council of Santa Barbara, Cal., granting the Electric Development company permission to use the streets, alleys, highways and other public places of the city of Santa Barbara for electric lights and power.

The capacity of the electric light works of the town of Merced, Cal., has been doubled in order to supply the increasing need of the city. A Corliss engine of 240 horse power, with new steel boilers, to run a 1000 light dynamo, has been substituted for the old plant.

The city council of Richmond, Va , has adopted a resolution authorizing the committee on electric light to advertise for bids to furnish the city with from 300 to 500 electric lights of 2,000 candle power each, for two and four years, and with power to award the contract.

The Brush Electric company has filed three suits in the United States Circuit Court against Mandel Bros., George H. Williams & Co., and Frank Bros of Chicago, alleging that these firms are using arc lamps that are infringements of the double carbon patents owned by the plaintiff.

An extensive isolated lighting plant will be installed in the new sixteen story Unity building on Dearborn street, in Chicago, by the Chicago Edison company. Two 45 kilowatt compound wound Edison dynamos, driven by two 75 horse power Ideal engines, will be used, and the building will be wired for about 1,600 incandescent lamps.

There is trouble over the charter of the recently incorporated Riverside, Ill , Edison company. This village is near Chicago, and the Chicago Edison company is putting in a central station plant for the local company. It is now claimed that the new company was to file a bond for $10,000, but that the sureties did not qualify. A suit has been begun to have the charter declared forfeited.

An action has been filed in the Circuit Court at Valparaiso, Ind., to enjoin the city from fulfilling a contract entered into between the council and the Stratton Electric Light company. The legality of the contract is called into question. The case has resulted from a proposition on the part of a rival company to light the city at a lower rate per annum than the city is now paying.

J. W. Forbis, mayor of Greensboro, N. C., advertises for sealed bids for lighting that city "with electricity on and after April 15, 1892. Bids to be made upon an estimate of not less than 50 arc lights of 1,500 candle power each, or with incandescent lamps of equivalent lighting capacity." The bids are to be made on all night lighting and on moon table. The competition will close on February 1, 1892.

ELECTRIC RAILWAYS.

An overhead electric line is about completed at Bilboa in Spain.

The construction of an electric railroad from Blountville to Bristol, in Tennessee, is a probability.

The Radford, Va., Street Railway company is considering the construction of an electric railroad.

A new 150 horse power generator has been put in the power house of the Rochester Railway company.

A company has been organized with a capital of $1,000,000 to establish in Fresno, Cal., a complete electric railway system.

A Pittsburg dispatch says that the two great street railway systems of that city have been brought under one management and under the control of the Elkins-Widener-Lamont Whitney syndicate.

The Port Norfolk Electric Railway company of Portsmouth, Va., has applied to the legislature for a charter to build and operate a railway from Port Norfolk to Portsmouth, using horse, steam or electric power.

The Petersburg, Va , Street Railway company will change from horse power to the overhead electric system and build about two miles of additional track. The company has applied to the legislature for a charter.

The Riverside Park Railway company of Sioux City, Ia., has increased its receipts greatly by electrically lighting the park to which the road runs. Arc lamps are used, fed from the railway circuit, and skating and tobogganning by electric light have been enjoyed this winter.

The Rivermont Street Railway company of Lynchburg, Va., has petitioned the legislature for a charter. The company is to be privileged to construct, own and operate a street railway, using horse, steam, electric or other motive power. The capital stock is to be not less than $30,000, nor more than $200,000.

The Thomson Houston company is at work on a new electric passenger locomotive, somewhat similar to the freight locomotive recently completed. The mechanism will be boxed in, something like a dummy engine. A

[illegible] finished.

[illegible] The company will then have sufficient power to run cars every two minutes, should occasion demand.

ELECTRIC MINING.

The [illegible] that A. Tregidgo of that place intends to establish an electric power plant for mining purposes. Mr. Tregidgo is the owner of five water rights in the mountains above the town where the generating plant will be located. The enterprise will involve an expenditure of about $130,000. It is proposed to furnish power to all mining companies desiring it. The company expects to be ready for business by May 1st.

The Electric Reduction company of Albuquerque, N. M., has been organized with a capital stock of $20,000, of which $11,000 was paid up at the meeting of December 11th. The object of the company is to treat by electricity and other processes all gold and silver ores, both refractory and free, and the plant is expected to be in operation inside of ninety days. The company has already contracted for machinery. The exact location of the plant has not yet been decided upon, but it will be in a short time. This is to be in the nature of an experimental plant, and should it prove as the projectors desire, the company will erect extensive works.

TELEPHONE.

At Toronto the telephone company is under contract to pay the city five per cent. of its receipts for the privilege of erecting poles and doing business in that city. The city has just collected $1,172 for the three months ending December 1st.

A system has been introduced by the General Telephone company of Stockholm, Sweden, providing for an annual charge of $2.75 and a charge for each telephonic message of 3 cents, the conversations to be registered by an automatic appliance The instruments are of the usual kind, and the new central office, which has recently been opened, has already 300 subscribers.

TELEGRAPH.

It is stated that Western Union dividends will be made in 1892 at the rate of 6 per cent. per annum.

Considerable dissatisfaction exists with the frequency of serious delays in telegraphic communication between Glasgow and London. Whenever any atmospheric disturbance occurs to disable one or two wires the inconvenience is very great.

Measures are being taken for the purpose of bringing the Transvaal in direct communication with Delagoa Bay by wire. There is a distance of less than a hundred miles to be spanned by the wire, when direct communication between Pretoria and Delagoa Bay, through Barberton, will be attained.

MISCELLANEOUS.

The Thomson Houston Electric company employes in its works at Lynn, Mass., 3,400 operatives.

The New York Stock Exchange has listed the Edison General Electric company's additional issue of capital stock of $1,000,000.

Earl Russell, the defendant in the recent sensational divorce case in London, is said to be coming to this country to lecture on electricity.

In the United States Circuit Court at San Francisco, Judge Hawley has given judgment for the California Electrical works in the suit against G. L. Henzel to restrain an infringement by the defendant of a patented electric apparatus for lighting purposes.

The "Hello" Club, composed of the telephone operators of the Chicago police department, gave a ball last week which was greatly enjoyed. Among the dances was a lively berlin "Send the Wagon," a "Still Alarm," schottische a "Pull Again" waltz, and an oxford "Ring Off."

On November 28th a portrait of Sir William Thomson, subscribed for by a number of friends to signalize his election to the office of president of the Royal Society of England, was presented to the Glasgow University by A. J. Balfour, chief secretary for Ireland, who said that Sir William Thomson had been identified with the University from his earliest years.

The trial of the Sims-Edison dirigible torpedo at Newcastle-on-Tyne, in England, on December 10th is reported in the cable dispatches as being eminently satisfactory, despite the foggy weather, there being no [illegible] or other disabling occurrences. An exhibition of this torpedo will shortly be given before the lords of the admiralty at Stokes Bay.

The United States Port Electric company has taken out a charter under the laws of West Virginia, having for its object the transportation of mail and express matter by the port-electric system. The first operations contemplated are the establishment of a line from New York proper to the Brooklyn post-office, and also one to the Grand Central station in New York; second, the establishment of the system in other cities of the country where rapid transit is required with a large suburban territory [illegible]

tween neighboring cities with a large volume of business transactions. The capital of the United States Post Electric company is $2,000,000 and the president is Thomas L. James, who was postmaster-general under Garfield. Among the other incorporators are Judge A. J. Dittenhoefer, John Stratton, Percival Knauth, Col. Henry Huss and Charles F. James.

TRADE NEWS.

The Law Telephone company, 85 John street, New York, reports the receipt of a number of large orders for immediate shipment to western cities, for the Law battery.

The "A. B. C." lamp, manufactured by Alexander, Barney & Chapin of New York, is still meeting with remarkable success, as is shown by the large number of orders booked recently.

The Electric Secret Service company of New York is very busy attending to the large number of orders for individual arc light and motor cut-outs it has booked for delivery before January 1st.

The Electric Construction & Supply company, New York, is running its factory overtime, to meet increasing demands from the South and West for the "Ward" arc lamps, for direct current, street railway circuits and alternating current.

The E. S. Greeley & Co., New York, has bought the patents of the Crosby dry battery and the Hussy blue-stone battery. They have given a large contract for the manufacture of these batteries to C. J. Hirlimann of 117 McDougall street, New York.

The Western Electric company, Chicago, is placing on the market a new dry battery called the "Phœnix." The battery is the product of a number of exhaustive tests, and there are features about this cell for which the company claims unequaled superiority.

The increasing use of platinum is noticeable. The books of Jas. Scbawel & Co., New York, indicate the extent to which electrical workers employ the metal. The stock handled by this firm is of the very best quality, a large part of it being imported from Paris.

The American Electrical Works of Providence, R. I., got out a neat holiday souvenir to show the patrons of the concern that they were not forgotten. The card contained a suitable inscription and will be appreciated by the patrons of the American Electrical Works.

The Crescent Insulated Wire company of Trenton, N. J., although a new concern, is getting a goodly share of orders, especially in the West, where its business has been unusually good. An order for a large amount of wire for shipment to the Pacific coast was received last week.

C. S. Van Nuis, 136 Liberty street, New York, reports that his circuit breaker and indestructible switch is giving great satisfaction. During the past month be has received orders from the South and West for the coming year, so that the parties may receive them as early as possible.

The John E Beggs Manufacturing Supply Co., of New York reports business as being brisk, especially for the different kinds of dynamos which they always have on hand. Persons intending to purchase either a dynamo or odd arc lamps, or high speed engines, etc., would do well to call at 74 Cortlandt street.

The Central Electric company, Chicago, has just taken the agency for Illinois, Missouri, Nebraska and Indiana for the Interior Conduit & Insulation company and will carry stock at Chicago, St. Louis, Kansas City and Omaha. The company reports since taking the agency for the Interior Conduit & Insulation company that it has secured an order for 50,000 feet of one size tube.

Julius Andrae, Milwaukee, Wis., has just issued a neat and very complete catalogue of electrical supplies. In a one page circular attention is called to the Andrae shade holder This new holder is made of one piece of brass. It is highly polished, and there are no joints or rivets to be come loose. The holder is made 2¼ or 3¼ inches to fit [illegible] Westinghouse sockets.

At a recent meeting of the board of directors of the [illegible] a resolution was unanimously adopted, expressing entire appreciation and satisfaction [illegible] president of the company, for the [illegible] management of its affairs [illegible] for the [illegible] of its [illegible] that they were [illegible] of the enterprise.

[illegible]

celain for the electrical trade to go to Cuba for use as telegraph insulators. A great deal of credit for the success in manufacturing is due to Thomas G. Smith, the general manager of this concern, who has spent many years in careful consideration of what is necessary for good electrical work.

BUSINESS.

A technical school to be known as the Chicago College of Engineering, has recently been started at 65 North Clark street. The plan outlined includes the teaching of mechanical, steam, civil and electrical engineering and architecture. B. M. Worthington is at the head of the institution.

The Scott Electrical Manufacturing company, manufacturer of arc lamps of all sorts, in a new catalogue which is in its way a work of art, calls attention to its railway lamp and alternating current lamp. Those desiring to purchase electric lamps of any kind for special work will find this catalogue worth a perusal.

The Dorman Dynamo company, Chicago, was incorporated December 17th. The company is now looking about for a place to locate a plant and begin manufacturing electrical machinery. It is said that negotiations are under way which may lead to the occupancy of the factory of the late Belding company.

The Easton Electric company, Brooklyn, N. Y., has just installed another 55 arc light dynamo in the store of Wechsler & Abraham, on Fulton street. This makes the fifth dynamo the Easton company has sold to this firm. The fact that the order was given after eighteen months' trial of the other four dynamos speaks well for the Easton system.

The Illinois Metal company is placing upon the market a novelty that is meeting with a successful sale. While not an electrical device it will probably prevent an electrician, as well as the common run of humanity, from losing his hat. It is called a "hat identifier," which is somewhat of a misnomer, but the successful style in which the advertising is being done will insure a very large sale.

The Delaware Hard Fibre company, Willmington, Del., is distributing throughout the country by mail samples of its product. The fibre of the concern is made in sheets from 1 100 to 1¼ inches in thickness, and about 40x66 inches square also in tubing, rods, washers and any desired special shape. It can be made very hard like a metal, or as pliable as leather. It is especially adapted for withstanding friction. The hard variety is a non-conductor of electricity.

Among the recent contracts made by J. G. Beckerleg, Chicago, for his Excelsior back pressure valve are the following: The Cook county abstract building, Washington street, one 10 inch; the Venetian building, Washington street one 8 inch; the A. J. Stone building, interseetion of Ogden and Ashland avenues, one 6 inch; the Fargo Boot and Shoe Factory, Dixon, Ill., one 5 inch. Mr. Beckerleg reports an increase in the demand for his apparatus having recently made a number of estimates for extra large sizes.

Last week the Aspen Mining company, Aspen, Colo., ordered four sets of Burton electric heaters from the Electric Merchandise company, Chicago, to be used in warming the mining company's motor stations. The Benson & Halcyon Heights Railroad company, Omaha; the Edison General Electric company, Portland, Ore.; the Maschinenfabrik Oerlikon, Oerlikon bei Zurich, Switzerland; the Newburyport & Amesbury Horse Railroad company, Newburyport, Mass., and the Warrensburg Electric Light company, Warrensburg, Mo., have also placed orders for Burton heaters.

The Chicago office of the Thomson-Houston Electric company has just closed a contract with the Benton-Bellfontaine Railway company, St. Louis, for the equipment of thirty cars with two motors each, of the company's latest improved type, known as the water proof. The contract includes the furnishing of three 333 horse power compound wound generators of the Thomson-Houston manufacture, and it is understood that the railway company will do everything that is required to make this installation model, complete and perfect in every respect. The Thomson-Houston company has its electric railway equipment in exclusive use in St. Louis on the following roads. St. Louis & Suburban, Union Depot, Mound City, Missouri Railroad, Suspension Bridge, and East St. Louis, and it is now generally conceded that St. Louis has more Thomson-Houston electric railway apparatus in use than any other city in the United States, with the single exception of Boston.

According to a list of recent shipments the Ball Engine company, Erie, Pa., has reason to be congratulated. Out of a long list of engines sold to different concerns the following shipments were made to electrc companies: Lawrence Gas & Electric Light company, New Castle, Pa., one 150 horse power; Attica Electric Light company, Attica, N. Y., one [illegible] horse power; Citizens' Electric Light company, Braddock, Pa., one 150 horse power; Youngstown Electric Light company, Youngstown, O., one 350 horse power cross compound; Pittsburg & Birmingham Traction company, Pittsburg, Pa., one [illegible] horse power; Calif Electric Light company, San Francisco, Cal., one 300 horse power cross compound; Claremont Electric Light company, Claremont, N. H., one [illegible] horse power; Johnstown Electric Light company, Johnstown, Pa., one 200 horse power; [illegible] Electric Light company, North [illegible], one 100 horse power tandem compound; [illegible] power.

ELECTRICAL PATENTS.

Issued Dec. 15, 1891.

464,955. Means for Propelling Boats by Electricity. Otto Busser, Oderberg, near Berlin, Germany.

464,959. Telephone. Charles Cuttriss, New York, N. Y.

Claim two is quoted:

"The combination, in a telephonic transmitter with a vibrating diaphragm of a carbon spiral connected therewith and included in the circuit, aad adapted to be compressed and released by the movements of vibration of said diaphragm."

464,979. Electric Signaling Apparatus. George E. Miller, Lynn, Mass.

464,986. Electric Conductor. William E. Oehrle, Philadelphia, Pa.

Claim two reads:

"A flexible electric conductor consisting of a metallic core covered with insulating material, a moisture-repellant material, a protective coating of paraffine, an insulating fireproofing material, and an exterior braided covering."

465,034. Electric Car-Brake. Edmond Verstraete, St. Louis, Mo.

465,039. Portable Electric Lamp Holder. John Baker and Henry S. Graham, Indianola, Iowa.

465,046. Automatic Circuit Breaker. William R. McLain, Des Moines, Iowa.

465,078. Method of Controlling Alternating Current Induction. Elihu Thomson, Lynn, Mass.

The third claim is quoted:

"The method of controlling the strength or induction or self induction in an electric circuit or circuits, consisting in moving a portion of core on which a coil is wound from a position of substantial magnetic coincidence of axis with that of another coil which is in circuit with the first to a position of inversion of magnetic axial relation."

465,089. Riveting by Electricity. Elias E. Ries, Baltimore, Md.

465,093. Electric Belt. Andrew Erikson, Hawley, Minn.

465,104. Dynamo Electric Machine. William P. Wiemann, Allegheny, Pa.

465,202. Coupling for Electric Conductors. William C. Preston, Providence, R. I.

465,206. Packet or Pad for Electric Batteries. Lewis H. Rogers, Brookline, Mass.

The third claim is given:

"A packet or pad for an electric cell, consiting of an electrolytic chemical and a casing or envelope of absorbent or porous material containing said chemical, substantially as described, having a portion of said casing made of increased thickness to retard polarization of the cell."

465,212. Feed Water Regulator. George W. Schilling, Philadelphia Pa.

465,218. Adjustable Rheostat. Frank J. Sprague and Charles R. Pratt, New York, N. Y.

The first claim reads:

"The combination, in an adjustable rheostat, of a series of contact plates spirally arranged and a relatively-moving switch-contact adapted to co-operate with said contact plates."

465,233. Commutator Connection for Dynamo Electric Machines, Carl O. C. Billberg, Philadelphia, Pa.

465,234. Brush Holder for Dynamo Electric Machines or Motors. Carl O. C. Billberg, Philadelphia, Pa

465,250. Process of Extracting Copper Pyrites. Thomas A. Edison, Llewellyn Park, N. J.

465,278. Electrical Sewer Gas Indicator, James J. Lawler, Scranton Pa.

465,292. Electric Motor Switch. Edwin W. Rice, Jr., Lynn, Mass.

465,349. Magnetic Ore Separator. Clinton M. Ball, Troy, N. Y.

465,359. Converter System for Electric Railways. Mark W. Dewey, Syracuse, N. Y.

465,360. Electric Fan. Philip Diehl, Elizabeth, and Edwin H. Bennett, Jr., Bayonne, N. J.

465,361. Electric Fan. Philip Diehl, Elizabeth and Edwin H. Bennett, Jr., Bayonne, N. J.

465,365. Bracket for Supporting Electric Conductor. John A. Duggan, Quincy, Mass.

465,369. Production of Insulating Coatings or Linings in Electrolytic Apparatus. Ludwig Grabau, Hanover, Germany.

465,396. Train Signaling Apparatus. Paul Synnestvedt, Chicago, Ill.

465,404. Switch Actuating Mechanism for Electric Motors. Charles G. Armstrong, Chicago, Ill.

465,407. Electric Railway. George F. Green, Kalamazoo, Mich.

465,423. Electric Heater. Warren H. Boles, Syracuse, N. Y.

The last claim is quoted:

"In an electric heater, the combination of a cylindrical core having an aperture, a resistance coil spirally wound upon the core, a pin or bar mounted in the aperture in the core, a shoulder on the pin for engaging with the core, and clamps for securing the wire to said pin or bar."

465,426. Electric Switch and Case for the Same. Curtis P. Chappell, Providence, R I

465,430. Electric Connector. William F. Z. Desant, New York, N. Y.

465,432. Electrical Railway. George F. Green, Kalamazoo, Mich.

465,442. Electrical Indicating Instrument. Edward Weston, Newark, N. J.

The first claim reads:

"The combination, in an electrical indicating instrument, of a coil supported so as to be [illegible] movable, a means of producing a permanent field of force around said coil, and a means independent of the coil support for indicating the extent of movement of said coil."

[illegible]. Electric Motor. Henry Groswith, Philadelphia, Pa.

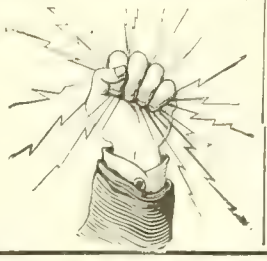
[illegible] connected, respectively, to the two other brushes for external connection."

EUGENE F. PHILLIPS, President. W. H. SAWYER, Sec'y and Electrician.

AMERICAN ELECTRICAL WORKS,

PROVIDENCE, R. I.

RAILWAY FEEDER AND TROLLEY WIRE,
ELECTRIC LIGHT LINE WIRE.
Incandescent and Flexible Cords,
AMERICANITE, MAGNET, OFFICE AND ANNUNCIATOR WIRES,
FARADAY CABLES.



NEW YORK OFFICE, P. C. Ackerman, 10 Cortlandt Street.
MONTREAL BRANCH, Eugene F. Phillips' Electrical Works.

WANTED.

A skilled Engineer for Central Station in [illegible]. Must be a thorough mechanic and understand both arc and incandescent dynamos. Applications will be considered unless accompanied by references and copies of testimonials as to ability, character and sobriety. Salary $ [illegible] per month. Address

"Active Engineer."
Care WESTERN ELECTRICIAN, Chicago.

WANTED.

A practical electrician, thoroughly competent to plan and direct the electrical and mechanical construction of motors and dynamos. One who is theoretically and practically familiar with different types of machines. Answer by letter only, giving complete record, reference and salary wanted. No personal applications considered. Address "Chicago."

Care WESTERN ELECTRICIAN

FOR SALE CHEAP.

[illegible]

A. L. IDE & SON, Springfield, Ill.

A GENTLEMAN,

Who has had [illegible] years' experience as [illegible] and Superintendent of [illegible] desires a position for the coming year. Address "Superintendent."

Care Western Electrician, Chicago.

THE "CLARK" WIRE.

Insulation Guaranteed wherever used, Aerial, Underground or Submarine.

In a letter from the Inspector of the Boston Fire Underwriters' Union, under date of March 29, 1886, he says: "A thoroughly reliable and desirable Wire in every respect."

The rubber used in insulating our wires and cables is especially chemically prepared, and is guaranteed to be waterproof, and will not deteriorate, [illegible] weather, and is not affected by heat. The insulation is protected from mechanical injury by one or more braids, and the whole slicked with Clark's Patent Compound, [illegible] have now adopted for all our solid wires as an extra weatherproof protection, and also preventing chafing and abrasion, which is water, acid, and [illegible] durable when all others fail. We are prepared to furnish Single Wires of all gauges and diameter of insulation, for Telegraph and Electric Lights from [illegible] to furnish our Clark Wire with a white outside finish for ceiling cleat work as well as our standard color.

Clark Joint Gum should be used for making waterproof joints. This is put up in half pound boxes, in strips about one foot long and [illegible] and pressed firmly it makes a solid mass. **FOR RAILWAY** and **MOTOR** use, we make all sizes of stranded and flexible with Clark insulation.

WE GUARANTEE OUR INSULATION WHEREVER USED, AERIAL, UNDERGROUND OR SUBMARINE, and our net prices [illegible] other first-class Insulated Wire. We shall be pleased to mail Catalogues with terms and discounts for quantities.

EASTERN ELECTRIC CABLE CO.,

61 to 65 Hampshire Street, BOSTON, MASS.

HENRY A. CLARK, Treasurer and Gen'l Manager.
HERBERT H. EUSTIS, President and Electrician.

ELECTRICAL INSTRUMENTS

RECALIBRATED.—REPAIRED.

CHICAGO ELECTRIC MFG. CO., 73 W. Jackson St.

H. T. PAISTE,

MANUFACTURER OF

SWITCHES, SOCKETS, ETC.,

341 The Rookery, Chicago, Ill 10 So. 18th St., Philadelphia, Pa.

See our full page advertisement in issue Sept. 12, for illustrations, prices, etc.

SOMETHING NEW!

An improved 4 or 6 volt Combined Storage Battery especially for Dentists' use at very low price. Purchasers can exchange discharged for charged cells, without extra cost, beyond expense for charging the batteries. Manufactured by

J. K. PUMPELLY,
Room 301, 205 S. Canal St., Chicago.

ESTABLISHED 1848.

HEMINGRAY GLASS CO.,

Offices, Covington, Ky. Factories, Muncie, Ind.

STANDARD SCREW GLASS INSULATORS,

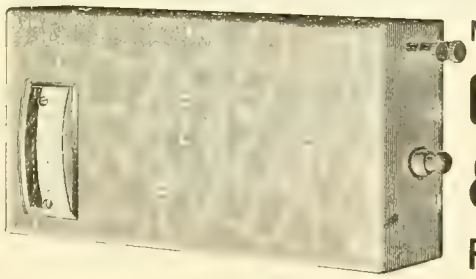
Glass Break Knobs, Floor Insulators, Battery Jars.

ARC LIGHT GLOBES FOR ALL SYSTEMS.

WORK ON SPECIAL DESIGNS SOLICITED.

FOR DIRECT AND ALTERNATING CIRCUITS.

The WAGNER-QUEEN Portable Voltmeter.



Made by QUEEN & CO., PHILA.

Send for Descriptive Circular No. 265.

TO MAKE A STATION PAY

Buy only the best quality of goods. This you can do by sending your orders to us.

Prompt Shipment. Reasonable Prices. Full Measure. No Charge for Boxing or Cartage.

WE ARE HEADQUARTERS FOR
National Alternating and Direct Current Dynamos, Generators and Transformers;
Packard High Grade Lamps; Eddy Motors;
"Helmet" Weather-proof Wire; "Helmet" Moisture-proof Wire.

Save time and money by placing your orders with

The Electrical Engineering and Supply Co.,

931 Rookery, CHICAGO. 134 E. 6th St., opp. Hotel Ryan, ST. PAUL. 409 W. Michigan St., DULUTH.

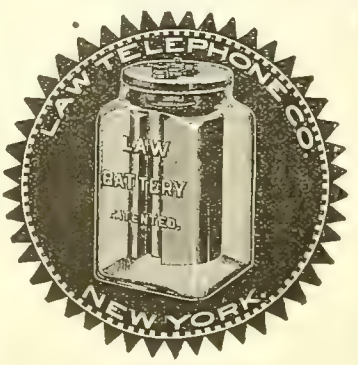
SEND FOR CATALOGUE AND DISCOUNT SHEETS.

43 and 45 Franklin St.

For Sale Cheap, Second-hand Machinery, Arc and Incandescent. Also Motors. All Apparatus Guaranteed.

CHICAGO.

The Electrical Construction Co.



The Winner of 1890 will win again in 1891.
Eleventh year.

SOLE MAKERS:

LAW TELEPHONE COMPANY,
85 John St., NEW YORK

BINDERS

For the WESTERN ELECTRICIAN,
—$1.00—

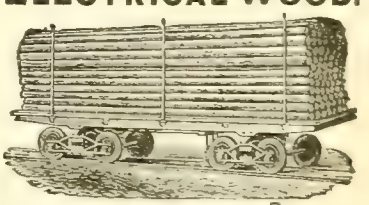
MICA

ALL SIZES AND QUALITIES

For Electrical Purposes.

EUGENE MUNSELL & CO.,
218 Water St., New York.

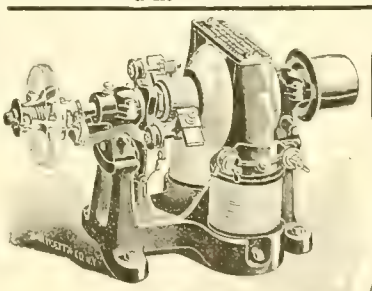
ELECTRICAL WOOD.



Telegraph
Telephone
Electric Light
CROSS ARMS
POLES

OCTAGONAL PINE AND STEEL POLES.
C. H. HOLMES, Room 410 Com'l Bldg., St. Louis, Mo.

—THE—



Crocker-Wheeler

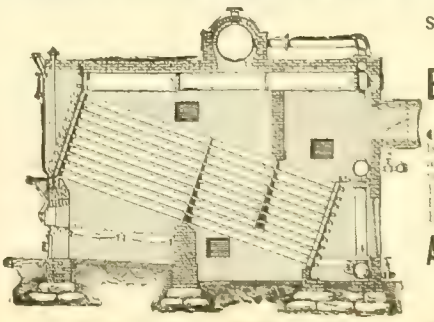
ARC MOTORS,

½, 1, 1½, 2, 3, 5 H. P. Sizes.

With Automatic Centrifugal Governor. No Switches.

430 West 14th St., New York.

ROOT'S WATER-TUBE BOILER.



Root's Sectional Safety Boiler.

SAFE. ECONOMICAL. DURABLE.

AN EXCELLENT

Electric Plant Boiler.

[illegible] Companies [illegible] Electric Light [illegible]

Abendroth & Root Mfg. Co.,
28 Cliff St., New York.

BRANCHES: Chicago, Boston, Philadelphia, Denver, Rochester.

ESTABLISHED IN 1861.

E. BAGGOT,

WHOLESALE AND RETAIL DEALER IN

ELECTROLIERS,

COMBINATION

GAS AND ELECTRIC FIXTURES.

ELECTRIC AND GAS GLOBES,

SHADES, Etc., Etc.,

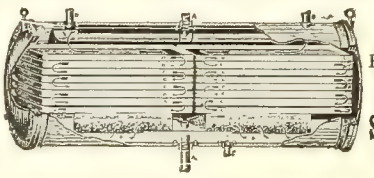
171 E. ADAMS STREET,

CHICAGO.

—BRANCH STORE—

2134 Michigan Avenue.

Stilwell's Patent Live Steam-Feed Water Purifier.



Removes all Impurities.

Entirely prevents **SCALE** in Steam Boilers. Catalogue on application.

STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.

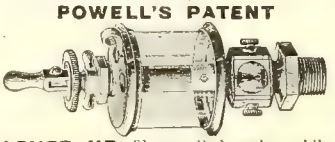
SYNOVIAL DYNAMO OIL.

Second to None. Free from Gum or Acids.

By refiltering can be used continually. Adopted by the largest Electric Plants of the West.

Write for Prices and Samples. **S. TAUSSIG, Agent, 45 River St., CHICAGO.**

POWELL'S PATENT



LEVER UP—Shows oil dropping while machinery runs.

SIGNAL OILERS

Still in the Van as the BEST for **HIGH-GRADE ENGINES and DYNAMOS.** The stop-feed features prevent waste of oil which item alone will more than save their cost in a short time. **HAS OTHER EXCEPTIONAL POINTS OF MERIT.** Send for full descriptive circular. Address **THE WM. POWELL CO., CINCINNATI, OHIO.**

PLAYING CARDS.

You can obtain a pack of best quality playing cards by sending fifteen cents in postage to P. S. EUSTIS, Gen'l Pass. Agent C., B. & Q. R. R., Chicago, Ill.

THEN AND NOW.

Years ago the traveling public considered a seat on the driver's box of a stage coach the acme of comfort, luxury and exclusiveness. The traveler of to-day asks for limited trains, made up of Pullman sleeping and dining cars, vestibuled and fitted up in the most sumptuous style of modern decorative art.

Such trains are run over the Erie Lines, through without change between Chicago and New York, passing through the beautiful Western Reserve, Mahoning Valley, by Chautauqua Lake, and then through the mountains of Southern New York and Northern Pennsylvania, the most picturesque and beautiful scenery between Chicago and the sea. Tickets over the Erie can be purchased at any of the principal ticket offices.

HARD FIBRE

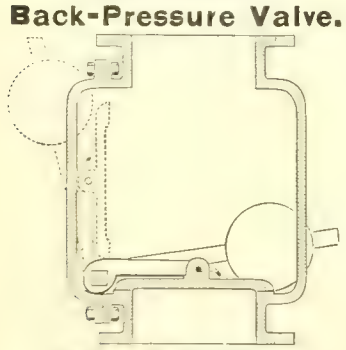
for insulation and mechanical construction is manufactured in Sheets, **Rods, Tubing, Washers, Discs** and all Special Shapes. Estimates and samples furnished upon application.

DELAWARE HARD FIBRE CO., WILMINGTON, DEL., U. S. A.

THE EXCELSIOR

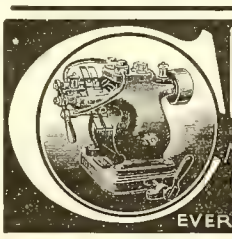
Straight-Way Noiseless

Back-Pressure Valve.



Simple! Reliable! Durable!

JAMES G. BECKERLEG,
229 S. Franklin St., Chicago.



OLBURN ELECTRIC MFG. CO.

No. 180 MAIN ST.
FITCHBURG, MASS, U.S.A.
MANUFACTURERS OF DYNAMOS FOR LIGHTING, PLATING AND EXPERIMENTAL PURPOSES.
ALSO MOTORS.
EVERYTHING LATEST DESIGN AND HIGHEST EFFICIENCY.

Manufacturers of
OCTAGONAL AND CEDAR
TELEPHONE & ELECTRICAL
RAILWAY POLES & CROSS ARMS
THE H. M. LOUD & SONS LUMBER CO.
OSCODA, MICH.

ELECTRIC LIGHT AND BATTERY **CARBONS.**

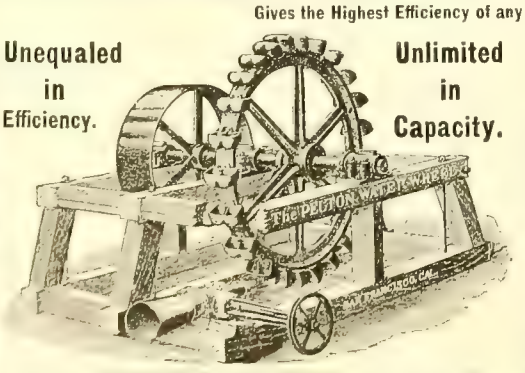
MOTOR BRUSHES.

CLEVELAND, OHIO.

THE PELTON WATER WHEEL

Gives the Highest Efficiency of any Wheel in the World. Over 2,000 in use.

Unequaled in Efficiency.



Unlimited in Capacity.

Affords the most simple and reliable power for all mining and manufacturing machinery. Adapted to heads running from 20 up to 2,000 or more feet. From 20 to 30 per cent. better results guaranteed than can be produced from any other Wheel in the country.

ELECTRIC TRANSMISSION.

The advantages the Pelton Wheel affords in the way of a uniform and reliable power, close regulation and the facility of adaptation to varying conditions of speed and pressure, have brought it into special prominence and extensive use for this class of work. All applications should state amount and head of water power required, and for what purpose, with approximate length of pipe line. SEND FOR CATALOGUE.

THE PELTON WATER WHEEL CO.,
121-123 Main St., San Francisco, Cal., U. S. A.
143 LIBERTY STREET, - - NEW YORK.

☞ It having come to our notice that our patent rights are being infringed upon, intending purchasers are hereby warned that all such infringements will be duly prosecuted.

PELTON WATER MOTORS. Varying from the fraction of 1 to 15 and 20 horse power, unequaled for all light running machinery. Warranted to develop a given amount of power with one-half the water required by any other. ☞ Send for Motor Circular. Address as above. Deliveries made from San Francisco or New York, as may afford the most favorable freight rates.

THE BUTLER HARD RUBBER CO.,

33 Mercer Street, New York,

POSSESS SUPERIOR ADVANTAGES IN THE MANUFACTURE OF

HARD RUBBER GOODS

Especially in articles adapted to electrical industries, having obtained the sole right to manufacture HARD RUBBER under the valuable Patents granted to WILLIAM KIEL.

ALL OPERATIONS OF SAWING, CUTTING, TURNING AND POLISHING OUR NEW STANDARDS OF

SHEET, ROD AND TUBING Can be performed with a large reduction in the wear and tear of tools, and considerable saving of labor. Our new standards are of a richer black throughout, not subject to change in color, are tougher and more flexible, do not become brittle with age, and are [illegible] and approved by the leading electrical companies of the United States. In addition to these advantages, we also offer advantages in prices.

KIEL'S PATENT HARD RUBBER CELLS FOR STORAGE AND PRIMARY BATTERIES

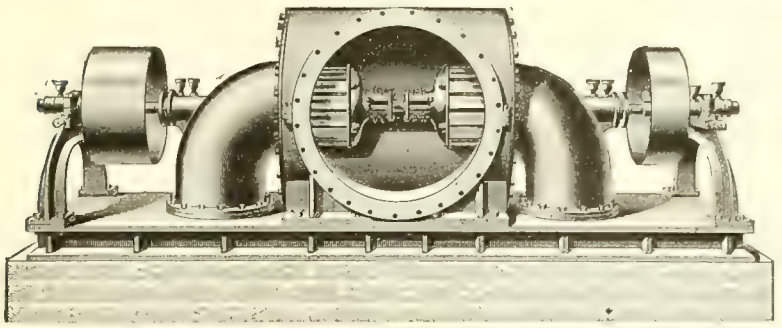
Still remain the most satisfactory and cheapest in the market, unequaled for strength, durability, insulation and resistance to acids.

HARD RUBBER GOODS OF EVERY DESCRIPTION MANUFACTURED.

Correspondence solicited from all manufacturers and dealers in electrical machinery and supplies. SEND FOR PRICES AND ESTIMATES.

For Sale by THE CENTRAL ELECTRIC CO., CHICAGO.

VICTOR TURBINE WATER WHEEL.



The attention of ELECTRIC COMPANIES [illegible] CELEBRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency**, and **large Capacity** [illegible] **diameter**, being **double** the **Power** [illegible] by a number of the leading electric [illegible] economical use of water it is without an equal, producing [illegible] per cent of useful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" is highly recommended [illegible] and it can be belted directly to dynamo.

The accompanying engraving represents a set of [illegible] **VICTOR TURBINES** arranged on a horizontal shaft [illegible] Tubes, End Bearings for Shaft and Driving Pulleys complete, all mounted upon a substantial cast-iron bed plate. The entire arrangement is very complete and strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., DAYTON, OHIO.

GLOBE CARBON CO., RAVENNA, OHIO. MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

ELECTRIC SLATE

Switch-boards a Specialty.

Small samples of plain and marbleized free.

T. J. MURPHY,

Electrical Exchange Bldg. Room 215. **136 Liberty St.,** NEW YORK.

YOU WILL OBLIGE

Both Advertiser and Publisher by mentioning the WESTERN ELECTRICIAN when writing to advertisers

J. C. TEMPLE,

(Formerly of STOUT, MILLS & TEMPLE),
DAYTON, OHIO,

Hydraulic and Mechanical Engineer

Improvement of Water Powers, Arrangement of Power Plants, Shafting, etc., for Electric Power and Light. *CONSTRUCTION SUPERINTENDED.*

WM. S. TURNER, Pres. GEO. A. BELL, V. PRES. J. LESTER WOODBRIDGE, Sec. and Treas.

WOODBRIDGE & TURNER ENGINEERING CO.,

Consulting and Constructing

ELECTRICAL AND MECHANICAL ENGINEERS.

Complete Equipment of Electric Railways. Steam and Electric Plants.

47 Times Building. Telephone Call, 1009 Cortlandt. **NEW YORK.**

LINK-BELT MACHINERY CO.,

CHICAGO, ILL.

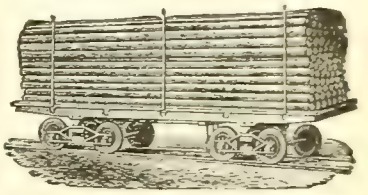
Manufacturers of

Elevators and Conveyors,

For the economical handling of Coal, Ashes, Sand, etc., etc. Send for reduced price list on Link Belting.

CEDAR POLES.

Railway Ties and Posts.



If in want of Poles, Ties and Posts, save money by getting my prices.

W. C. STERLING, Monroe, Mich.

VULCANIZED FIBRE CO.

ESTABLISHED 1873.
SOLE MANUFACTURERS OF

HARD VULCANIZED FIBRE

In Sheets, Tubes, Rods, Sticks, and Special Shapes to order. Colors, Red, Black and Gray. Send for Catalogue and Prices.

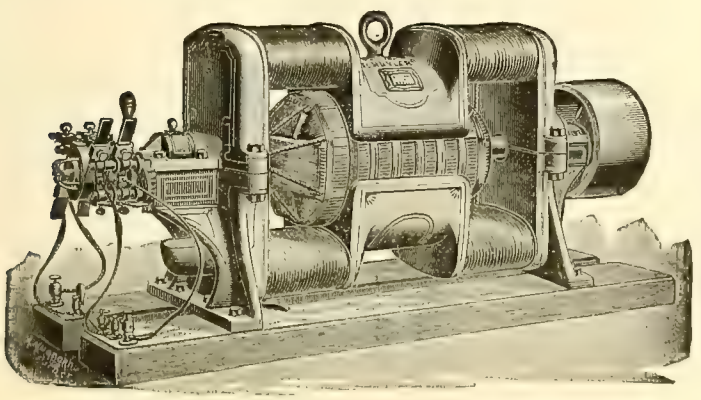
FACTORY: WILMINGTON, DEL. **The Standard Electrical Insulating Material of the World.** OFFICE: 14 DEY ST., N. Y.

THE SCHUYLER

—SYSTEM OF—

ARC LIGHTING

CONTAINS THE FOLLOWING IMPORTANT FEATURES:



Instantaneous and Automatic Regulation.

Self-Lubricating Boxes.

Ventilated Armature, proof against a burn-out.

A Pure White Steady Light.

THE SCHUYLER ELECTRIC CO.,

MIDDLETOWN, CONN.

GIVEN AWAY!!

SAMPLE ORDERS OF

Buxton's Packing

At Only 50c. Per Pound.

"The Engineer's Favorite."
All Orders Guaranteed.

Agents wanted in every State in the Union. We can quote the very lowest prices on Ring Packing. Send for discount and price list.

ESTABLISHED 1882.

GEORGE B. BUXTON,

17 VIRGINIA ST., EAST SOMERVILLE, MASS.

BINDERS

—FOR THE—
WESTERN ELECTRICIAN,
ONE DOLLAR.

BERNSTEIN ELECTRIC CO.

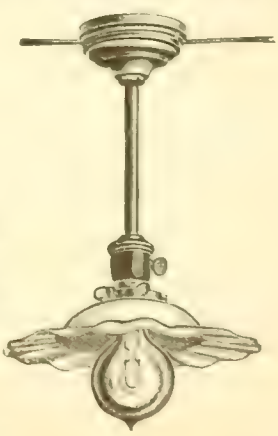
INCANDESCENT LAMPS

—FOR—

ARC LIGHT CIRCUITS.

SIMPLE. RELIABLE. DURABLE.

The only safe socket for series lamps, and the only socket having insulating material for the outside parts. Send for Illustrated Catalogue.



620 ATLANTIC AVENUE,

BOSTON, - MASS.

C. & C. ELECTRIC MOTORS and DYNAMOS.

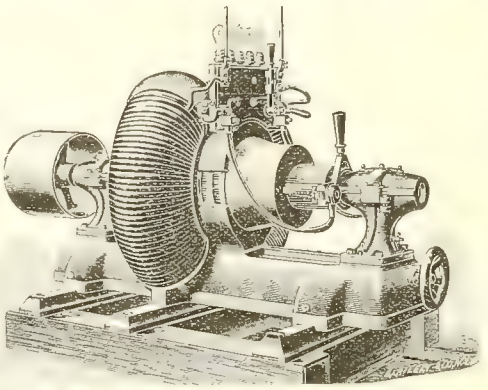
ELECTRIC MOTORS in all standard sizes, up to and including 100 H. P., for operating elevators, pumps, printing presses, and machinery for general manufacturing purposes.

POWER GENERATORS.

ELECTRIC MINING MACHINERY of all kinds, Hoists, Tram Cars, etc.

FAN OUTFITS, Electric Plants for pumping Church Organs.

We call the special attention of Station Superintendents to the fact that our machines are absolutely unsurpassed for economy of electric current.



DYNAMOS for isolated plants and the equipment of Mills, Banks and Office Buildings with Electric Lights.

ELECTRIC BLOWERS for ship ventilation. Have equipped 18 U. S. and foreign War Ships with ventilating apparatus.

NEW ENGLAND Office, 63 Oliver St., BOSTON.
PHILADELPHIA Office, 38 S. Fourth St.
CHICAGO Office, - Phenix Building.
SAN FRANCISCO Office, - 35 Market St.
ST. LOUIS Office, - - 421 Olive St.
NEW ORLEANS Office, 78 Customhouse St

THE C. & C. ELECTRIC MOTOR CO., 402-404 Greenwich Street, NEW YORK.

KARTAVERT

THE BEST SUBSTITUTE FOR HARD RUBBER.

A HARD AND FLEXIBLE FIBER.

IN SHEETS, RODS and TUBING. FOR ALL ELECTRICAL PURPOSES WHERE PERFECT INSULATION IS DESIRED. PATENT INSULATING CLEATS.

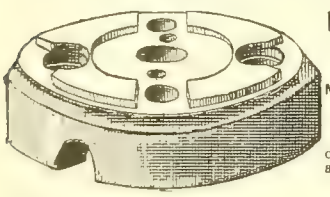
The Kartavert Manufacturing Co.,

WILMINGTON, DEL.

NOW THEN! FOR SALE CHEAP!!

Six 400 light Thomson Houston Incandescent Dynamos, 110 volts. Perfect order.
Three 25 light 2,000 candle power American Arc Dynamos. A 1 order.
Two 50 light 2,000 candle power Sperry Arc Dynamos. A 1 order.
700 Goose Necks, Sockets, Lamps, etc., complete, good.
50 miles No. 10 American Electric Co. Wire, good order, used one year. In ½ mile reels.
Two 400 light Thomson-Houston New Armatures.
70 American Single Carbon 2,000 candle power Arc Lamps. A 1 order.
Two 70 H. P., 700 volts, Edison Generators, used six months.
Ten 5 H. P. Sprague Motors, used six months.
Two Edison Electric Mining Rock Drills, used six months.
High Speed Engines and Full Station Equipments, Poles, etc.
Eighty 2,000 candle power American Double Carbon Arc Lamps, used three months.

JOHN E. BEGGS MFG. & SUPPLY CO., 74 Cortlandt Street. NEW YORK.



EMPIRE CHINA WORKS,

144 to 156 Green St., Green Point, BROOKLYN, N. Y.

MANUFACTORY OF

Non-Conductive Blocks, Rosettes and Bases for Cut-Outs and Switches; also Insulators, Cleats, Lamp Trimmings and other Electrical Supplies.

Our production is a dense body. The glazing and body of our ware are of same composition, and are baked alike, which are the features of

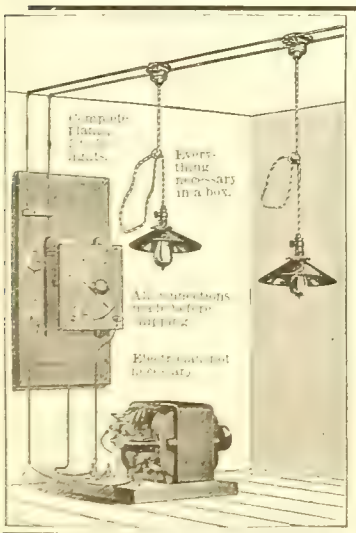
TRUE HARD PORCELAIN.

ELECTRICAL AND MECHANICAL ENGINEERING AND SUPPLIES.

REPAIRING

ELECTRICAL MACHINERY

The Electric Supply and Contracting Company,
S. E. Cor. Fifth and Sycamore Sts., (Nevada Building,) **CINCINNATI, O.**



You can	Lights	Thoroughly		Send
Put	Are Standard	Reliable	Prices	For
It up	And	And	Reasonable.	Illustrated
Yourself.	Full size.	Practical.		Pamphlet.

BAIN ELECTRIC MANUFACTURING CO.,

47 So. JEFFERSON STREET,

CHICAGO.

THE PIONEER LOW SPEED HIGH GRADE MACHINES.

PERRET ELECTRIC MOTORS.

ALL SIZES FOR ALL PURPOSES. **THOUSANDS NOW IN USE.**

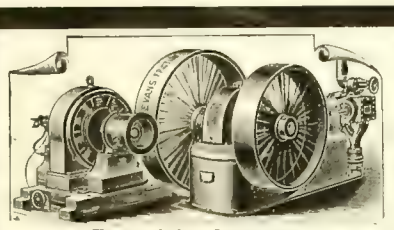
PERRET - ELECTRIC - LIGHT - SYSTEM.

COMPLETE APPARATUS FOR ISOLATED PLANTS.

THE ELEKTRON MFG. CO., Springfield, Mass.

NEW YORK OFFICE,
89 Liberty Street.

SELLING AGENTS: **Washington, D. C.,** J. L. BURKETT & CO., 1109 N. Y. Avenue. **New Orleans, La.,** GEORGE BAQUIE, 139 Gravier Street. **St. Paul, Minn.,** F. J. RENZ, 95 East 4th Street. **Philadelphia, Pa.,** PENNSYLVANIA MACHINE CO., 29 North 7th Street.

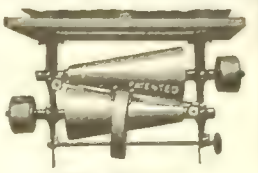


For Driving Dynamos.

The Clinton Gas Light Co., Clinton, Mass., have thoroughly tested and have adopted the Evans System of Driving Dynamos in their new Electric Light Station.

Thousands of Horse Power in use driving Dynamos, and hundreds of sets of Cones in operation, driving all classes of machinery. Address

THE EVANS FRICTION CONE CO.,
85 Water St., BOSTON, MASS.



Evans' Cones. For Varying Speed.

CHICAGO INSULATED WIRE COMPANY,

MANUFACTURERS OF

HIGH GRADE INSULATED WIRES

OF ALL DESCRIPTIONS.

WEATHERPROOF WIRES,
OFFICE AND ANNUNCIATOR WIRES,
MAGNET WIRES,
INCANDESCENT LAMP CORDS,
ETC., ETC., ETC.

Our facilities are such that we are prepared to fill orders of any size.

WRITE FOR QUOTATIONS AND SAMPLES.

CHICAGO INSULATED WIRE CO., 48-52 N. Clinton St., CHICAGO, ILL.

EVERYTHING IN

WIRE—FUSE— STRIPS.

WRITE US.

MANUFACTURED BY

The Sperry Electric Mining Machine Co.
39th St. and Stewart Ave., CHICAGO.

THE MILLIKEN PATENT POLE

For Electric Street Railways and Electric Light Work.

55 LIBERTY STREET, NEW YORK.

MANUFACTURED BY

MILLIKEN BROS.

59 DEARBORN STREET, CHICAGO.

Designers and Builders of Iron and Steel Roofs.—Iron Work for Light Stations a Specialty.

WRITE FOR CIRCULAR AND CATALOGUE.

THOS. G. SMITH, Jr., M. E.

Consulting and Contracting Engineer.

Engines and Complete Steam Plants for Lighting and Power Installations.
Bent Pipe and Coils in Iron, Brass and Copper, for all kinds of service.

11 Hammond Building, Telephone 1358. CINCINNATI, OHIO.

H. WARD LEONARD & COMPANY.

Secure bid from us for Electrical Apparatus or Construction before deciding. Railways, Lighting, Transmission of Power, Wiring, etc.

Electrical Exchange Building, NEW YORK CITY.

DOUBLE CARBON LAMPS

Afford the Only Reliable and Efficient Means for

ALL NIGHT ELECTRIC LIGHTING.

All other devices are crude, expensive and unsatisfactory.

THE BRUSH ELECTRIC COMPANY

Has established its broad foundation patent for Double Carbon Arc Lamps, No. 219,208, having ***won four distinct infringement suits*** in the United States Courts, two of them on final hearing, the decisions being rendered by Judges Gresham, Blodgett, Brown and Ricks.

The public is warned against the use of infringing lamps or any crude substitute for the Brush Invention.

Arc Lighting Apparatus,
Alternating Current Apparatus,
Electric Motors and Generators,
Incandescent Lighting Machines,
Carbons for Arc Lighting, Etc., Etc., Etc.

THE BRUSH ELECTRIC CO.,

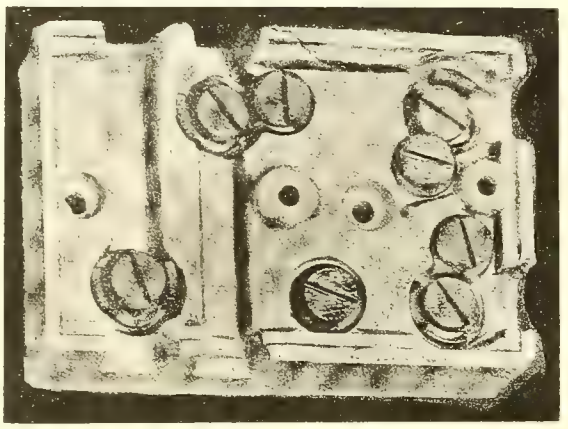
CLEVELAND, OHIO.

XMAS

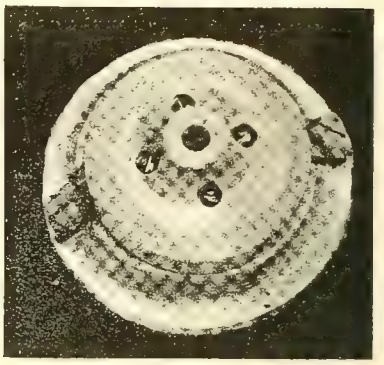
Imported China Switches.

THE FINEST THING MADE.

PRICES RIGHT.



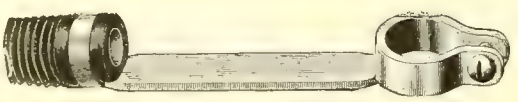
Full line branch and main cut-outs—all styles and sizes, lowest prices.



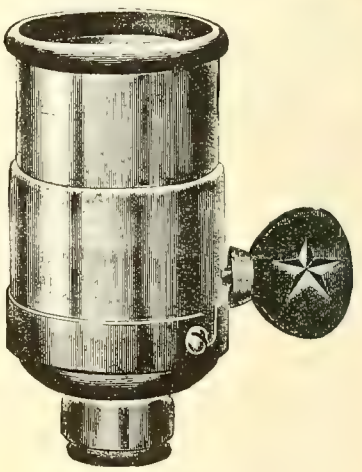
Ceiling Cut-Outs, 16 cents.

WE HAVE NOT

GIVEN



Gas Attachments. 6 cents.



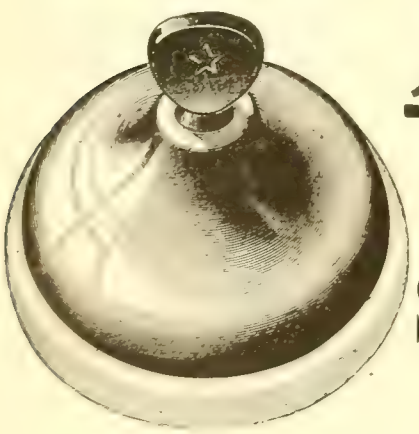
Key Sockets. 24 cents. All systems.

5 ampere "Baby," 25 cents
New steel handle and bind posts.

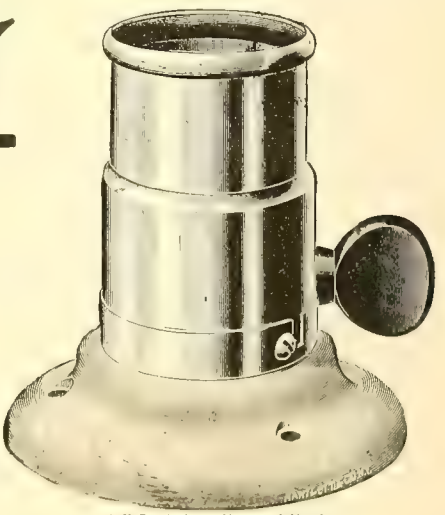
AWAY

Our Old and Unsalable
Stock of

SOCKETS AND SWITCHES.



10 ampere, 28 cents.
New handle and bind post.



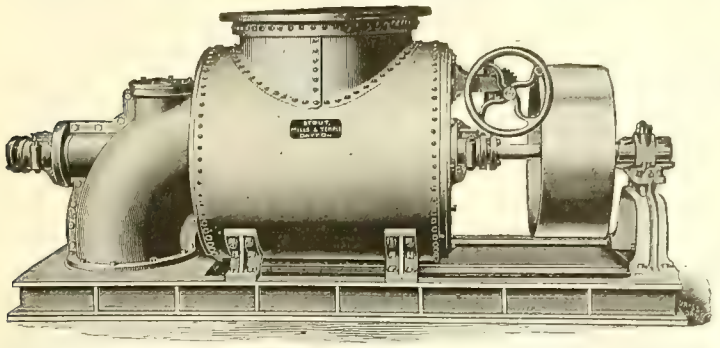
Wall Sockets. Key and Keyless.

STAR ELECTRIX CO.,

641 N. Broad St., Philadelphia.

Chicago Agents: The Illinois Electric Material Co., 158 Fifth Ave.

The New American Turbine Water Wheel.



PARTICULARLY ADAPTED TO DRIVING

ELECTRIC LIGHT AND POWER STATIONS,

On account of its high efficiency at all stages of gate, steadiness of motion and easy working gate, the construction of which makes it the most sensitive to the action of a governor of any wheel on the market.

SEND FOR CATALOGUE Illustrating various styles of setting on both vertical and horizontal shaft.

THE DAYTON GLOBE IRON WORKS CO.,

SUCCESSORS TO
STOUT, MILLS & TEMPLE, **DAYTON, O.**

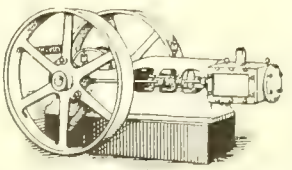
STEAM PLANTS

INSTALLED BY

W. B. PEARSON & CO.,

MECHANICAL ENGINEERS AND CONTRACTORS.

403 HOME INSURANCE BUILDING, - CHICAGO.

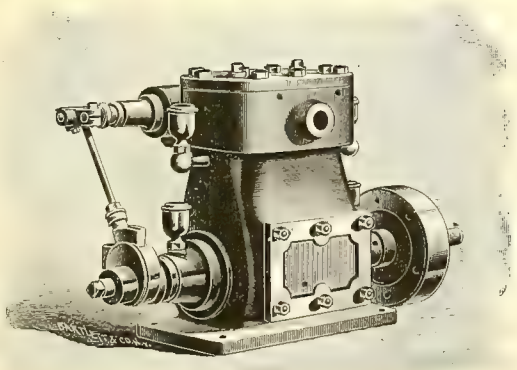


WILLIAMS AUTOMATIC ENGINE.
For all purposes requiring steady power.
WILLIAMS ENGINE WORKS: No. 417 North street, BALTIMORE, MD.

BALL AUTOMATIC CUT OFF ENGINE
MADE ONLY BY
THE BALL ENGINE CO
ERIE PA.

Binders FOR THE Western Electrician $1.00.

WESTINGHOUSE ENGINES



THE ORIGINAL WESTINGHOUSE ENGINE,

BUILT A. D. 1880.

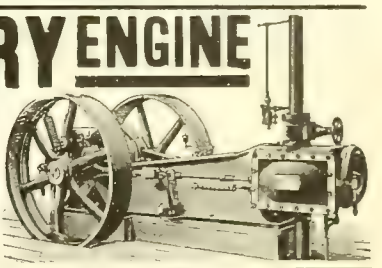
SIZE 3x3. 1,000 REVOLUTIONS.

Now preserved in the Offices of the Company, Pittsburgh, Pa.

THE WESTINGHOUSE MACHINE COMPANY.
PITTSBURGH, PENNA. U.S. OF A.

THE WOODBURY ENGINE

SELF-CONTAINED, AUTOMATIC
HIGH SPEED STEAM ENGINE
for Electric Lighting and Street Railway Service,
WITH BOILER PLANT COMPLETE
— Catalogue sent on application.
STEARNS MFG. CO. ERIE, PA.
BRANCH OFFICES: Philadelphia, 942 Drexel Bldg. San Francisco, 29 & 31 Spear St.



FOR ALL KINDS OF
PRINTING PLATES
TRY
BRAUN ILLUSTRATING CO.
334 DEARBORN ST
HALF TONE PLATE SPECIALTY
CHICAGO.

DRY STEAM

FURNISHED BY

THE POND SEPARATOR.

The Pond Separator is guaranteed to relieve the steam of all entrained water, and return this water to the boiler, thus effecting a large saving in fuel.

Send to Nearest Office for Circular.

POND ENGINEERING COMPANY.

ST. LOUIS. OMAHA. CHICAGO. DALLAS. KANSAS CITY. SEATTLE.

GRIMSHAW TRADE MARK WHITE CORE INSULATED WIRE

TAPES AND COMPOUNDS,

VULCA WIRE DUCTS,
ELBOWS, JOINTS, ETC., ETC,

All Supply Stores Keep Them.

THE NATION'S CHOICE.

NEW YORK INSULATED WIRE CO.,
78-80-82 Franklin Street,
CHICAGO.

MAIN OFFICE,
649 and 651 Broadway,
New York.

Geo. H. Meeker,
Western Manager.

NEW YORK INSULATED WIRE CO. NEW YORK
MOISTURE-PROOF
VULCA
ELECTRICAL WIRE-DUCT
NON-INFLAMMABLE
TRADE MARK
AND CHICAGO.

DID YOU SEE IT
AT THE CONVENTION?

THE NEW COMBINED

Snow - Sweeper - and - Plow

EXHIBITED BY THE

THOMSON-HOUSTON ELECTRIC CO.

SEND FOR ILLUSTRATED CIRCULAR, PRICES AND FULL INFORMATION CONCERNING IT.

We are Prepared to Make Quick Delivery.

The Motors and Equipments can all be utilized on other cars after the Winter Season is over.

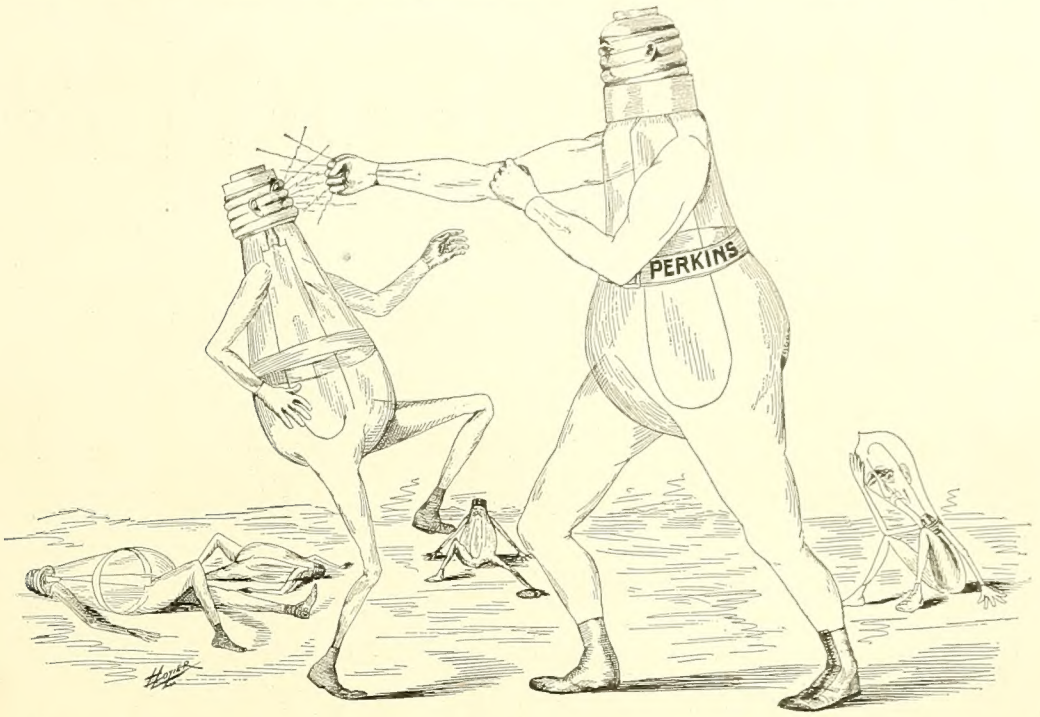
ADDRESS,

THOMSON-HOUSTON ELECTRIC CO.,

BOSTON OFFICE:
620 Atlantic Avenue.

CHICAGO OFFICE:
148 Michigan Avenue.

KNOCKED OUT!



The great popularity of the Perkins Lamp is due to the fact that it has always maintained its **HIGH EFFICIENCY**. It is never out of training and having met all comers in the electrical ring, it has proven itself the Champion. It sells for a little more money, but is cheaper in the end.

PERKINS INCANDESCENT LAMPS

ARE SOLD BY

J. W. MASON, Kansas City, Mo.

W. L. BRETHERTON, Tacoma, Wash.

CALIFORNIA ELECTRICAL WORKS, San Francisco, Cal.

AND

THE KNAPP ELECTRICAL WORKS,

Western Agents, CHICAGO, ILL.

Letters of Credit.

We print these letters from ENGINEERS who have used the Improved Brush.

CHICAGO ELECTRIC MFG. CO.,
73 W. Jackson Street.

DECEMBER 1, 1891.

THE ELECTRICAL SUPPLY CO., Chicago.

Gentlemen:—We are using your Patent Dynamo Brushes on our incandescent dynamo and have been at some pains to observe their behavior. We find that as the load changes on our dynamo there is decidedly less tendency to spark with the use of these brushes; the practical result to us being that the dynamo runs with less time spent for attendance. The wear on the commutator appears remarkably small and even when absolutely neglected and allowed to spark, the sparking does not have the cutting effect which is usually the case.

Yours truly,

DICTATED BY IRVING USNER. CHICAGO ELECTRIC MANUFACTURING CO.

UNION LEAGUE CLUB.

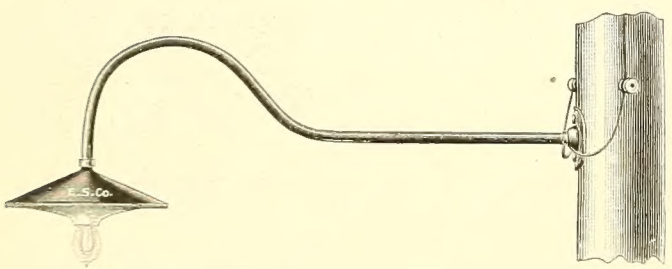
CHICAGO, November 19, 1891.

TO THE ELECTRICAL SUPPLY CO., City.

Gentlemen:—After trying one set of your Patent Dynamo Brushes I have put them on all three of our incandescent dynamos, and like them so well that I would not be willing to use the old style of brush again.

Yours truly,

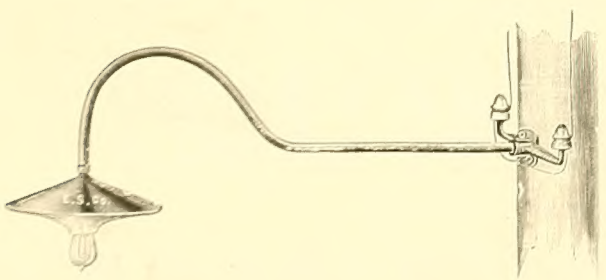
D. B. RAMSEY, *Chief Eng. U. L. Club.*

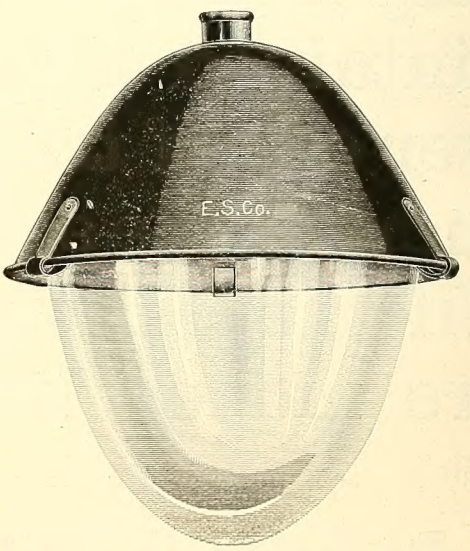


We are manufacturing a complete line of

STREET FIXTURES FOR INCANDESCENT LIGHTING.

These two new patterns are meeting with general approval. Prices quoted on application.





WIRT'S REFLECTING HOOD FOR INCANDESCENT LAMPS.

Globe secured by Spring Clips, and easily removed for replacing lamp. Water and dust tight.

The Electrical Supply Co.,

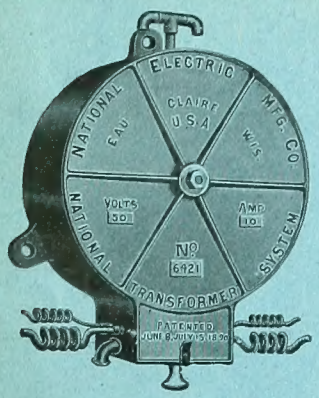
WESTERN OFFICE AND WAREHOUSES

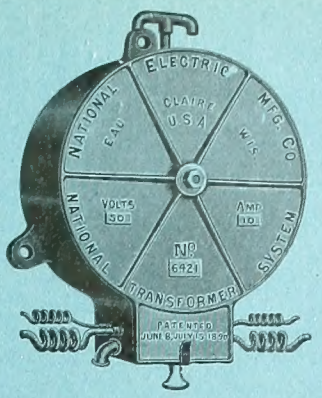
Cor. Randolph St. and Michigan Ave.,

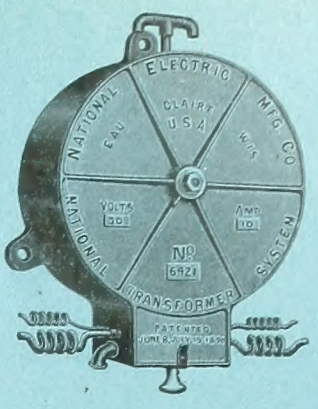
CHICAGO.

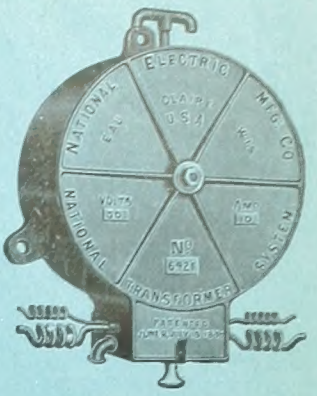
Eastern Office and Factories
Ansonia, Conn.

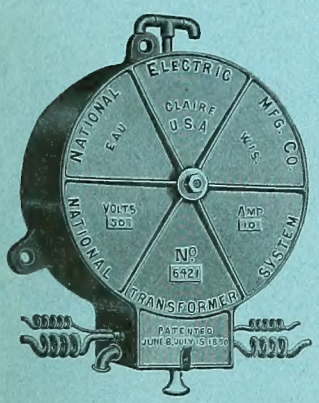
Enclose Business Card for Illustrated Catalogues.











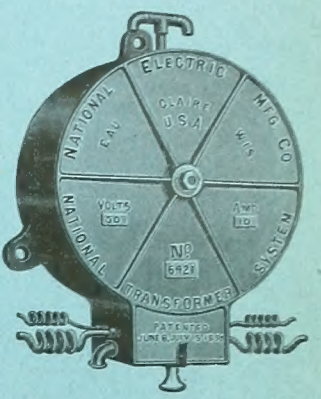
THE

National Transformer System

— OF —

INCANDESCENT LIGHTING.

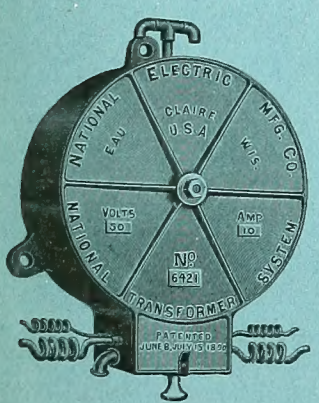
TRANSFORMERS FOR ANY SYSTEM.



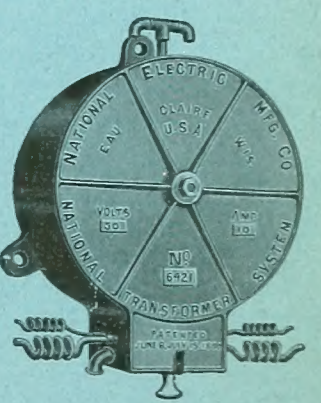
Alternating and Direct Current Dynamos.

MOTORS.

Our Apparatus is of the Highest Efficiency, Mechanically and Electrically.



We are prepared to undertake the construction of Electrical Plants of whatever magnitude. Correspondence solicited.



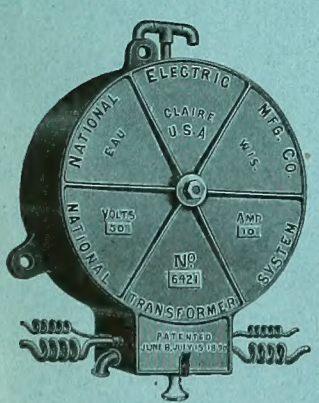
National Electric Mfg. Co.,

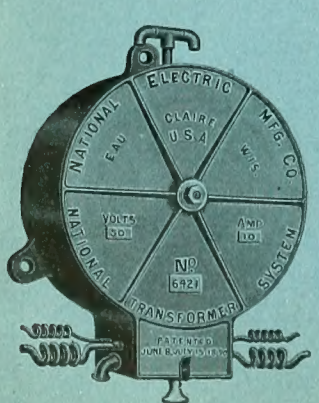
EAU CLAIRE, WIS.

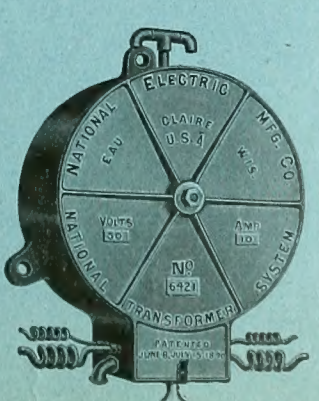
GEO. B. SHAW, Gen'l Manager.

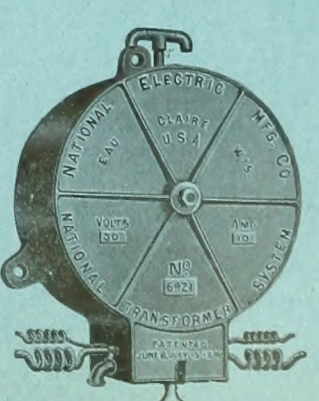
AGENTS:

New York, N. Y.—NATIONAL ELECTRIC MFG. & CONSTRUCTION CO., Electrical Exchange Bldg.
Buffalo, N. Y.—F. P. LITTLE & CO., 141 East Seneca Street.
Cincinnati, O.—W. N. GRAY, 12 Chamber of Commerce.
Washington, D. C.—L. N. COX, 16 Fifth Street, S. E.
Philadelphia, Pa.—PENNSYLVANIA ELECTRIC ENGINEERING CO.
St. Paul, Minn.—THE ELECTRICAL ENGINEERING AND SUPPLY CO.
Detroit, Mich.—COMMERCIAL ELECTRIC CO.
Denver, Col.—THE MOUNTAIN ELECTRIC CO.
Winnipeg, Man.—SIMPSON-DAVIS ELECTRICAL CONSTRUCTION CO.
San Francisco, Cal.—NATIONAL ELECTRIC DEVELOPMENT CO.
Lincoln, Neb—LINCOLN ELECTRICAL MFG. AND SUPPLY CO.
Duluth, Minn.—THE ELECTRICAL ENG. AND SUPPLY CO.
Kansas City, Mo.—THOMAS WOLFE, 515 Main Street.
Seattle, Wash.—CHAS. H. BAKER & CO.
New Orleans, La.—ENTERPRISE CONSTRUCTION AND SUPPLY CO.









FORT WAYNE ELECTRIC CO.,

FORT WAYNE, IND.,

—MANUFACTURERS OF THE—

SLATTERY INDUCTION AND WOOD ARC SYSTEM

—OF—

ELECTRIC LIGHTING.

THE MOST PERFECT OF ANY.

For references as to the merits of these systems, inquire of the local companies, the operators, or the customers in the large cities of this country where these systems are now being used almost exclusively after other systems have been tried and thrown out—Philadelphia, New Orleans, Cincinnati, St. Louis, Kansas City, Louisville, Detroit, etc.

WE MAKE ALL STANDARD SIZES OF

INCANDESCENT LAMPS FOR THE ALTERNATING SYSTEM.

Also Arc Lamps of Standard Sizes, 2,000 c. p., 1,200 c. p. and 800 c. p.

Main Office and Factory, FORT WAYNE, IND.

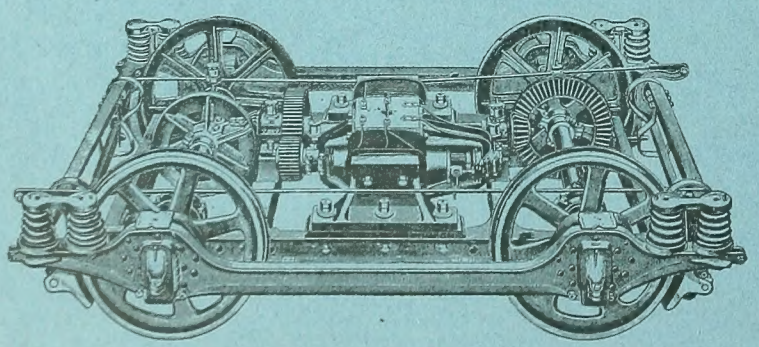
BRANCH OFFICES.

NEW YORK.....115 Broadway.	PITTSBURGH, PA.....533 Wood Street.
CHICAGO.....185 Dearborn Street.	SAN FRANCISCO.....35 New Montgomery Street.
PHILADELPHIA.....907 Filbert Street.	TORONTO, CANADA.....138 King Street, W.
DALLAS, TEXAS.....McLeod Building.	BUFFALO.....228 Pearl Street.

ONE MOTOR DRIVING BOTH AXLES

Of a street car, is the same principle as having all driving wheels of a locomotive connected, which is the AMERICAN SYSTEM.

Sizes: 15, 30 and 40 Mechanical Horse Power.



One Heat Proof Motor, Driving Both Axles.

This cut represents the latest construction of our Standard Apparatus equipped with our HEAT PROOF MOTOR. Attention is invited to the work being done by these equipments on the Merrimac Valley Street Railway, Lawrence, Mass.; Consolidated Street Railway Company, Grand Rapids, Mich.; and the People's Electric Street Railway, Springfield, Ill.; where, in each place, the two largest electric companies have put their latest equipments against them, with the result of proving our claims and strengthening the advantages derived from utilizing the full traction of the car, and driving all wheels simultaneously.

PATENTEES AND SOLE MANUFACTURERS:

DETROIT ELECTRICAL WORKS,

DETROIT, MICH., U. S. A.

Also Manufacturers of Electrical Power Machinery, Standard Line Appliances and General Electrical Supplies.

CORRESPONDENCE INVITED.